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ABSTRACT

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FACILITATORS AND BARRIERS TO ACHIEVING EQUITY AND REFORM IN MIDDLE-SCHOOL MATHEMATICS

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INTRODUCTION

There have been many calls for reform in mathematics education (Croom, 1997; National Commission on Excellence in Education, 1983; National Council of Teachers of Mathematics (NCTM), 1989; National Science Foundation Directorate for Education and Human Resources, 1994), most citing the under-achievement of minority groups as a major reason for reform. The Statewide Systemic Initiatives (SSIs) of the National Science Foundation (1994) answered these calls. The SSIs were intended to address, in a systemic fashion, the teaching and learning of mathematics and science for all students. The Ohio SSI, funded in 1991 by the National Science Foundation, focused the role of change agent on the teacher and, in this regard, provided sustained professional development and follow-up activities for participating teachers. The Ohio SSI program was based on six-week intensive summer institutes for middle-school mathematics teachers. The institutes were content based, and taught in an inquiry mode. Common to all of the institutes was a focus on equity and the implementation of the NCTM standards (NCTM, 1989). Instructors modeled inquiry teaching throughout the institute, with teachers having to commit to participate in, throughout the next academic year, six follow-up one-day workshops concerning the pedagogy of inquiry teaching. Most institutes included a specific equity component, which focused on equitable teaching and assessment practices.

BACKGROUND

In 1994, a major study (*The Landscape Study*) was initiated to evaluate the impact of the Ohio SSI model of professional development on all aspects of teaching and learning in middle-school

mathematics and science in Ohio. The study reported here utilizes only a small part of all data collected for *The Landscape Study,* namely the qualitative data collected during site visits to seven middle-schools across Ohio. It builds on evidence presented elsewhere (Damnjanovic, 1996; Goodell, Parker, & Kahle, 2000; Kahle & Rogg, 1996; Kahle & Rogg, 1997; Supovitz, 1996; Tims Goodell, Kelly, Damnjanovic, & Kahle, 1997) which shows that (i) students in classes taught by SSI teachers achieved significantly better than non-SSI students on an achievement test constructed from NAEP public release items which incorporated inquiry objectives; (ii) teachers who had participated in the professional development activities of the SSI (henceforth referred to as SSI teachers) made significant changes to their teaching practices, and were able to sustain those changes over time. This study explored teachers' experiences in greater detail and depth. *Its purpose was to determine the facilitators and barriers middle-school mathematics teachers faced in trying to implement equity and reform objectives suggested by the Ohio Statewide Systemic Initiative (SSI).*

DATA SOURCES AND METHODOLOGY

Data for this research were gathered during site visits to seven schools that had been involved with the SSI activities. These site visits were conducted by four different researchers over a one-year period. The methodology of cross-site analysis (Anderson, 1995; Huberman & Miles, 1983; Miles & Huberman, 1984, 1994; Rossman, 1993), was used to analyse the data. Rossman's four dimensions of reform were synthesized from the seven case studies. Those dimensions are:

Technical:	Professional knowledge and skills, and the means by which they are acquired.
Cultural:	Values, beliefs and school norms—both in terms of a general ethos and competing perspectives that contend with each other.
Political:	Matters of authority, power and influence, including the negotiation and resolution of conflicts.
Moral:	Matters of justice and fairness.

DATA COLLECTION

The data were collected in May 1995 and May 1996. Before visiting each site, lengthy meetings of the research team took place. During these meetings, the overarching principles of the whole study were discussed as well as some interview protocols. At each site, one teacher who had

participated in the SSI activities was chosen as the focus teacher. At some schools, the focus teacher was the only SSI teacher. At sites where there was more than one SSI teacher, the focus teacher was randomly chosen. In preparation for each site visit, the researchers were given as much background information about the focus teacher and the site as possible. This included access to the questionnaires that the teacher and principal had completed as part of the overall evaluation study referred to previously. During site visits, the respective researchers spent the majority of their time in the focus teacher's classes. Researchers also conducted interviews with the focus teacher, the principal, and some students from a focus class chosen randomly by the focus teacher. Overall, researchers in their site visits emphasized those equity and reform issues which were raised either through the questionnaires or through observations and interviews at the site. Facilitators of and barriers to implementing equity and inquiry principles remained the main focus at all times, and researchers were encouraged to keep an open mind during the interviews and pursue topics that were identified by teachers as important. After each site visit, respective researchers produced a detailed site-visit report. The reports highlighted issues that had arisen during the interviews or observations that were important factors in facilitating or inhibiting equity and reform objectives.

RELIABILITY AND VALIDITY CONCERNS

Reliability and validity (in the positivist sense) of the qualitative data. were enhanced by each researcher using the completed teacher's questionnaire as the starting point for interviews. Interviewees were given a copy of their responses and asked to comment on each question, or on particular questions that the researcher had highlighted. This facilitated comparability between sites in terms of the range of issues likely to be covered. Of course, each site was unique; so researchers pursued those issues that were of most importance at each particular site.

In addition, following Guba and Lincoln (1989) the methodology included constant data analysis at the same time as data collection, properly-conducted member checks, presenting emergent findings to "disinterested peers", searching for discrepant cases and the reasons why these cases were discrepant, and establishing an audit trail with respect to the authenticity of the

study.

Transferability was ensured by "thick" description of the context, culture, place and time of the site visits. Credibility was enhanced through intensive observation at the site, peer debriefing with others not involved with the site visits but with knowledge of the school system and the SSI, full transcription of all audio-taped interviews, and the production of interpretive site-visit reports by each researcher. Dependability was enhanced by the use of extended quotes from the teachers, students and principals interviewed in the study, enabling others to follow the researchers' logic in constructing interpretations.

ANALYSIS AND RESULTS

The data were analyzed with the help of the qualitative-data-analysis software package NUD•IST. Broad initial codes that corresponded to each of the Rossman dimensions were created first. Further sub-categories were generated as the analysis continued. The Rossman framework accommodated nearly all of the issues identified; however there was sufficient evidence to suggest one possible further dimension: that of *Caring*. Once all of the issues were classified, the cross-site analysis, which synthesized how the issues in that dimension had impacted on the implementation of the equity and reform objectives of the SSI, was completed. A summary of the issues identified in each of the four dimensions, *Technical, Cultural, Political* and *Moral* and the proposed extra dimension of *Caring*, follows.

The Technical Dimension

The professional development experience

The first *Technical* element was the professional development experience itself. Many of the teachers interviewed thought that their experience with the SSI had enabled them to change not only their teaching practices, but also the way they thought about teaching. Barb Arnold encapsulated this sentiment as follows:

> I look at everything I teach now—every lesson that I have—wondering how I can do this in an inquiry method. And these things kind of rattle around in my brain. I come up with my

best ideas when I'm lying in bed going to sleep, or in the summer time I start thinking about some lesson that I did last year, and "Well, I could have done this... and then if I do that, I could do this...". Though I still look at the things and think about it each time I have a new lesson that I'm coming up with. You know, how could I do this inquiry? It kind of sets the seeds going, and all of a sudden it kind of comes together.

Barb Arnold, May 1995

The perception of most teachers was that, without the professional development experience, it would have been unlikely that they would have made any changes to their teaching practices. Some participants had been teaching for twenty or more years, and relished the revitalization they experienced after their SSI experience. This teacher expected much more from her students as well, as indicated by the following quote:

K Before *Project Discovery* I was getting to the point where I was bored to tears. I just, you know, twenty something years of the same thing, over and over and over again, it was getting very tiring. ... Now, its "let's work with a partner and let's see if we can come up with the solutions together, or "let's work with a group, or let's get down on our hands and knees and find out the area of this room and the perimeter." You know, draw or make something that shows area, make something for me that shows perimeter. They actually have to show an understanding as opposed to just being able to do. I think that was the difference. Before maybe there wasn't an extreme understanding, just being able to do the problems....

Kathy Straub, May 1995

Classroom teaching resources

The second *Technical* element concerned the availability of appropriate classroom teaching resources to support the new pedagogies suggested by the SSI. For some teachers, a lack of resources did not prevent them from making their classroom equitable and connected. However, for other teachers, it made the process of implementing inquiry lessons a rather arduous task, resulting in a somewhat disjointed approach. During interviews, most SSI teachers reported, and students confirmed, that they had largely dispensed with using text books for most lessons, although for some teachers there was little else available to replace the text. This lack of

suitable and available curriculum materials to support the goals of the reform was an issue at a number of sites. For example, Barb Arnold enrolled in a program which provided her with access to video-taped model lessons and printed curriculum materials to support these lessons in the classroom. In contrast, Annie Golf, who was dissatisfied with the progress she had made in transforming her teaching to a more inquiry-oriented style in the year since her involvement, relied on modifying existing materials or inventing her own, a task that had been very difficult and time consuming.

Networks

A third *Technical* element was the availability of a network of colleagues who had participated in the SSI with whom teachers could discuss their successes and failures. The electronic network provided by the SSI, *DiscoveryNet*, was especially valuable for those teachers who were the only ones in their school involved with the SSI.

I: What would you say are the most important things that you are taking from Discovery—the most important ideas about how learning happens?

D: Well, I think some of the things, and we did this in the follow-up, is where we shared ideas with other teachers from other parts of the state. You know, "I tried this in my classroom, and it worked, but you might want to try it this way." Or, "This failed." It's like, gee, other people fail at things. This is how you can build on it and go from there. You try, you fail, you have a tendency not to try it again. But you could improve on it, and try again.

I: So having a support group of other teachers who are doing this is very important?

D: Yes. And I have met some friends that I would say are a long distance from here, and if I want to run an idea by them, if they are on the network I can use a computer and talk back and forth on the computer with them.

I: Do you have access to Discovery Net from here?

D: Not in our building, but I do at home.

I: At home. Do you use that often?

D: Yes. I use it quite a bit. Towards the end of the year I haven't used it much. And I like to read the lounge, and see what the other teachers...and questions they have ... and I mean it's a network of teachers that you can get into all over Ohio.

Diane Young, May 1995

Being able to communicate with a similarly placed colleague who had succeeded with inquiry activities appeared to be one of the most critical elements in encouraging teachers to risk implementing with new types of teaching methods in their classrooms. The negative consequences of limited inter-teacher communication were demonstrated by the case of Ms Fisher at Daniel Miller Middle School. In terms of SSI-related outcomes, her teaching and assessment methods seemed to be the least reformed of all seven teachers visited during the site visits. Importantly, however, she was not using *DiscoveryNet* at the time of the site visit to her classroom and, although many of the other mathematics teachers at her school had been involved with the SSI, there seemed to have been little communication between those teachers (possibly due to the structure of the school timetable which allowed no time for department meetings). Thus, unlike many of the other teachers interviewed in this study, Ms Fisher's opportunities to discuss her successes and failures after trying new classroom activities were limited.

Equity issues

A fourth *Technical* element concerned teachers' awareness of various equity issues. In order for a teacher to be able to recognize and act on potentially inequitable situation, she must have an understanding of what the issues are. By far the biggest barrier teachers in this study faced in creating an equitable classroom was their limited awareness of potential problems. The following examples demonstrate that their awareness of equity issues was highly dependent on immediate day-to-day experience. This poses real problems for professional developers, in making "equity" meaningful in terms of participants' own experiences.

For some, equity was seen as referenced to ethnicity. As one superintendent said "When you said equity, I thought you were talking about ethnic minorities." For others, equity was interpreted as "gender" equity. Ms Michaels, for example, was aware of potential gender issues in her classes. She and a colleague had discussed the idea of grouping the students into single-sex

classes for mathematics because the perception was that some girls were afraid to answer questions in case were to bruise the boys' egos by outperforming them. She commented on her own experiences of this phenomenon during an interview.

> A lot of times either the boys are out to impress the girls or the girls are afraid to be perceived as too smart by the boys and it might make things easier if you had all girls or all boys in a class. Not that you would run the class any differently but the girls could then feel free to express themselves. ... I know that my husband will not bowl with me anymore because I beat him a couple of times and, you know, it was very damaging to his ego and I think that happens in classes too. That you know, you want to be popular and the cool guys don't want the smart girls.
>
> Betty Michaels, May 1996

Ms Michaels also showed awareness of what has been called the "critical mass" issue in relation to gender. She remarked on a distinct difference in those of her classes where there were more girls than boys..

> Now that's not a problem in this last class that you saw because there are only 8 boys in that class. They're outnumbered by the girls. There are 21 girls. So the girls have no problem taking over in that class. But in some of the others, there are kids that sit back and, you know they don't want to give the answer, they don't want to be seen as the one that has the right answer all the time.
>
> Betty Michaels, May 1996

Similarly, when asked what equity meant to her, Ms Fisher replied:

> Equity to me is treating everybody equally, giving everybody a fair shake. I think I do that very well in here. If anything I favor my girls more than I do my boys, I push my girls harder than I push my boys. I have told my girls, you need to go out in the world and prove yourself which means your are going to have to work hard, so you have to expect more from yourself. I do more outside of class work with my girls than I do my boys. They'll come for extra help, they will come in during study hall after school, just to clarify and make sure they are doing things correctly.
>
> Pamela Fisher, May 1996

For many, socio-economic issues dominated their interpretation of equity. Ms Golf , for example, was concerned that, in the institutes she had attended, only cultural and racial equity issues were considered. Given the homogeneity of the population in her community, racial and cultural differences hardly existed and were not recognised by teachers as a problem in that context, simply because the vast majority of the school and community population was white. When asked about the equity focus of her institute, Ms Golf replied

> We did a lot of sessions on that and it took up a lot of time and we actually were kind of resentful that it took up that much time, because in this area the thing we deal with more than anything is the (income) difference. I really don't perceive any gender problems nor race problems in this area, it's more economic, and the emphasis was put on different cultures and we were mad. You saw our kids today, we just don't have that. We felt, I think, the people that I talked to and most of the people in my group—we were pretty close—we were kind of resentful that so much time was spent on that. Not that we don't think that its a problem, it probably is a problem in places where you have that mix.
>
> Annie Golf, May 1996

A further dimension of equity related to the way in which schools were funded, which was seen to lead to great disparity in per-pupil spending between districts.

> [The] equity issue here is that we're funded about 75 percent by the state and about 25 percent locally. Again I'm not exact on those figures, but I know those are close. But per pupil expenditure is very low compared to some schools, where they are spending double per pupil what we are. And obviously the equity issue is that we should be getting more money. Money needs to be allotted up more equally but that hasn't happened. Whether or not it will happen is to go to court I suppose. They are supposed to be hearing the arguments and should be making a decision. Our legislators aren't going to make that decision, you know. I don't know, I cant really say that honestly that we should be able to take money from lets say {Somewhereville}, where they spend $10,000 a kid and we spend about $4,000, you know. Should we be able to take money from their community? I don't know.
>
> Anderson Middle School assistant principal, May 1996

Even those teachers who expressed their awareness of equity issues in their classrooms reported that it was difficult for them to be self aware of their treatment of different groups of

students while they were teaching. Because of the shortness of the site visits, a detailed analysis by the researchers was not possible either, so it is not really possible to say whether an awareness of potential equity problems makes for a more equitable classroom. Barb Arnold encapsulated this sentiment in her comments below.

> But, I try to spread it around a lot, and I've heard a lot of the programs on sex equity. Where boys tend to get treated different from girls, or teachers tend to have higher expectations for what boys do in their classes—or in Math and Science classes, anyway—than girls. And I've never felt like I did. But, of course, I can't sit there and watch myself teach, so I don't know if I am or not. But, I may go the other direction, and I may expect more from the girls and less from the boys, for all I know. I don't think I do, but... I probably couldn't tell unless somebody was sitting there watching me, and telling me what I was doing. I've never had any kids complain that they felt like I treated boys or girls—one or the other—like I expected more of them. So...or like they were more intelligent, or had better answers, and... I know one of the things they said was teachers tend to let boys give detailed explanations of their ideas, and girls just give brief answers. And, I've never felt that I did that, I don't know—do you notice me doing that? (laughs)
>
> Barb Arnold, May 1995

None of the teachers interviewed mentioned any other potential equity problems in their classes, which could mean one of two things: either there were no other problems, or that the teachers were not well enough informed to discern any other problems. One thing was clear from this analysis: there was the wide variety of interpretations of the meaning of the term "equity". Even though this SSI was clear about its equity focus, individuals translated the term very differently. This made it difficult for individual researchers to find evidence of equity or inequity during site visits. This has implications for equity advocates trying to move their agenda forward in large-scale reform. These implications will be discussed at the end of this paper.

Summary: How technical issues influenced the implementation of equity and reform objectives

From the analysis presented here, it seemed that there were certain *Technical* issues which were critical in enabling teachers to implement equity and reform objectives. The actual professional development experience was one critical element. The six-week model with follow-

up sessions and support from master teachers were essential pieces of its success, as was the facilitation of the formation of teacher support networks. With regard to the formation of teacher support networks, the point must be made that these networks do not form or sustain themselves without central facilitation or ongoing support. The Ohio SSI provided this support and most teachers interviewed mentioned the importance of the support networks. Other *Technical* issues that facilitated teachers implementing reform were the availability of suitable written curriculum materials, and an awareness of potential equity problems. One *Technical* issue raised by some teachers, which did not seem to have been addressed to any great extent in the institutes attended by the participants interviewed for this study, was how they could monitor their own interaction patterns with students in order to determine how equitable those patterns were.

The Cultural Dimension

Cultural elements which emerged as important at a number of sites were concerned with parental support, teacher expectations, students attitudes, and the general atmosphere of the school.

Parental support

None of the teachers or principals interviewed reported a high level of parental support. Interestingly, the three teachers who reported the lowest levels of parental support were those who were least successful in their implementation of reformed teaching practices.

Ms Young from West Side Middle School said that she often had around 40% of her parents turn up for the first parent-teacher conference of the year, but that this percentage dropped sharply later in the year. In comparison to other schools, 40% was quite high; so the reported lack of support is a matter of perspective.

Ms Herman encapsulated the general sentiment expressed by many teachers who were part of this study as follows:

> Most of their parents are minimally educated, whether it be high school or not high school

> yet. And it's something that is not important at home. They don't see the example at home and they don't see an importance. Most of the parents that I talk to, the first thing they say to me when they hear that I'm the math teacher is they say, "I never did well in math. That's why my child doesn't do well in math," which gets under my skin and it annoys me. I don't think this is just my students. I think that this is a national thing. I've never heard a parent say "I'm illiterate, that's why my child does poorly in English", but they're almost proud of the fact that they're poor in math.
>
> Freda Herman, May 1995

So in mathematics, these teachers were having to deal with not only a negative attitude toward education in general, but an even worse attitude towards mathematics in particular. Teachers perceived that without parental support, it was pointless to assign homework, as it was often not completed. Some teachers felt unable to implement changes in their teaching because they thought parents would not support change. Whether or not this was true was not really important. The critical factor was the teachers' perceptions, and whether the teacher was prepared to initiate activities in this regard. Ms Michaels at J. Adams Middle School for example, reported lower levels than any other teacher interviewed of parent support for parent-teacher conferences and attending school events. She still managed however to conduct inquiry activities and was not concerned about homework not being done. Ms Michaels overcame the problem of parents not turning up to parent-teacher conferences by telephoning those parents she needed to talk with rather than relying on their attendance at parent-teacher conferences. Ms Michaels also mentioned that the school had an annual open day for parents which was very successful. Similarly, Annie Golf at Anderson Middle School involved parents in the school's mathematics program by organizing a Family Math night which was extremely successful (despite warnings from the principal that it would "never work"). Lack of parent support in the form of not valuing education was certainly an issue for many schools in this study. Finding ways to involve parents more and to help them to value their child's education was undertaken with some success by some schools.

Teacher expectations

Some teachers tended to hold expectations of their students which were stereotyped in accordance with their perceptions of the students' background. For example, if they had low expectations of what their students were capable of, they did not attempt many inquiry lessons. This was particularly evident at Daniel Miller Middle School. The focus teacher, Ms Fisher, did not trust her students enough to engage in inquiry activities.

> I'd like to do more hands-on. I would like to do more student-centered activities. These kids don't handle freedom and responsibility very well. They can't, they're not{pause} I'm not going to say they can't. A lot of the times they choose not to do what they are suppose to do. They've never had to accept the responsibility and that makes it really difficult.
>
> Pamela Fisher , May 1996

Ms Fisher felt inhibited by her expectations of what her students were capable of. In contrast to Ms Fisher, Ms Young at West Side Middle School was a teacher whose involvement with the SSI had encouraged her to trust her students, at least initially. When asked how she had changed since her involvement she replied

> Well, I probably, maybe once in a while tried group work and it was so chaotic that, "Well, I can't do this again." Or, if we're using manipulatives, the first thing I would have said, "Oh, well they'll steal them all, or, they'll throw them, they'll kill each other, I'm not even going to try it." Where, now at least I'll try it, sometimes it doesn't always work, but I'll try it this way ..... and know what to expect.
>
> Diane Young, May 1995

Ms Arnold on the other hand, was willing to keep trying inquiry activities with her *Chapter 1* class, a small group of remedial students:

> The students in *Chapter 1* classes do not have any of their own ideas (laughs). I mean they very seldom do, and as far as designing an activity to test it, they wouldn't have a clue. I could design something to test their ideas, but they don't want to bother. If they have an idea, they don't want to bother designing something to test it. Either it's right or it's wrong. Well, I don't just say "you figure it out". They would just turn them off. But then that's *Chapter 1*. I can get that, I can work with my regular classes and get that in the regular

> math, but in the *Chapter 1* math I haven't been able to. Again, this is my first year doing *Chapter 1*, and I may find a way in the future, but right now I don't. It doesn't mean I won't. ... And sometimes I get surprised. Kids that I expected that wouldn't get involved with the exploration activities, do.
>
> Barb Arnold, May 1995

Ms Arnold made these comments after the researcher had observed a lesson with the *Chapter 1* class in which the students had been attempting an inquiry activity (Macon Junior High School field notes, May 1995). One group in the class was very successful, which surprised both Ms Arnold and the researcher. Had she avoided giving these students a chance at exploration, they would not have been able to surprise her.

Clearly, teachers' expectations of what their students are able to do has a significant impact on their willingness to try new teaching methods, and to persist with those methods. Having the opportunity to interact with other teachers trying the same sorts of things and experiencing similar reactions from their students may be the most effective way of helping teachers to overcome their reluctance to try new teaching methods.

Student attitudes

Another important part of the cultural context of the schools visited which impacted on the implementation of equity and reform objectives appeared to be related to students' attitudes towards to the types of experiences they were having in the SSI classes. Learning to work cooperatively and experiencing success in mathematics were two aspects of students' attitudes that were encountered across a number of sites.

Many teachers mentioned the students' lack of prior experience with inquiry learning and exploration as a major inhibiting factor for them, particularly at the beginning of the year. Ms Michaels commented on this in her interview as follows:

> I don't think the kids are used to [inquiry learning]. Just as when I first started with cooperative learning, it was very difficult for the students to accept that it wasn't cheating to share your ideas with someone else. This is difficult for them too, this last class that was in. In the beginning of the year they were going nuts. It was like "well if you would show

me" because I would say "what do you think" "well, but you're the teacher, your supposed to tell me". So until they're more used to it and as we try to incorporate that into our sixth grade curriculum and seventh grade, now when they go to eighth grade and get to Mary, she'll have an easier time because they'll be familiar with that. And that's generally what the difficulty is. They're still real dependent on the textbook. They want the security of "I have a math book. I have an assignment in the math book. I know exactly where I am, what I'm doing, what page I'm on."

Betty Michaels, May 1996

However, once students became accustomed to hands-on activities, they generally liked it, and appreciated the opportunity to work interactively, as noted by these two students from Naylor Middle School.

I like it, it is real fun, I mean, everybody I talk to they like Ms Straub and stuff because of the activities that we are doing, like we are doing out there right now (measuring, outside). And they are not always not working out of the book. So far I like her better than most of my math teachers.

Naylor Middle School student 1, May 1995

I don't know, we do a lot of fun things like the tangram, we go outside sometimes and measure poles and stuff like that. Like yesterday we were measuring things like sidewalks and stuff. We always do fun things like that.

Naylor Middle School student 2, May 1995

Students in classes where a lot of activities were done looked forward to coming to class and seemed to genuinely enjoy these activities, and, as a result, had positive attitudes towards mathematics. This change of attitude was particularly evident at Naylor Middle School, where Kathy Straub had noticed a change in the attitude of her students since she had been doing more hands-on activities. Her students were even thanking her personally.

K: Attitude, um, I don't hear so much anymore, "I hate math." I hear, "Math is my favorite class", "I enjoy going there", or "can we stay, and not go to the other classes today". You know, that is a very good feeling. And I have gotten notes this year

again.

I: What do you mean by notes?

K: It used to be when you were teaching you would get notes from kids, "thank you for this", "thank you for that". And for years I hadn't gotten any, and this is from that first class you observed. They just gave it to me the other day and there was another big thing that went with it.

Kathy Straub, May 1995

The positive atmosphere of trust and mutual respect that most of these successful teachers had created appeared to enable each student to fulfill his or her potential in mathematics. For many students of teachers interviewed in this study, past achievement had been very low. A series of demoralizing "D" or "F" grades in mathematics had been what they were accustomed to. However, a cooperative, caring approach such as that taken by Ms Arnold for example, helped some students to experience success for the first time.

> Well the class is, I like it because it helps me. Ms, Arnold, I had a whole year so she help me because last year I had an F and Ds and Cs, I didn't get a B or an A but then when I came to Ms Arnold's class this year I've gotten Bs and I think I got an A. I'm doing really well on the test too so Ms Arnold has helped me a lot.
>
> Macon Junior High School student 2, May 1996

Culture of the school

The culture of some schools seemed to be quite negative, even threatening for some teachers. At Urban Middle School, the school population, both staff and students, was very transient. The principal appeared to be aware of the problems this caused, but had been unable to do anything about it. The focus teacher Ms Herman felt constrained in her teaching by the constant absence from school of many of her students. At Daniel Miller Middle School, Ms Fisher said that she wasn't concerned about her personal safety, but was aware that some people were. However, she was afraid to take risks in her teaching for fear of her classes becoming uncontrollable, which many at the school appeared to be. These two teachers were among a number of teachers

interviewed in this study who expressed their views of students from a remedial perspective, in that they felt that their students' poor attitudes were the main problem preventing them from maximizing their potential. Further, they blamed the parents for passing on poor attitudes towards school to their children.

There were, however, other examples where teachers were not so greatly influenced by the apparent nature of the school culture. Ms Michaels at J. Adams Middle School for example initiated contact with parents rather than waiting for parents to come to see her. J. Adams Middle School also had a homework hotline that students or their parents could call to check what homework had been given to the class if the student had been absent. The atmosphere of the schools in which teachers had made most progress towards implementing reformed teaching practices—Macon Junior High School and J. Adams Middle School—appeared to be more stable with a more cohesive staff, and a supportive principal. This was in contrast to those schools where the teachers appeared to have made least progress towards reform—Urban Middle School and Daniel Miller Middle School—where a general feeling of unrest, disorder and a lack of support was felt by the visitors and teachers alike. This dimension overlaps with the *Political* dimension discussed below.

Summary: How cultural issues influenced the implementation of equity and reform objectives

There were certain *Cultural* dimensions that appeared to hinder some teachers and not others in their efforts to implement the goals of the SSI. Lack of parental support was evident at most schools, but for some teachers, this was not a significant hindrance. Absenteeism and poor attitudes towards education were evident at many schools, but again, the degree to which these impacted negatively on teachers varied greatly. In general, a disorganized, unruly atmosphere at a school, with poor parental support and low teacher expectations (like that at Daniel Miller Middle School and Urban Middle School) appeared to be associated with some teachers having difficulty implementing reform. In contrast, an organized, stable, and disciplined atmosphere, with high teacher expectations (like that at Macon Junior High School) appeared to be conducive to reform.

The Political Dimension

Proficiency tests

The first element in the *Political* dimension was related to the influence of the state-mandated proficiency test in determining not only what content was taught, but also how it was taught and assessed. In Ohio, the proficiency test is a multiple-choice test which all students in the state are required to pass in order to graduate high school. Students first take this test in eighth grade, and re-take it until they pass. This means that some students are still trying to pass the ninth grade tests in twelfth grade, or beyond if necessary. The tests are "high-stakes" not only for students, but also because they are used to monitor schools and teachers.

> About the same time as the first eighth graders took the proficiency test, it filtered through, that one of the school districts, they are tracking kids who are deficient and if there is the pattern of the same teachers, those teachers are going to be gone. Well, this kid may just be, somebody who is doing nothing, and that is not fair. And that is another—you know, here you go again, are you going to have a job, are you not going to have a job, is it really going to be done that way?
>
> Kathy Straub, May 1995

In all of the schools visited as part of *The Landscape Study*, teachers talked about the pressure put on them from principals, superintendents and other administrators in their school districts to improve their proficiency scores. Ms Arnold talked about this pressure.

R: Having the proficiency tests taken in the eighth grade has made a big difference to they way I teach now. There's a lot more pressure on us to be teaching to the proficiency tests in the eighth grade.

I: Who puts the pressure on?

R: It's still downtown administration. Indirect—it's very indirect, but they..."You've got to be doing this, and you've got to be doing this, and we've got to get those test scores up, and if they aren't up then it's your fault..." It's not anything—they're not coming out and saying, "You've got to teach it **this** way...", but if you don't teach it that way and the kids fail the proficiency test the first time around, then there's just the feeling that they're going to come back around and say, "Hey, you should have

been doing this."

Barb Arnold, May 1995

Teachers reported spending up to two months of teaching time doing almost nothing else but preparing students for the proficiency tests:

> ...close to the time of the proficiency test, starting like in January—we take it in the first part of March—the administration want to know and they ask a lot 'What are you going to do to prepare for proficiency?' So we really lose two months of teaching preparing them for the proficiency test and that's what they want you to do, drill and practice for two months, and I just hate that.

Annie Golf, Anderson Middle School, May 1996

Some teachers also drilled their students on how to take standardized tests:

> This year I spent the month of February going over how to take a standardized test, how to read the questions, what the questions are asking, strategies for how to answer the questions, way that they try to trick you by moving decimal points, not putting square units in for area, that kind of stuff. We talked about that, we actually practiced taking standardized tests and time limits, they learned to pace themselves.

Pamela Fisher, Daniel Miller Middle School, May 1996

The influence of the proficiency tests did not stop there. Throughout the whole school year, teachers structured their day's work to include proficiency-test practice. There were a number of books available, such as one by Bassett and Arnold (1993), which focused on test-taking and problem-solving skills. Ms Straub at Naylor Middle School indicated how she included proficiency practice in her daily schedule.

> Well everyday, on the side board there are three problems that are typical of problems that they will face on the proficiency exam. And they are taken from proficiency books or algebra books, or whatever. And they have to write them out, work them and then I give them double credit at the end of the quarter.

Kathy Straub, May 1995

The principal from Urban Middle School was also very firm in her belief that the

curriculum must match the proficiency test.

> Basically in the state of Ohio we have proficiency tests and everything that we as public educators that's what we must do. We must drive our curriculum to match that, what Ohio is saying our children need in order for them to be proficient. Regardless of any other curricular thoughts or ideas, those are negated simply because this is what our state that we live in says that we need from the ones that we've elected to represent us and what have you. Then we must drive our curriculum to meet those needs and to meet those objectives.
>
> Urban Middle School principal, May 1995

Some teachers liked having the proficiency tests because they were "forced to move along, not be in a rut...and it forces you to cover every area" (Betty Michaels, 5/15/96). Ms Michaels was accustomed to following a set curriculum in a set order and did not see anything wrong with a little bit of extra encouragement in the form of having to meet deadlines for the proficiency test.

A key question for this research concerned the interaction between the proficiency tests and inquiry teaching. In this regard, some teachers and principals believed that inquiry teaching methods help to increase student understanding and, as a result, help to increase proficiency test scores.

> Our proficiency scores as a result of using more hands-on more peer to peer helping have increased. Our scores went from, I think we had a 7% passing rate in math and it jumped up to 13% which is not great, but, it's almost double. And I didn't think it was that terrific until somebody from the district approached me and said 'what did you do in your building that made your scores go up that high? Everybody else's went down or stayed the same.' And we decided that it was because of using inquiry methods of having a proficiency class where the kids got some extra help using the computer lab, things like that, so that's helped the scores and I hope they're even higher this year.
>
> Betty Michaels, May 1996

Others, however, regarded inquiry teaching as too time consuming, and, although they agreed that it resulted in greater understanding of concepts, saw it as incompatible with efficient preparation for the proficiency tests. These teachers reverted to lecturing, drill and practice, or rote memorization techniques.

> I find that I don't do inquiry things before the proficiency tests because they take so long for the kids to get anywhere with and I wouldn't even, there are a lot of kids that can pick things up with the lecture so I figure that I'm benefiting more of the kids with the lecture than I am without, though the depth of their understanding is probably not as good. They'll probably do better on the proficiency test which is what they want downtown.
>
> Barb Arnold, May 1995

It appeared that the main barrier preventing teachers from using inquiry teaching methods when preparing their students for proficiency tests was their belief that inquiry methods were too time consuming. Related to this was perceived pressure from school and district administrators who were also not fully convinced of the benefits of inquiry methods. Unfortunately the proficiency test scores were not made available to *The Landscape Study*; so it is not possible to compare SSI and Non-SSI teachers in terms of their students' proficiency test scores. However, analysis of data from the achievement test given as part of *The Landscape Study*, presented elsewhere (Goodell, 1998; Tims Goodell, et al., 1997), showed that students in SSI classes scored significantly higher than students in Non-SSI classes on this test, and that the differences were greatest for females. Convincing administrators of the effectiveness of inquiry teaching remains a challenge for reformers, one that will be addressed in the next section of this paper.

Principal support

A second important *Political* element impacting teachers' ability to implement reform was the principal's support of the teacher and of the teacher's efforts to implement reform. While SSI teachers had already enjoyed a degree of support from their principal (because they had to have the principal's agreement in order to participate in the SSI summer institutes and follow-up Academic Year Seminars (AYS)) it seemed that, for some teachers, this initial support was not carried through to support for the "new ideas" they brought back to their classrooms. For example, although the principal at Anderson Middle School had supported Ms Golf's request to attend the institute, he was not very supportive of her innovative instructional practices.

S: My principal supports my innovative instructional practices, seldom and very

important. Like I was telling you at lunch time he doesn't like this, it's not structured enough. It's like I told him I said we're are going to go out and shoot free throws. We'll be outside for approximately fifteen minutes. He was like "O.K." and rolled his eyes. You know it's just like you know he doesn't like it, but he really is getting better, he really is. He's been so much better.

I: Is that due to the new superintendent?

S: She's very supportive and he knows that and when you're in that position, you do what they, whatever's popular at the top, so he's turned around a lot.

Annie Golf, May 1996

In contrast to the situation at Anderson Middle School, Ms Arnold at Macon Junior High School felt that the support of her principal was one of the main factors that helped her take risks with new teaching practices.

> Having [the principal] as supportive as he is makes it possible for me to do inquiry type activities because it eliminates a lot of the behavior problems that you would run into otherwise. Or it reduces them at least. It makes them less serious. So you have—you're a lot more flexible in doing things like that in your classroom, because you know it's supported, and the kids know that it's supported—and so they do what you ask them to do. I did a lot of group activities, but they had to be a lot more structured when I had a less supportive administration. And though they probably would have supported me, they didn't support a lot of the discipline around the building, and the kids pick up on that and just assume that they wouldn't support me either.

Barb Arnold, May 1995

Overall, the degree to which the principal further supported the changes teachers were trying to implement varied greatly across the seven sites visited as part of this study—from unconditional support for any changes through to active discouragement of change.

Teacher disempowerment

The third *Political* element identified through the cross-site analysis was the degree of control over the curriculum which teachers had. The curriculum content was tightly controlled by school districts and indirectly by the State of Ohio through the Ohio Model Curriculum on which

the proficiency tests were based. Most teachers considered that deviating from the curriculum was not an option for them. In one of the districts visited, not only were teachers expected to follow exactly the same curriculum, but they also had to administer interim tests provided by the district in exactly the same week as every other school in the district. This micro-management made the teachers feel very disempowered. They felt they were unable to influence even the pace at which they taught their students. Without the freedom to teach topics in the order in which they felt was important, or at the pace which suited their students, some teachers felt they were unable to incorporate inquiry lessons to any great degree, mainly because of the amount of time required for successful inquiry learning.

Summary: How political issues influenced the implementation of equity and reform objectives

Political issues remain an important influence in the process of reform. Principals have the power to block teachers from participating at all, and even when teachers do participate, principals can work against the reform at the school level through subtle and not-so-subtle means. State-wide mandated testing is also a powerful influence on classroom activities. District and school administrators who are not convinced of the efficacy of inquiry teaching in preparing students for proficiency tests can bring considerable pressure to bear on teachers to "teach the proficiency skills", usually through drill and practice. Through the use of state-wide mandated testing, and in some cases district-level mandated testing as well, most teachers perceive that they have little control over the content, and sometimes the order, in which they teach prescribed curriculum content. This implication of this is that very few teachers recognise the power of the curriculum as a whole in maintaining the hegemony of mathematics.

The Moral Dimension

Moral issues identified through the cross-site analysis are those issues which are concerned with justice and fairness, both of which require some judgment on the part of the researcher. The two *Moral* issues identified were: tracking, the practice of providing differentiated curricula based on past performance; and encouraging change without providing sufficient resources to effect the change. Both of these can be thought of as issues of fairness.

Tracking

Tracking has been shown to be a discriminatory practice that denies students the chance to fully participate in the scientific pipeline (Oakes, 1990; 1992). As the decision to track students is usually a school-policy level decision, it is not really an issue that the classroom teacher has any control over. All but one of the teachers visited in *The Landscape Study* spoke about some form of tracking at their school, often only in mathematics classes, but sometimes across several subjects by grouping the brightest students into one family for all core subjects. Ms Fisher for example thought that it was better (in terms of discipline) to keep the brightest students involved and interested by moving from one topic to another at a fast pace. She did not wait for every student to fully understand a concept, but instead moved on to the next topic when about 75% of her students had a reasonable grasp of things. Sometimes the tracking was formal, for example with *Pre-Algebra* and *Algebra* classes in seventh and eighth grade. In other cases it was more informal or implicit in the way the curriculum was structured. At Daniel Miller Middle School for example, the most able students were grouped together into one grade-seven-and-eight family. Unlike those in other families, these students studied foreign language and advanced music programs.

The *Moral* issue of inequitable treatment through placing students into a remedial class which receives a diluted mathematics curriculum appeared to warrant much greater attention at Macon Junior High School, where funds for what was known as "*Chapter 1*" classes were provided to the school based on the number of *Chapter 1* students enrolled. At Macon Junior High School in 1996, there was enough funding to employ a full-time teacher's aide. This person assisted in all of the *Chapter 1* classes, and also helped Ms Arnold in her other classes when she was available. All of Ms Arnold's classes were tracked, and these included *Algebra 1, Pre Algebra, General Math* and *Chapter 1*. The level of work and general atmosphere in the *Chapter 1* class was very poor. The students were nearly all African American (which did not reflect the demographic make-up of the school), and attendance was often low, with almost half the class absent every day in both of the three-day site visits in 1995 and 1996. Mathematics was the only subject in which this happened—students were in mixed ability groupings for all other core

subjects. However, Ms Arnold was convinced that Macon Junior High School's current practice of tracking was best for the students who were taking *Algebra 1* and *Pre Algebra*. She was just as convinced that her *Chapter 1* students would never pass the proficiency test, no matter what she did. She had not considered that placing her *Chapter 1* students into *General Math* classes, with the aide to assist, might have been more equitable.

Financial resources to support reform

As Apple (1992; 1995) and Tate (1995) have pointed out, the issue of "fiscal equity for urban schools is one of the United State's most critical dilemmas" (Tate, 1995, p.195). Is it moral to expect change without providing sufficient resources to facilitate that change? The NCTM standards and the implementation of inquiry teaching advocated by the SSI call for a radically different type of mathematics, in some cases requiring additional resources and smaller classes. In some of the SSI institutes, participants were provided with a small range of mathematical equipment, thereby overcoming a potential problem of not having equipment to facilitate the hands-on activities that are so much a part of inquiry teaching.

At the school level, the biggest resource issue was that of providing computers, graphics calculators and software. Such resources are important in the implementation of inquiry teaching, because graphics and other technologies can enable students to construct their own understanding of mathematical concepts in quite novel ways. However, although the cost of graphics calculators has decreased significant in recent years, at most schools visited during this study even the most basic four-function calculator was not readily available to most students. There were also other issues associated with using technology in the classroom—such as those of professional development and textbooks that incorporate the use of graphics calculators—needing to be addressed before teachers who were part of this study could fully implement even moderately advanced mathematical software and technology in their classroom.

Summary: How moral issues affected the implementation of equity and reform objectives

Issues of justice and fairness identified as *Moral* issues in this cross-site analysis have impacted on the implementation of reform. Tracking is one issue that was practiced in varying degrees at

most sites, suggesting that, in mathematics, tracking is still commonplace. Providing a challenging curriculum for all students was a major goal of the SSI, and tracking has been shown overall to work against this. Tracking, however, is an issue usually outside the control of any one classroom teacher; so the focus for change should be on those with the power to change these practices, namely school and district administrators. Likewise, providing appropriate technology, professional development and curriculum materials to support the use of appropriate technology is also outside the control of the classroom teacher, again indicating the need to focus on district administrators.

What's missing: A sense of "Caring"

In most of the issues that surfaced in this cross-site analysis, the reason underpinning whether or not teachers were able to implement equity and reform objectives could be attributed to their personal philosophy of teaching, their personal sense of what is fair and equitable treatment, and their care and concern for their students' well-being. It is more than an issue of a person's morality, because in some senses it could be quite possible to have high moral standards without really "caring". Teachers who genuinely cared about their students demonstrated this in their every action, with students commenting on this in the interviews. Both Ms Michaels and Ms Arnold were very caring and concerned for their students' well being. This is not to say that the other teachers did not care about their students, but that there was something extra that these two teachers had that the others did not. It was a sense of respect for the students as people, as human beings like themselves, that the students really connected with, and this is what really made the difference to the atmosphere in their classes, and their whole approach to teaching and capacity to overcome barriers to reform.

Teachers like Ms Michaels, Ms Arnold and Ms Golf appeared to have implemented many new teaching practices predominantly because they thought these strategies would improve their students' understanding and learning. All three of them seemed convinced that inquiry teaching was a better way to teach because, from their experiences, it enhanced student understanding and enjoyment of mathematics. The students' lack of motivation was not an issue

for these teachers. They wanted to make their classes as interesting and valuable for their students as they possibly could, and inquiry teaching made that goal possible. The absence of sufficient resources, a supportive principal, an accessible network of other SSI teachers, parent support or control over the curriculum did not necessarily prevent them from trying to create an equitable classroom, although the presence of these elements could certainly enhance this outcome.

With so many interactions and factors affecting what happens in a classroom, it is impossible to say exactly what combination of elements are essential to create the equitable classroom. However, one thing that was common to all three of the teachers who created the most elements of the connected equitable classroom was the caring way in which they approached all of their teaching and student interactions. It is significant, in terms of the theories underpinning this study, that this aspect was not addressed in the Rossman framework.

IMPLICATIONS AND CHALLENGES

Challenges for Reformers

This study has demonstrated that many of the features built into the Ohio SSI were essential in enabling teachers to make and sustain changes to their teaching. These included the six-week summer professional development institute with follow-up and support in the next academic year, the facilitation of the formation of support networks, the provision of hands-on materials and an awareness of equity issues. Other elements that facilitated teachers implementing equity and reform objectives were a supportive principal, the freedom to choose and order their curriculum, and a caring attitude that enabled them to overcome many of the barriers placed in their way.

An important finding from this study was that some SSI teachers chose not to use inquiry-based teaching practices to prepare their students for proficiency tests because they thought these practices were too time consuming and would therefore not adequately prepare students for the tests. This presents a challenge for reformers—how to convince teachers that the use of inquiry teaching does not disadvantage students, but in fact would advantage them by

ensuring better understanding as opposed to rote memorization. Related to this, is how to ensure that school- and district-level administrators support and understand the potential of the reforms offered, because teachers indicated in their interviews that it was often pressure from administrators that made them revert to drill and practice methods for preparing students for proficiency tests. Another related question is how to convince the large numbers of teachers who did not directly participate in the SSI to subsequently engage in reformed teaching practices. Mandated changes have been shown to have limited long-term impact (Fullan, 1993), and there is rarely the time or money to reach all teachers using the Ohio six-week model (Kahle, 1997). Arguably, one skill that teachers should be given during a professional development experience is how to share their skills and knowledge with those teachers at their school who did not participate. Of the seven teachers studied, Annie Golf presented a number of workshops for teachers in her district at the invitation of the district superintendent. It should be noted, however, that this superintendent had been involved with the SSI as an advisor prior to her taking up her position as superintendent, so perhaps this was a special case. To address this challenge, the Ohio SSI provided "Resource Teacher Institutes" to help SSI teachers prepare professional-development activities for teachers in their own districts. This has proven to be an effective way of scaling up the reform to reach much larger numbers than would be possible using an intensive six-week model (Schnipper & Tims (Goodell), 1996).

Another way to convince other teachers of the efficacy of the professional development experience would be to provide evidence of a link between reformed teaching by SSI participants and improved learning by their students. This makes it very important to continue to collect achievement data over time and to disseminate to teachers and district administrators results such as those found in this study. This process was started in 1996 with the publication of "A Pocket Panorama of *The Landscape Study*, 1995" (Kahle & Rogg, 1996), which set out the preliminary results of *The Landscape Study* in an easy-to-read brochure format that was sent to every school district in the state of Ohio, as well as other educational institutions around the country.

A further important challenge for reformers is how to help teachers adapt existing curriculum materials to support the goals of the reform, and how to identify appropriate new

curriculum materials. Recently, a number of important NSF-funded curriculum projects have been commercially released (see for example *The Connected Mathematics Project* (Lappan, Fey, Fitzgerald, Friel, & Phillips, 1997) and *Mathematics in Context* (National Center for Research in Mathematical Sciences Education & Freudenthal Institute, 1997)). Most of these have a large research base to validate their use and implementation in new situations, which future reformers could easily take advantage of. Evidence from this study suggests that the progress of reform could be enhanced if teachers were not continually faced with having to adapt resource and curriculum materials for every inquiry lesson.

A final challenge for reformers relates to the finding that the characteristic common to all three of the teachers who created the most elements of the equitable inquiry-oriented classroom was the caring way in which they approached all of their teaching and student interactions. It is significant, in terms of the theories underpinning this study, that this aspect was not addressed in the Rossman framework. This study has shown that the enhancement of these characteristics in every teacher is a challenge for those trying to effect school mathematics reform.

Challenges for Equity Advocates

The most important challenge for equity advocates which emerged from this study is to define, in operational terms, what equity means and looks like in a classroom, school, or district setting. Not having a clear and shared understanding of what equity really meant was one of the major obstacles of this study. Another important challenge for equity advocates is how to transmit equity goals to participants in a reform without engendering a backlash. Further, it important for equity advocates to recognize that teachers' understanding of equity is contextually constrained, and thus to ensure that local equity issues, as well as issues of state-wide or national concern, are incorporated into discussions about equity conducted during professional development sessions.

Related to this, is the need for teachers to develop the skills to monitor their own classroom interactions with students. Interaction patterns once established can be difficult to change. Developing techniques to assist teachers in analysing their own patterns of interaction in

the classroom should be a priority for professional development programs focused on equity of process and outcomes, as this SSI clearly was.

A final challenge for equity advocates is how to ensure that classroom teachers are empowered to question and challenge the scope, sequence and content of the curriculum, so that they may adopt a perspective that is appropriate to their circumstances, particularly when the reform is concentrating on teacher content and pedagogical knowledge. Little evidence was found that teachers acknowledged the way in which the choice of mathematics curricula could advantage some groups of students over others. As indicated earlier, this is not surprising given that they felt so disempowered by a system that told them exactly what to teach and when to teach it.

Since this study began, all of the authors of this paper have been involved in research to accomplish this goal. Kahle (1998) took a global approach and defined an equity metric to assist reformers in determining the progress of systemic reform towards equity. Goodell and Parker (2000) took a classroom-centered approach and defined the characteristics of a "Connected, Equitable Mathematics Classroom" from a practitioner's perspective. We are committed to continuing our efforts to ensure that equity for all students does not get lost in the goals of reform, because as demonstrated by Goodell (1998), although equity and reform goals are closely aligned, particularly in mathematics education, the two concepts are not synonymous. Without careful attention to equity goals, both globally and in the classroom, equity goals can get lost in the process of reform.

CONCLUSION

The research presented in this paper was conducted as part of a larger study of both mathematics and science teachers who had participated in the activities of the Ohio SSI over the period 1992 - 1996. The findings of this research have significant implications for those trying to effect reform in middle-school mathematics classrooms. As many authors have pointed out, teacher change is slow and difficult to achieve for a variety of reasons (Fullan, 1993,1995; Goertz, Floden, & O'Day, 1996, June; Hargreaves, 1992, 1994; Little, 1989). Systemic reform efforts have produced

significant changes in some classrooms, but, unless the barriers raised here are able to be addressed, it is doubtful whether reform will become "systemic" enough to truly transform teaching and learning, and significantly impact all students in Ohio. The importance of conducting rigorous evaluation studies such as the one described in this paper, and dissemination of the results of studies such as this cannot be overstated. If the challenges presented for both reformers and equity advocates are able to be overcome in future systemic reform efforts, the goal of transforming mathematics education will be far more rapidly achieved.

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