High Expectations: A “How” of Achieving Equitable Mathematics Classrooms

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ABSTRACT: Dramatic changes are occurring in the teaching and learning of mathematics in the nation's classrooms. It is no longer sufficient to be proficient in basic skills; students are now expected to develop deep conceptual understanding of a broad range of mathematical content areas. While there has been an increased focus on the need for equal opportunities for all students, African American students continue to score below their white counterparts, particularly in these critical areas. This paper suggests that low expectations play a significant role in the level of achievement of African American students in mathematics. It then examines the teaching of an effective mathematics teacher in an urban middle school and finds that high expectations are at the core of his teaching. Examples are given to illustrate three facets of his high expectations.

As the vision of what it means to be mathematically literate in our society has shifted from a basic skills curriculum for some to a more demanding standard for all, the limits of past pedagogical practice have become increasingly apparent. In response to this, the National Council of Teachers of Mathematics (NCTM, 1989) published its Standards for mathematics education. These Standards reoriented conventional sequencing of mathematics concepts, encouraging the introduction of geometric and algebraic concepts as early as the first grade. They also emphasized the development of conceptual understanding through a range of exploratory strategies including manipulatives, word problems, and open-ended questions. Basic skills continue to have an important role, however they are greatly de-emphasized relative to past practice, and they are envisioned as emerging through the application of conceptual understanding, rather than through direct instruction.

Over the past two decades, the underachievement of minority students in mathematics has been well-documented (Secada, 1992; Tate, 1997). Tate (1997) examined the mathematics achievement of diverse groups from national trend studies and found that African American and Hispanic students continue to score at significantly lower levels than white and Asian American students. He further reported that while minority students have made achievement gains in recent years, these gains were only on low-level and basic mathematics skills. This is problematic since basic skill proficiency is not enough for "true knowledge and mastery of mathematics" (Secada, 1992, p. 630).

Recognizing the disparity between minority students and their white counterparts, NCTM (2000) published a revised version of the standards of mathematics education...
entitled *Principles and Standards for School Mathematics* which attempts to include one of the important omissions of the previous standards document (i.e., NCTM, 1989). This omission includes the importance of high expectations for all students in order to implement the “new” visions of mathematics curriculum and teaching as suggested by the previous document. NCTM (2000) provides the mathematics education and mathematics education research communities with an Equity Principle which suggests that “equity [in mathematics education] requires high expectations and worthwhile opportunities for all” (p. 12). The issues here are: what constitutes worthwhile opportunities at the secondary level and what can be done to promote high expectations of minority students among the mathematics education community?

**Worthwhile Opportunities for All**

NCTM (2000) asserts that schools have an obligation to ensure that all students participate in a strong instructional program that supports their mathematics learning. Such programs are built around worthwhile opportunities that elicit mathematics learning among all students. These opportunities include, but are not limited to, problem solving, reasoning, and communication. Moreover, such opportunities should embody aspects of abstraction, invention, proof and application (Romberg, 1987)).

In accordance with this view, Schoenfeld (1994) posits that “when one focuses on mathematical thinking – the ability to do or use mathematics – then one needs to pay attention to: content, problem-solving strategies or heuristics, control (how well one uses resources), beliefs, and how well one functions as a member of a mathematical community” (p. 58). This shift from computational “basics” to a “body of knowledge” to be incorporated within mathematical tasks reflects a shift of seeing mathematics as ideas and not just procedures. The important issue here is how does this transition in what constitutes mathematics learning alter the current makeup of the mathematics curriculum of minority students? In particular, what kinds of curriculum and instruction uphold the idea of worthwhile opportunities?

**Worthwhile Teaching**

The National Council of Teachers of Mathematics (NCTM, 1991) encourages mathematics teachers to focus on new and innovative techniques and strategies to improve the quality of mathematics instruction. By developing means other than the “empty vessel” pedagogy, diverse populations can be supported and accommodated in their mathematics learning. The standards (i.e., NCTM 1989 and 1991) call for a curriculum that prepares students to be mathematically literate (i.e., to use mathematics to communicate, problem solve, and reason) and instructional practices that are student-teacher interactive, tapping higher-order cognitive thinking, problem solving, and discovery learning.

Mathematics teaching with a new vision requires teachers to view both the mathematics classroom and their roles in teaching differently. In order to allow students to construct knowledge, mathematics classes should be viewed as places where students re-discover and re-invent concepts and methods of solution. Viewing mathematics classrooms in this manner requires a different perspective of the roles of mathematics teachers in such settings. What are some of the “new” roles of mathematics teachers in such environments? Lappan (1998) notes the following four new roles:

1. engaging students in the task,
2. pushing student thinking while the exploration is proceeding,
3. helping students to make the mathematics more explicit during whole-class and group interaction and synthesis, and
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(4) using and responding to the diversity of the classroom to create an environment in which all students feel empowered to learn mathematics (p. 135).

The above roles noted by Lappan (1998) do not suggest that the roles of teachers involve a "guide on the side", but instead that teachers teach in a different manner. Instead, the mathematics education research community collectively posits that teachers should take on the role as "coordinators" and not "main actors" in mathematics classrooms as they were characterized in the past (Lappan, 1997). Such teaching involves students learning to use mathematics to help make sense of the "stories they encounter" in their everyday lives, a reasonable analogy for understanding the vision in mathematics reform efforts.

Teaching in this manner requires that teachers make several decisions. Teachers must decide on the role of each mathematical task (Schoenfeld, 1994) and what to use (Romberg, 1987). More specifically, teachers must determine if problems should be: relatively accessible, draw forth multiple methods of solution, used as introductions to mathematical ideas or mathematical explorations. This is very important because this determines the focus of each mathematics lesson. If there does not exist a focus on what mathematics should emerge within a unit or lesson, unfortunately little mathematics understanding will be developed. Also teachers must make sure that chosen curriculum units or lessons are appropriate for students' level of understanding. While lessons must not be out of reach of the majority of the students, it is also important that they are not too easy, which would convey a message of low expectations to students.

Such teaching has come to be known as "constructivist" or student-centered rather than teacher centered teaching. Unfortunately, Knapp (1995) has claimed that teachers use the antithesis of constructivist principles when working with minority students: more teacher-directed instruction and less student-led exploration, little cooperative and peer-supported learning, and more structured, lecture-style presentations. Thus, teachers tend to provide fewer opportunities for high-level mathematical learning when they work with what they perceive to be low-status students (Foster, 1986). Consequently, factors such as poverty and the prevailing climate of the school community influence teachers' expectations about the level and form of learning that should take place (Knapp, 1995; Knapp & Shields, 1991).

The Importance of High Expectations

Understanding how minority students learn (Hilliard, 1989) and what constitutes worthwhile opportunities (NCTM, 2000) will not bring about change alone in the mathematics achievement of minority students. For instance, Lipman (1993) has suggested that, despite massive attempts at school reform and restructuring, teacher ideologies and beliefs often remain unchanged, particularly toward African American students and their intellectual potential. Hilliard (1991) offers the following summary of past reform efforts of the mathematics education research community and why such efforts such as those suggested by NCTM (2000) may continue to fail minority students:

Untracking is right. Mainstreaming is right. Decentralization is right. Cooperative learning is right. Technology for all is right. Multiculturalism is right. But none of these approaches or strategies will mean anything if the fundamental belief system does not fit the new structures that are being created (Hilliard, p. 36).

In other words, if perceptions of students' abilities do not coincide with the purposes of initiatives to improve the performance of minority students, then change will not occur. Teachers cannot be expected to change their beliefs, knowledge, and actions based on a change process that consists primarily of the issuance of policy statements and the adoption of new texts. It is clear that this approach to policy implementation is not enough to achieve the policy's intended goals. As Rosenthal and Jacobson (1968) maintained over 30 years ago and as Cooper and Good (1983) later reiterated, teachers not only must believe in what they
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are doing, they must believe in their students' ability to learn. What follows is an example of an urban middle school mathematics teacher, “Mr. Lee” (pseudonym) whose approach to teaching embodies the belief that his students can learn meaningful mathematics, and whose students respond in positive ways.

Exhibitions of High Expectations - A Story worth Sharing

This is a portion of a study designed to identify features of effective mathematics teaching in an urban setting. A process of “peer nomination” was utilized to identify a middle school mathematics teacher who was found to consistently nurture positive outcomes in his students. When supervisors, teachers, and other knowledgeable individuals were asked to identify such teachers in a mid-sized urban district, one name consistently surfaced. The teacher (a white middle-aged male with over twenty-years of teaching experience) was approached and he agreed to be a part of an observational study that continued for over two years. Excerpts from this observational study will be used to illustrate several important features of his teaching.

Exhibitions of High Expectations: Mr. Lee's Classroom

The school was an urban middle school. The classroom was orderly. Students were busily working on their mathematics problems, answering and asking questions of the teacher and occasionally each other. This was the scene day after day, period after period, in Mr. Lee's 8th grade pre-algebra classrooms. The school's walls were thin and the sound of neighboring teachers' loud complaints punctuated the air: “I told you to be quiet; stop throwing that paper; get to work or I'll send you to the office.” When asked about the difference between his students and those in the room next door, Mr. Lee explained “Oh, those are the kids that you just saw in my room last period”. Why was there a difference? What was it about Mr. Lee’s classroom that facilitated student engagement? What lessons can we find in this story that would be helpful to teachers?

Teachers in urban middle schools might believe that Mr. Lee’s secret was strict classroom management. While it is true that learning cannot take place in a classroom that is out of control, Haberman (1991) found that “urban schools that serve as models of student learning have teachers who maintain control by establishing trust and involving their students in meaningful activities [therefore] ... discipline and control are primarily a consequence of their teaching and not a prerequisite condition of learning” (p. 293). Unfortunately, whether or not a teacher engages students in meaningful, challenging tasks often depends upon how the teacher perceives the abilities of the students. Research from the 1960's has suggested that teacher's expectations often acts as a self-fulfilling prophecy (Rosenthal & Jacobson, 1968). Too often minority students have been victims of teachers’ low expectations and the students’ achievement has mirrored those expectations (e.g., Oakes, 1990).

High expectations manifested through both words and deeds are necessary if all students are to reach high levels of mathematics achievement (NCTM, 2000). Concurring with this assertion, Mr. Lee states, “your expectations as a teacher have to be high”. He actuates this idea as he teaches a lesson on integer subtraction.

Several facets of Mr. Lee's teaching sent the subtle message to his students that he held high expectations for them. For example: (a) by using students’ prior knowledge as building blocks to new knowledge he let them know that they already had the foundation needed to learn. (b) by expecting students to be active participants in their own learning, he made it clear that they were to take responsibility for their own learning, and (c) by providing opportunities for students to understand concepts prior to learning rules, he made it clear that he knew they could understand the content and that it was understandable. While these pedagogical practices are consistent with current reform recommendations (e.g., NCTM, 2000), they also create a space in which academic excellence can become the norm for minority students (Ladson-Billings, 1994). Examples from his development of
integer operations will be used to illustrate these messages.

Mr. Lee began his first lesson on integer subtraction by letting students know that "today we are going to begin talking about subtraction. We're going to begin to develop the rule for subtracting integers". Segments of this lesson are included here to illustrate important components of his teaching. Various models were used to help them conceptualize integer subtraction and determine which answers made sense. It became clear to the students that he was not merely concerned with their ability to manipulate integers to obtain correct answers, but that he also expected them to understand where the rules came from.

Using students' knowledge. His lesson began by building upon students' procedural knowledge of subtraction.

Mr. Lee: If I take 43 minus 21, I come up with:

Student: 22

(Mr. Lee writes the following on the board)

\[
\begin{align*}
43 & \rightarrow \\
-21 & \rightarrow \\
22 & \rightarrow 
\end{align*}
\]

Mr. Lee: Let's go back a little further because I'm going to be referring to the words. Anyone know what these (pointing at the three numbers above) are referred to in subtraction?

Student: Product

Mr. Lee: Product is the answer to a multiplication problem

Student: Sum

Mr. Lee: The sum is the answer to an addition problem. Anybody else?

Student: equation.

Mr. Lee: An equation is a statement that has an equal sign. If I say to you that the difference between 6 and 4 is...

Students: 2

Mr. Lee: How'd I find it?

Student: Subtract

Mr. Lee: What word told you?

Student: Difference

Mr. Lee: Difference. The top number is called the minuend. I know you remember that. The number underneath is called the subtrahend.
What does the prefix sub mean?

Student: you subtract from the minuend

Mr. Lee: laughs. What else does it mean? A submarine goes under. OK. If I wanted to check this problem what could I do?

Student: add 21 and 22

Mr. Lee: OK, do the inverse operation so take the subtrahend 21 and add to difference 22, and see if you get the minuend 43.

Mr. Lee built upon what students already knew when developing new concepts. Familiar models were utilized: the number line and the vector models of whole number addition; the connection between addition and subtraction of whole numbers (e.g. if $9 - 4 = x$ then $x + 4 = 9$); and a “debt” model of negative integers (if you owed $4 and then borrowed another $5, where would you be?). Using these models and a series of questions, Mr. Lee helped the class to figure out the answers to several subtraction problems involving integers. By “asking”, not “telling”, Mr. Lee communicated to the students that they were already knowledgeable, and were not empty vessels waiting to be filled.

Expecting students to be active participants in their own learning. Mr. Lee involved his students actively in deriving the rules for subtracting integers. Using familiar models, students were able to arrive at sensible answers to a series of subtraction problems. Mr. Lee then placed the minuend, subtrahend, and difference for each of the problems in a table on the board, with columns labeled “a”, “-b” and “=c”.

<table>
<thead>
<tr>
<th>a</th>
<th>- b</th>
<th>= c</th>
</tr>
</thead>
<tbody>
<tr>
<td>+9</td>
<td>+4</td>
<td>+5</td>
</tr>
<tr>
<td>+6</td>
<td>+11</td>
<td>-5</td>
</tr>
<tr>
<td>-4</td>
<td>+5</td>
<td>-9</td>
</tr>
<tr>
<td>-6</td>
<td>-3</td>
<td>-3</td>
</tr>
</tbody>
</table>

Students were then prompted to look for a way to answer his question “How can we use a and b to get c”? The class searched for patterns within the table because “we don’t always want to go through … and find the length of the vector, so we want to find a rule, a ‘short cut’ that gives us this [the answers]”. “How could +6 and +11 when I subtract give a −5?” Students expressed their conjectures, but Mr. Lee’s response was always “does it work?” The proof that a rule was mathematically sound was not whether it agreed with
one found in the book, but that it “worked” for the various cases in the table. Students saw that they too could produce rules, that mathematical tools could come from them, and that they therefore made sense.

**Structure of the lesson – understanding precedes rules.** It is important to note that students developed the rules only after they were able to perform integer subtraction by using various models. Through this process Mr. Lee made it clear that rules were only a “short cut” to aid computation, and not a substitute for understanding. It also became clear to the students that Mr. Lee was not merely concerned with their ability to manipulate integers to obtain correct answers, but he expected them to understand where the rule came from. This is contrary to the “pedagogy of poverty” (Haberman, 1991) found in many inner city classrooms where students were expected only to memorize rules without meaning, and hopefully apply them correctly.

**Students’ opinions of Mr. Lee.** Students were given the opportunity to share their ideas about mathematics teaching and learning through a questionnaire. Below are characteristic responses to two of the questions that shed some light on their opinions about Mr. Lee’s teaching:

a. If you would be able to choose exactly how your math teacher would teach next year: in what ways, if any, would you want him/her to be the SAME as your math teacher this year?

- I would want my new teacher to do exactly the same thing. It helps me understand better
- I would want them to be willing to spend time with us so you can understand the assignment.
- I would want my teacher to teach exactly the same as Mr. Lee

b. In what ways, if any, would you want him/her to be DIFFERENT FROM your math teacher this year?

- I really enjoyed math this year and wouldn’t want it to change.
- Only if I could take Mr. Lee with me to my High School I would be totally satisfied. But this school needs him.

**Conclusion**

Mr. Lee’s story is an optimistic one. In a setting where many other teachers were struggling to keep their students on task, Mr. Lee’s classes were consistently focused and productive. It was clear that high expectations shaped his interactions with students, and that students responded in a positive manner to those expectations. While this is a positive story, all was not perfect. There were still days when the normal flow was broken, there were still students who failed to turn in homework or missed too many days of school. All students did not flourish. Yet students saw Mr. Lee as a teacher who made mathematics accessible and understandable.

The world that our students will become a part of will demand much of them. All students should have the opportunity to face those demands fully prepared. High expectations, translated into pedagogy that empowers students to reach those expectations, are imperative.
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References


