In this chapter, the authors describe their efforts, as co-directors of Pasadena City College's Teaching and Learning Center, to increase success rates in pre-algebra and address issues of equity and access through a faculty inquiry-based process.

Making Pre-algebra Meaningful: It Starts with Faculty Inquiry

Brock Klein, Lynn Marie Wright

Community college instructors of basic skills math and English face a daunting task every day of every semester, engaging students who see little or no value in writing essays about essays or finding the value of the ever-elusive x. Whether or not students felt any differently about essays or x's in the "good old days," we know that the students sitting in basic skills English and math classes back then were very different ethnically, economically, and socially than the students in those same seats today. In California, for example, the community college student population has changed dramatically in the past 20 years (Hayward, 2004). At some point, without many educators realizing it, California community colleges acquired a new "typical" student, and the transformation to a student body that is predominantly of color, immigrant, low-income, and under-prepared for college appears to be permanent. In addition to a more diverse student body, we also have a larger one; according to the non-profit advocacy group California Tomorrow, the state's college-age population is steadily increasing, with more than half a million additional students projected to attend California community colleges in the next five to ten years. Because our student population is becoming larger, more diverse, and less prepared, issues of access and equity are more troubling than ever.

A Call to Action: It's Not Just about Programs

While much discussion about student success as it relates to access, equity, and under-preparedness at the collegiate level is taking place

nationally (for example, the Lumina Foundation-funded *Achieving the Dream Initiative*) and statewide (for example, the California Community Colleges' *Basic Skills Initiative*), a strong and specific concern prompted some of us at Pasadena City College (PCC), a large urban community college located northeast of downtown Los Angeles, to address the issues head-on: students in our summer bridge/first-year experience program were staying in school and their classes, but an unacceptably large number of them were failing their courses, particularly math. We desperately needed a swift and effective intervention.

At PCC, the Teaching and Learning Center was created specifically to develop innovative programs to provide greater access to higher education for under-prepared students[1]. These programs are based on a learning community model and include .XL, a Summer Bridge/First-Year Experience (SB/FYE) program which we, the Center's co-directors, authors of this chapter, and notably composition rather than math instructors, designed for young, under-represented first-generation college students taking pre-collegiate-level English and math classes. Students begin the program with a six-week summer bridge that includes a pre-algebra math class, a study and student success skills course, and mandatory homework labs. They continue in the fall and spring semesters in two cohorts to complete their English and math requirements before moving on to general education courses. The first-year pathway has always been filled with challenges, but particularly troubling was the consistently high failure rate in math. After several years of program modifications based on evaluation findings and recommendations, we realized that focusing solely on program design was not enough; we needed to turn our attention to what goes on in the classroom, specifically with our under-prepared teachers.

[1] In 2006 analysts in the college's Institutional Planning and Research Office (IPRO) reported specifically on under-preparation for transfer-level math: over 85% of new students at the college place into pre-collegiate math; success rates have been on a downward trend for more than 10 years; less than 15% of all students will ever complete the three-course basic skills math sequence, and on average it will take them six years to do so; and Latinos and African Americans are over-represented in basic skills math courses.

Identifying the Problem(s): The Genesis of the Inquiry Process

It has been standard practice during the summer bridge portion of the .XL program for the math instructors, mentor/tutors, counselor, and program coordinator to meet weekly to discuss group dynamics and students' individual academic progress as well as to determine any needed interventions. Initially, these meetings were simply a community of teachers and staff getting together to talk on a regular basis, a precursor to what we now call a Faculty Inquiry Group (FIG), broadly defined as a team that works together over time to understand students' needs and develop strategies to address them. Early on in these meetings we recognized a misalignment between the summer bridge math instructors' espoused teaching philosophy and their practice. These instructors, Ann and Jay, were caring individuals dedicated to helping basic skills math students succeed, yet their actual teaching practices often ran counter to their intentions. They understood, for example, how important it is to address "non-math" issues, such as reading, writing, and study skills, in their classes but struggled to integrate them into the curriculum and, at the same time, cover the required topics and concepts.

Through our weekly summer meetings we realized that our deeply committed math instructors were stuck in a traditional math teaching paradigm and unable to recognize the problem on their own, let alone do anything about it. They felt powerless to change the basic skills math curriculum at PCC, which is influenced both by tradition and by textbook writers and publishers. Math instructors generally teach the way they were taught and use their textbook as a script. In addition, a tacit sink-or-swim sentiment persists among many in PCC's math department; if students don't make it through the fast-paced, concept-packed basic skills courses, perhaps they don't belong in college. We thought that actively engaging faculty (specifically, Ann and Jay) in creating more meaningful curriculum would solve the problem of poor student engagement

and success. However, our ongoing dialogues about teaching practice soon revealed a greater challenge: effective curricular transformation relies on significant faculty transformation. The pre-algebra curriculum would not change without faculty first changing notions about themselves and their students. It became clear that we needed to be faculty development coordinators as much as program directors. We needed to create a place for the scholarship of teaching and learning, a place in which faculty could be empowered so that they in turn could empower students. Our first official FIG (faculty inquiry group) soon followed.

The Inquiry Process and Outcomes

The inquiry process is a very effective tool that teachers can use to become scholars of teaching and learning and ultimately provides increasingly diverse groups of students access to greater academic, personal, and professional success. In essence, FIGs constitute collaborative self-study research "in which teachers examine their beliefs and actions within the context of their work as educators (Whitehead, 1993) and explore pedagogical questions. It allows professors to renew their instructional tools as well as discover new tools" (Louie, 2003). The process we describe here began with a group of instructors who identified a problem (low success rates in our summer bridge pre-algebra classes) and hypothesized that meaningful math would lead to greater student engagement and that greater engagement would lead to greater student success. The process they followed was structured, sustained, and faculty-led; it was also "designed down," that is, participants began by defining their outcomes. We view the FIG process as an iterative one that includes research, discussion, reflection, piloting, evaluation, and modification. Critical to success and legitimacy is the fact that the FIG process and outcomes rest on a culture of evidence.

Ann and Jay, the .XL pre-algebra instructors, were the obvious leads for this first FIG[2] because they were teaching the course that needed change and had been prepared for it through both their .XL Summer Bridge teaching collaboration and their active participation in previous TLC professional development opportunities. With a very clear initial outcome in mind—curriculum reform (including the development of pre-algebra learning outcomes and assessment instruments, and a deadline (the .XL Summer Bridge pre-algebra courses were only nine months away, they recruited six of their colleagues, created agendas, facilitated discussions, led research, and provided lunch. Brock and/or Lynn attended most their meetings, took notes, helped create agendas, and led debriefing sessions with Ann and Jay.

Although this FIG was clearly outcomes-driven, Ann began indirectly by helping the inquiry participants negotiate an understanding of the FIG individually and collectively. What is inquiry? Why is it an effective tool? What did the participants expect to occur? When does the process end? Interestingly, several instructors came to this first meeting with feelings of trepidation, suspicion, and fear. What was the agenda? Were the participants being blamed for students' poor success rates in math and criticized for what they thought they did well? Were standards and rigor going to be thrown out the door? Ann posed several questions to her colleagues to allay their concerns:

- What should a PCC student know about math to function well in life?
- What should a pre-algebra student know and be able to do at the end of the course?
- How much time should a pre-algebra instructor spend on "non-math" issues such as time management and test anxiety?
- How much do reading and writing skills relate to success in math courses?

[2] Since 2005 there have been FIGs for instructors at all three levels of the basic skills math sequence, at the first level of the basic skills English sequence, and in natural sciences.

- Do tests measure the learning instructors expect and value?
- Are there forms of assessment other than traditional tests that can and should be used to measure learning?

Rather than blame the instructors for the low success rates in math or allow them to turn the FIG into a series of unproductive gripe sessions, at this crucial first meeting Ann deftly challenged her colleagues to develop effective practices, learning outcomes, and alternative forms of assessment. She focused on empowering them to implement short, easy to accomplish classroom activities (what we call "small, do-able things"). For example, the group set ground rules (participate actively, respect your colleagues by listening to them, and state a problem only if you can offer a potential solution) and completed a reflective writing assessment (What do you believe is the main objective of this project? What is the main benefit for your students, yourself, the math division, and the college? Why did you agree to participate in this FIG? How effective was this first meeting?). The participants decided on a day and time for the next meeting, and Ann assigned homework, asking the instructors to make a list of what they wanted their pre-algebra students to know and to be able to do upon completion of the course. (This was our first foray into working with faculty on the development of student learning outcomes.) She also asked them to bring in one effective practice to share with their colleagues. The meeting ended with pizza, and we were on our way. A community of math teachers and learners had been formed.

The pre-algebra FIG met every two or three weeks throughout the sixteen-week fall and spring semesters, and, although Ann and Jay's specific intention was to revise the curriculum for the .XL program, the participants found value in the constructive and collegial process. In addition, as program directors, we slowly began to understand that the transformation of the instructors themselves was more important than, and critical to, the transformation of methodology and curriculum.

Faculty Transformation and Evaluation

We know from our experiences as instructors that among any group of learners, some will engage actively, take risks, and transform significantly. Unfortunately, we also know that some learners will be peripheral participants who take small, hesitant steps, and others will remain unmotivated and uninterested and may eventually drop out. Of the eight instructors who participated in the FIG process, four clearly had a powerful experience; they attended all the meetings, participated actively in all the activities, engaged in research, made changes in their teaching practices, and are now powerful advocates for basic skills math students in their department and on campus. These instructors no longer see themselves just as content specialists but more importantly as community college professionals engaged in the dynamic process of teaching and learning pre-collegiate math. They identify themselves as change agents in their students' lives, a powerful responsibility that challenges them to engage their students and make math meaningful to them. They can no longer be simply the "sage on the stage" and expect students to "get" math, and they can no longer see themselves as filters who "weed out the students who don't belong in college." Key to identifying themselves as change agents has been getting to know their students, embracing them for who they are, and seeing pre-collegiate math instruction as an intellectually challenging and rewarding endeavor that requires them to move beyond the traditional and clearly ineffective math instruction paradigm and embrace "non-math" curriculum, such as reading, writing, and other student success topics, such as time management, note-taking, and techniques to reduce test anxiety. As a participant astutely pointed out during a FIG session, "It's not so much about teaching math as it is about teaching students that they can do math."

The actively engaged instructors employed several methods in order to get to know their students and understand how they learn. For example, Jay used "think-alouds," a process by which students are

videotaped speaking out loud what they are thinking while working through math problems. Jay videotaped several of his students working on word problems that involved negative numbers while "thinking aloud" and showed the tapes to the FIG participants, who discussed what they had seen and heard.

The think-alouds provoked great discussions among the math instructors about diverse learning styles, cognitive load, reading, critical thinking, problem solving, and motivation. They argued about the value of rote learning, shortcuts, and manipulatives. Most importantly, they all began to question their assumptions about how students learn math. The math FIG participants were surprised by many of the comments that the students in Jay's think-alouds made. Among their discoveries: 1) Students often rely on mathematically unsound strategies that they have acquired informally rather than correct or appropriate ones provided by their instructors; 2) they often "go wrong" early in the process and even if they felt that something is not making sense, they are unwillingly to stop, assess, and try something else; 3) when they discover that their answer is incorrect, they often begin guessing and eventually lose interest. ("Just tell me what x is."); 4) students struggle with word problems; their calculations may be correct, but they often arrive at an incorrect answer because they are unable to decode the language. Clearly, there are great differences between the ways math experts and novices solve word problems. In addition, what is transparent for math instructors is opaque for many of their students.

The FIG participants' valuing of the think-aloud process is one measure of the effectiveness of the FIG process. Other evidence is that FIG participants have become leaders within the math department and advocates for pre-collegiate math curriculum reform. Ann, for example, is an active participant in the California Community Colleges' Basic Skills Initiative here on our campus and mentors other math faculty who are interested in improving basic skills math success. Ann and Jay together have given campus-wide presentations on the process they used

to understand, implement, and assess student learning outcomes. In addition to documenting the pre-algebra FIG process and his action research for the *Windows on Learning* project on the Carnegie Foundation for the Advancement of Teaching website, Jay has also presented campus-wide for "The Passion for Teaching and Learning Workshops," helping non-math faculty understand the value of the inquiry process and how they can start their own. In addition, several of Ann and Jay's math colleagues have formed inquiry groups at the two higher levels in the basic skills math sequence, beginning and intermediate algebra; one has resulted in yet another online *Windows on Learning* project as well as a common final for intermediate algebra. Finally, there is now a powerful core of math faculty who are looking at data, questioning the efficacy of the curriculum and their practices, beginning to understand the value of creating and assessing clear, attainable learning outcomes, and sustaining a dialogue about student success.

Curriculum Transformation and Evaluation

As program directors, we have learned that faculty transformation is paramount to achieving student success; it is an essential predecessor to curriculum revision, but it is no guarantee that significant curricular or methodological changes will immediately occur. For example, while the faculty engaged in the inquiry process now see value in incorporating "non-math" topics into their daily lessons, they still struggle with the issues of content and coverage. Throughout the FIG process, participants grappled with several questions: Is our curriculum pedagogically sound? Can we expect students to master over 300 concepts in one course and apply them to concepts at the next higher level? If not, what are the essential concepts a student needs to know in pre-algebra to succeed in elementary algebra?

Not every FIG participant has resolved these questions of coverage, but several have come to terms with the fact that as algebra is usually taught, it has little relevance in the lives of many

community college students. Although PCC's basic skills math program is calculus-tracked, the vast majority of our students declare majors that do not require calculus for transfer or degree completion.[3] The college's commitment to provide diverse communities within its service area access to certificate and degree completion and transfer opportunities appears to have been unwittingly undermined by course sequence and articulation policies.

While faculty members have little initial control over these policies, they can make immediate changes in what goes on in the classroom. The revised pre-algebra curriculum that eventually did result from this guided inquiry process reflects the FIG participants' belief that making math meaningful to students will lead to greater student engagement and eventually greater student success. They have reduced the number of essential pre-algebra concepts by approximately a third and increased the time they spend helping students make connections between the math they are studying and life outside the classroom. Their goal is greater mastery of fewer concepts. .XL Summer Bridge pre-algebra instructors now introduce each chapter with a basic concept that includes a real-life application, asking students to perform meaningful math tasks, such as balancing a checkbook, budgeting for a party, and hanging photos equidistantly. These activities are clearly connected to Ann and Jay's student learning outcomes for the .XL pre-algebra course, and they have created pre- and post-assessments to measure outcomes achievement.

Assessment: A Work in Progress

Outcomes-based assessment has helped relieve faculty's anxiety about reducing the number of topics covered in a semester, but assessment was, and remains, a formidable challenge. Faculty who participated in the inquiry process have developed and implemented many new and innovative

[3] College data have revealed that less than .5% of the students who enter the math sequence at Level One (pre-algebra) will ever enroll in the beginning calculus course, and only half of them will pass it.

practices, yet they still struggle to see beyond the traditional, and often unfair and inappropriate, tests and quizzes that determine their students' final grades. They fret about what to do with students who repeatedly demonstrate their understanding of a specific math concept in class activities but fail to do so on a test. Several instructors admit that their logic about testing is circular and, therefore, flawed: "I give tests because math students have to take tests. That's what you do in math." Unfortunately, using multiple assessment measures appears to many to be an excuse for "dumbing down" the class and passing more students, and FIG participants still rely heavily on tests. A breakthrough for Ann and Jay, however, came when they created pre-algebra pre- and post-tests as part of their action research and asked us to edit them. As English and ESL instructors, we had red pens in hand in a flash – fragments, syntax problems, redundancies, misspelling. Then came our admonition: "Since you rely predominantly on tests, make sure they're well-written and well-formatted, not to mention fair and appropriate." What might have been an embarrassing professional moment was, instead, a powerful teaching and learning moment: two math instructors and two composition teachers working together to write and format a couple of pre-algebra exams.

The FIG participants' research into the effects that the inquiry process has had on student performance in basic skills math is promising. Preliminary findings reported by Ann and Jay about the impact of the FIG on student performance in pre-algebra (see Figure 1) show a significant increase in retention and a modest increase in success.

Pre-algebra	Retention	Success
FIG participants	88%	56%
Non-FIG particpants	77%	53%

Figure 1 (Data for Summer 2005 and Fall 2005)

The FIG's impact on .XL Summer Bridge pre-algebra courses can be seen in Figure 2. In Summer 2005, after completion of the FIG and revision of the curriculum, retention and success rates increased 8% each.

Pre-algebra	**Retention**	**Success**	**Persistence (Summer to Fall)**
.XL5 (Summer 2006)	100%	74%	95%
.XL4 (Summer 2005)	100%	76%	93%
.XL3 (Summer 2004)	92%	68%	93%
Matched Comparison Group (Age, ethnicity, course)	80%	53%	68%

Figure 2

Perhaps most important, research conducted in 2006 by PCC's Institutional Planning and Research Office revealed that .XL students who succeed in pre-algebra (Math 402) succeed at the next higher level of math (beginning algebra) at significantly higher rates than their non-.XL counterparts over time. As Figure 3 reveals, 40% of the .XL students in Cohort 4 (.XL 4) succeeded in beginning algebra within one year after successfully completing pre-algebra, as compared to 10% of all PCC students and 8% of Hispanic students at the college. A similar relationship is seen for Cohort 3 (.XL 3) two years after successfully completing pre-algebra and Cohort 2 (.XL 2) three years after. We will continue to monitor the impact of these curricular changes on .XL students' subsequent success in math.

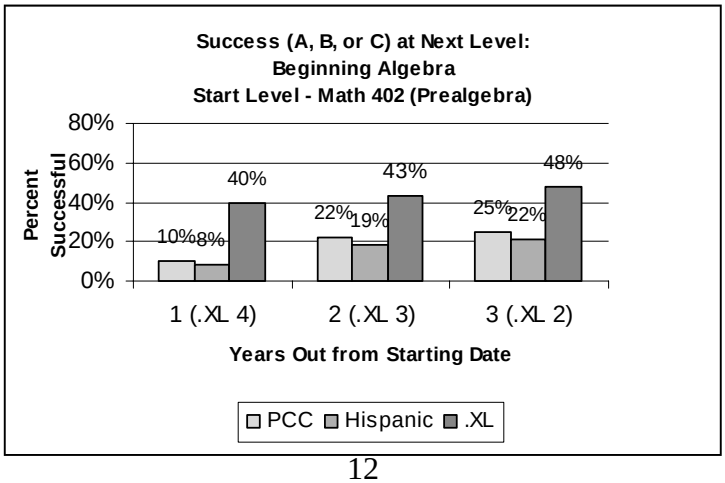

Figure 3

The Power of Inquiry: Implications for Professional Development

Even though in this, our first FIG, we urged inquiry participants to create student learning outcomes, as program directors, we were slow to recognize that we also had to identify key outcomes for our "students," that is, the faculty participants. [Program directors take note: practice what you preach!] Our own conversations about the inquiry process that we were coordinating became more regular and structured as we worked with the FIG leads and our external program evaluators. In addition to understanding what Ann and Jay were learning through their FIG process, we became more reflective about our role as coordinators and organizers through debriefing sessions with them. For instance, in our role as math "outsiders," we observed that faculty were relying on quick fixes, such as an extra hour of instruction per week, a better textbook, and teaching assistants to address retention and success problems in math. The faculty's desire for quick and easy solutions for students was the same as our initial outcome for the faculty; we simply wanted faculty to "fix" their curriculum so that students would be successful in the course. In fact, for all participants (ourselves included) the real outcome *should be* the development of self-motivated and reflective lifelong learners. The challenge for FIG participants was to understand how students learn and to align that understanding with the way that they themselves teach. Our measure of success was whether faculty participants could identify a problem that was in their power to solve, be open to fully exploring it, implement a change confidently, and evaluate its success (or lack thereof).

As mentioned previously, since the end of the pre-algebra FIG, two of the participants have documented some of their action research for the Carnegie Foundation for the Advancement of Teaching web project *Windows on Learning* (see "How Jay Got His Groove Back and Made Math

Meaningful" and "No Longer Lost in Translation: How Yu-Chung Helps Her Students Understand (and Love) Word Problems.") It is significant to note that their curricular revisions and research have continued well beyond the completion of their FIG and web projects.

Implications for Institutions

What does all this mean for the institution? Our work so far has been with small numbers of faculty and students, but college administrators want to impact the most people in the most cost-effective way possible. Although we understand their desire to scale up effective programs, resources, and services, we have also come to understand the value of intimacy and intensity, that is, working very hard with a small group for an extended period of time. We believe that the process that we have created and followed was necessary to affect deep transformation. Intense, small-scale inquiry tailored to specific concerns and interests is as important to faculty's development as it is to student success. As Carnegie Foundation for the Advancement of Teaching scholar Mary Taylor Huber (2008) notes, "Working with others who share a local context is not only more efficient and pleasurable;...collaborative inquiry and shared responsibility...is particularly important for basic skills education" (p. 9). Access and equity comes by nurturing a "right-to-succeed" environment, and creating that environment starts with transforming faculty identity, moves to methodological changes and curriculum reform, and ends with student success.

Inquiry has led us well beyond faculty development. We are now thinking more broadly about what influences equity, access, and success, including institutional policies. We have begun an inquiry group with our basic skills deans, and other administrators on campus are considering forming one of their own. We see inquiry groups as a way of developing a community of scholars of teaching and learning throughout all areas of the campus, a transformation perhaps long overdue.

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