THE BROOKINGS INSTITUTION

THE MISPLACED MATH STUDENT:

LOST IN EIGHTH-GRADE ALGEBRA

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P R O C E E D I N G S

MR. LOVELESS: I think we will get started. And I will be eventually speaking to some data that are in tables and graphs, so I hope you picked up the hard copy of the report that you're going to be hearing about. It's on algebra students. It's called "The Misplaced Math Student."

My name is Tom Loveless. Welcome to Brookings this morning. And I'd like to first introduce the panel.

First, Kati Haycock, who is president of Education Trust and a long-time commentator on education issues and a leader on education issues here in Washington, D.C.

Next to Kati is Hank, Henry "Hank" Kepner, who is president of the National Council of Teachers of Mathematics, NCTM. And Hank is also a professor in the Department of Curriculum and Instruction at the University of Wisconsin, Milwaukee.

And next to Hank is Vern Williams. Vern is a math teacher, middle school math teacher, at Longfellow Middle School. And he's served on the National Math Advisory Panel, which met for about 300 years, I think. It's what it seemed. Actually from 2006 to 2008, and

the report was released this year.

Before I begin I'd like to thank my assistant, Katie back there, Katie Field Mateer . And Gladys as well, in the back, for putting on the event. And also I'd like to thank the Brown Family Foundation for its generous support for this study. And Lipman Hearne for doing all the graphics for us and the publication strategy and PR strategy for the study.

Okay. This is -- basically what we're going to do is I'm going to talk for about 10 or 12 minutes and then each of the discussants will spend 10 minutes responding to the paper and then we'll open it up to discussion. So why don't we get started?

I hope you can all see the various screens that we have. And I've already forgotten how to use the clicker. Okay.

This is a study of advanced math students in eighth grade. And let me tell you a little bit how it came about. Kati and I were working on a paper for the Fordham Institute on the other end of the achievement distribution, on 90th percentile kids and above during the era of No Child Left Behind. And we were examining NAPE data, and these are known as the restricted use files. They're really all the student level files of

students who take NAPE. And we noticed when we looked at the 90th percentile that we were comparing them to the 10th percentile and I was shocked at the percentage of kids at the 10th percentile who were enrolled in advanced classes. And so these are kids who score in the bottom 10 percent of all students in mathematics in eighth grade, and yet they're enrolled in advanced classes. And we define advanced math classes as algebra, algebra 2, or geometry. And so that's really the target population that you're going to be hearing about today.

Now, there are two sort of strange things going on in the NAPE data. One is when you look at state NAPE scores, and here's the top 10 states -- you see the full list in hard copy -- when you look at the top 10 states you notice that states like Massachusetts and Minnesota enroll, you know, 45 percent and 35 percent of their kids in these advanced classes and they have -- those are the top two states on NAPE. But you also see states like the next two, in third and fourth place, North Dakota and Vermont have very high NAPE scores, but they enroll less than the national average in these advanced classes. And you see the same thing actually at the bottom of the distribution. So here are

the bottom 10 states. You see the District of Columbia, for instance, which is -- enrolls a lot of kids in these advanced classes, 51 percent. Much more than the national average and yet it has the lowest math scores in the country.

Now, when you actually compute a correlation coefficient for this you get basically around zero. There's no correlation between the percentage of students that a state enrolls in advanced math classes at eighth grade and how that state scores in eighth grade.

Another anomaly that I've noticed in the data, since I track NAPE quite a bit, is that students who are enrolled in advanced classes, their scores actually have been falling. And this shows you from 2000 to 2007, their scores have been fine. Now, this is just the average of these kids enrolled in advanced classes, all kids enrolled in advanced classes. The dotted line at the bottom is the national eighth grade score. Scores in math have been rising. They've been rising since the early '90s and they've made tremendous gains from 2000 to 2007. But the kids enrolled in our top classes have been declining. Now, that's not to say anything about those classes themselves. As you'll soon see, their

composition has changed. They've been enrolling more kids who score at low levels.

Here are the actual enrollment figures for 2000 and 2005. You can see there was quite a bit of change from basic classes, that's the light green. The advanced classes are in the dark green. You can see they went up from 26 and some-odd percent to the advanced -- in 2005, 36.6 percent. You can see the gain. And you see that those kids are coming out of the basic classes. The basic classes are typically pre-algebra or general math, and they've been coming out of those classes. The other category there is just anything else. It could be another math class. It could be the kid didn't respond to the item. It's basically any other response. And we didn't really scrutinize it although you see growth there as well.

Now, let's look at our 10th percentile and below students. These are our low achievers. And here's how they enrolled in math classes from 2000 to 2005. You can see in 2000, 8 percent of them were taking those 3 courses. In 2005, that has jumped up now to 28.6 percent. It's going to be interesting to look at NAPE data, you know, from '07 and '09 to see if this trend continues, but you see large growth in those

advanced enrollments. Again, these are 10th percentile and below students, and you can see the decline where they're coming from. They're coming from those two basic courses, both pre-algebra and general math.

Now, here, how do these kids score, these 10th percentile scores? And I tried to express them on the NAPE scale in such a way that you could compare them with some other groups. So the first bar, 291, that's the average of all eighth graders who are in advanced classes. The next bar, 279 in NAPE. And I like to use 11 points as roughly 1 grade level as just a ballpark figure of what a grade level is. So all eighth graders, the national average, that's 279. Fourth graders, and you can place fourth and eighth grade on the same scale although some people quarrel with exactly how accurate that is, but for the sake of argument here fourth graders scored 238 on NAPE. And you can see now our misplaced kids, our 10th percentile kids, they scored 211. So my kind of ballpark estimate of where they function in mathematics is approximately at the second grade level. And they are enrolled, once again, in algebra, algebra 2, or geometry in eighth grade.

Jeremy Kilpatrick at the University of Georgia has said, you know, that he doesn't really agree

with my scaling of this, that they might be a little higher than second grade. Even if they're third or fourth grade level in their functioning, they still -- it's still odd that they're enrolled in these advanced classes.

Now, to get an idea of what these students can and cannot do in mathematics, here is a sample item from NAPE. This is a public release item. It deals with percentages. By the way, all eighth graders have trouble with this item. You can see that overall only 36 percent of eighth graders can do it. In case you can't do it, I checked the right answer for you there

There were 90 employees in a company. This year, the number of employees increased by 10 percent. How many employees are in the company this year?

So you have to compute 10 percent of 90 and you get 9 and then you add that onto 90 and you get 99. If you don't do those two steps accurately, you miss the item.

You can see that in the advanced classes only about half the kids got that item right. So this item is missed by a lot of eighth graders. But our misplaced 10th kids, the 10th percentile kids, they really had trouble with it. Less than 10 percent, 9.8 percent got

this item correct.

Here's a rounding item. It's quite a bit easier. I won't read it to you, but you'll see that 85 percent of all eighth graders got this item right. It's rounding decimals to the nearest whole number. The advanced kids, this is basically mastery. They know this stuff. But the misplaced 10th kids really don't understand decimals. Only 37 percent got that item right.

There were three fraction items that we looked at. I can't share them with you because they're not in public release, so I'll just call them Items A, B, and C, and they involve fractions. You can see the first item is relatively easy, 72 percent of all eighth graders getting it right; the misplaced kids, only 42 percent. Items B and C, you can see about half of the eighth graders got it right, but they're completely lost when it comes to fractions, 3.9 percent and 6.6 percent.

The National Math Panel that Vern and I served on recommended -- or one of our very first recommendations was that American children need to master fractions before they take algebra, that this is what is required for preparation of algebra.

Now, who are these kids? Who are these

misplaced kids? So let's start with talking about the kids themselves. Here are some demographic characteristics of the kids. They tend to be poor. You see that 69.8 percent of them are eligible for free and reduced lunch. That's a proxy for poverty. Far below the national average, far below their peers in the advanced classes. They tend to be students of color, either black or Hispanic. In fact, if you add the black and Hispanic percentages, about three-quarters of these kids are black or Hispanic. And their mothers do not report graduating from college at the same rate as the typical eighth grader and not as much as the typical kid sitting in advanced class.

What do their schools look like? Here are some school characteristics. The schools these children attend tend to be urban, over half of them. Only a third, roughly, in the country are urban schools. They tend not to be suburban. They tend not to be rural.

In terms of school enrollment, these are large schools these kids go to. You can see, 1,012 is the average enrollment of the schools these kids attend. That's quite a bit larger. The typical class housing in eighth grade -- the typical school housing in eighth grade has about 800 kids. So these are much, much

larger, about 25 percent larger. They tend not to go to private schools.

Again, the school tends to be dominated by poverty that these children attend. Two-thirds of them have more than 50 percent of their student enrollment qualifying for free or reduced lunch. And they tend not to use tracking as much as other schools. They tend to be de-tracked although two-thirds of them still have some kind of tracking, but a third of them do not, which is higher than the national average.

What do their teachers look like? The teachers of these misplaced students tend to be less experienced. Thirty percent of them have less than 5 years experience. They're a little less likely to be regularly credentialed as the typical eighth grader in the United States. And they tend not to have majored in mathematics themselves as an undergraduate, only 20 percent compared to a national average of about 26 percent. So the teachers look less experienced and less qualified at least on these sort of paper credentials.

Now, here's the summary and it's the summary right out of the report. One hundred -- and by the way, we estimated in terms of the numbers of eighth graders we're talking about is 120,000 nationwide, and so I'll

begin the summary with that. One hundred twenty thousand eighth graders are sitting in advanced math classes every thought they score in the bottom 10 percent of students nationwide on the NAPE math test. They know about as much math as the typical second grader. They do not know basic arithmetic and cannot correctly answer NAPE items using fractions, decimals, or percents. These students are disproportionately black and Hispanic. They hail from poor households with parents whose own education is below the national average.

The schools that these children attend are large urban public schools with predominantly low socioeconomic status populations. Their algebra classes are populated by students with mathematical abilities spanning several years. Their math teachers are less experience, less credentialed, and less well prepared in mathematics training than the typical teacher of advanced math students in eighth grade. No element of this story is educationally sound.

Now, what's important about this is that we have two states, California and Minnesota, that have already decided to mandate algebra for all students in eighth grade. They have not yet implemented those

policies. Minnesota will be in two years; California will be in three. But the problem that is laid out here for you today is going to grow, certainly in those two states and in many districts across the country as they adopt a universal algebra for all students in eighth grade.

I think the students who are being poorly served by this are not just the students we're looking at here. It's also in many of these classes the kids, by the way, who also tend to be poor, black, and Hispanic, who are sitting right next to them and who really are prepared to take a real algebra class because they're enrolled in a class where the teacher has to continually back up and teach mathematics that one needs to know in order to learn algebra. So they're paying a price for this just as well.

Now, I made some recommendations in the paper for what I call elements of a realistic algebra policy. The first is let's get the goal right. Course completion should never be our goal. That's confusing course completion with learning. Kids take courses to learn, so they take algebra courses to learn algebra. Let's make our goal that more students will learn algebra, not that they'll take courses and especially

not courses in any particular grade level. So we really shouldn't be sweeping all our eighth graders into an algebra. Let's prepare more kids adequately. Let's prepare them to succeed at algebra. And whether they are ready to do that in eighth grade or seventh grade or fifth grade or ninth grade or tenth grade, that's when they should be taking an algebra class.

The second recommendation is to teach and assess prerequisite skills leading up to algebra. Let's make sure, for instance, they know fractions. And let's make sure that that's taught and that we assess whether or not that knowledge has been gained.

We also need early intervention. So we need to be identifying kids who are struggling with math very early and give them extra time so that they can catch up. Saturdays, after school, whatever it takes, we need to be identifying children who are struggling at mathematics very early. We do a better job of this in reading and I think we take struggling at reading much more seriously than we do math. We need to do that with math as well.

And then finally, let's collect data and conduct research. We need some good research on this. I couldn't find a randomized trial, for instance, at all

testing whether an algebra-for-all policy is a good idea. And we really do need some good experiments on this to see what the impact is because the impact may turn out to be negative, not positive.

That's it. Thank you. And Kati will go first.

MS. HAYCOCK: So good morning. As I begin this morning, let me read, those of you who haven't actually read the full report, a paragraph from page 11. It says, "There will be advocates," I gathered, by the way, that that would be me, "despite the data presented here who will continue to argue for placing low-performing eighth graders in algebra classes. They believe that a more rigorous course is always preferable to a less rigorous one. Many do not believe that students must learn basic mathematics in order to successfully tackle higher level mathematics. They will argue that keeping remedial math students out of algebra in eighth grade denies these students the opportunity that good math students take for granted."

What they will not say is this: The burden of realizing such an idealistic view of mathematics learning falls on the classroom teacher. The core suggestion here seems to be the following. That because

the data presented here should persuade any smart and rational person anybody who disagrees with that conclusion must be not smart and not rational, maybe even one of those radicals we've been hearing about in the presidential elections this year. And that since the burden of teaching high-level mathematics to low-level students falls on teachers, any of us who advocate that strategy must hate or at least be indifferent to teachers.

I have to say that caricatures like that, not to mention the even more offensive characterizations in this paper of low-income and minority parents and kids, make me literally want to stick pencils in my eyes. And as I traveled over here this morning, I was sorely tempted to just give in to that feeling and play out the role of screeching advocate that I obviously was expected to play this morning. But at least for this morning I am going to try desperately not to do that. After all, I was one of those smart eighth graders who took algebra back in eighth grade in the good old days. The good old days, by the way, were despite the fact that my school was heavily Latino, I don't remember a single Latino in my algebra class. Regardless of that, though, surely I can muster the mathematics that I

learned in that algebra class and the ones that followed it to calmly raise at least a few questions and concerns about what is in this report.

Before I do that, though, let me tell you, I've actually been a fan of Tom's for a very long time. In the vast bulk of his work, he's very careful to stay very grounded in what the data actually said. And in the report he referred to earlier that he did for Fordham he was very careful to say, even though the folks at Fordham spun it differently, that the recent gains made by low-achieving kids did not come or at least appear to come at the expense of gain for students at the stop. Oddly, however, in this report, there's none of that carefulness, Tom, and that concerns me.

Sure, throughout the report, as you see when you read it, there are occasional paragraphs warning you not to infer causality here. In between those paragraphs are very huge leaps that get pretty slippery, at least in my judgment. Worst among them, in my view, is the second graph you saw, which compares the growth in overall eighth grade mathematics performance to a decline in the performance of eighth graders taking advanced algebra -- or advanced mathematics courses. The reader is actually encouraged, I think you will

agree, to view that as high-achieving kids are suffering because of all these low-achieving, especially poor or minority, kids who are sitting in their classes.

What he does not tell you is that NAPE data do not back up that hypothesis. The fact of the matter is, since Bill Clinton ruined mathematics teaching and learning by encouraging parents and schools to put eighth graders in algebra, students at the 10th percentile, that is our low-achieving kids, grew by about 20 points since 1990. Okay. Eighth graders at the 90th percentile, that is our high-achieving kids, actually grew by 18 points. In other words, almost the same amount. In other words, those high-achieving kids, like their low-achieving counterparts, are actually achieving, in Tom's own words, actually by about 1-1/2 to 2 grade levels higher today than they were before Bill Clinton destroyed the country by encouraging eighth grade algebra.

And the same pattern actually occurred since George Bush ruined the country by pushing states to get all kids instead of just some to their standards. Since 2003, both high achievers and low achievers are up. Low achievers by 6 points, high achievers by 4. So I think there's a little miscommunication there to say the

least.

There's a similar lack of discipline in the suggestion that putting low-achieving eighth graders in algebra somehow damages them. The word I think Tom uses is it represents a lost year of instruction from which these hopelessly poor children will never recover. And one is encouraged to view that as a student sitting in the back of the classroom completely unable to get anything from the instruction because, after all, they're too poor. Well, that suggestion probably has intuitive appeal. There is, as far as I can see, no evidence that that's right. True, we don't have any random assignment studies, but the best available piece we do have, that is Bill Schmidt and his colleagues' analysis of seventh an eighth grade (inaudible) of the U.S. sample actually suggests just the opposite. Students who spend eighth grade in general math progress not at all when compared to their seventh grade performance, where students who spend eighth grade in algebra actually progress hugely even when -- with controls for prior performance. Put differently, although low achievers in those algebra courses may not master what we think of as a full algebra, they'll learn a heck of a lot more math than if we put them in another

year of general math, period.

So let, if I can, in closing, make a couple of points here. Number one, it is very clear to me, as I'm sure it is to all of you, when you look at the international data that all of our kids need to grow way more, way faster in mathematics. Our bottom kids need to grow. Our top kids need to grow. And I agree that that includes in particular our top-achieving low-income and minority kids. So please don't get me wrong here. I think all of our kids, including the high achievers, need to grow.

Second, I think we all can agree that we need to understand a lot more about how to do this well. I agree, in other words, with Tom's suggestion that we need to try different things and we need to study the effects on different kids. And that includes possible negative effects on initially high-achieving kids of different kinds of strategies.

Third, what I do not agree with, though, is the suggestion that we should somehow rush to stop what I would argue is actually a rather slow movement of eighth graders into algebra. If you think about the logic here it goes something like this: Okay, we've taken a bunch of low-income and minority kids who

haven't been taught much math kindergarten through seventh grade. And we put them into algebra courses, but we've assigned them our least well educated, least experienced teachers. Gee, that didn't work very well. So the answer is take them out of algebra, not assign them stronger teachers; not beef up the mathematics instruction in their schools before eighth grade; not provide teachers with better curriculum and more professional development; not give it to them, but with an hour-long support course on the side, which, by the way, is what most high-achieving schools do. No, the answer is take them out of algebra.

That just doesn't make sense. Sure we ought to do all those other things: stronger teachers, more supports for teachers, more time for the kids who need it. And arguably, we ought to do those things first, right? But I got to tell you, if I have learned anything during 20 years of working in education it is we never do those other things -- never do those other things -- until we create a time certain for the bottom line. In other words, in this case, all kids in algebra.

I didn't always think about it that way. Frankly, I can remember a time 15 years or so ago when I

was sitting with a group of other education reformers and we were very calmly laying out this very linear strategy around getting new standards, getting new curriculum assessments, providing teachers with more help, making sure we gradually upped the rigor, and on and on and on. And finally -- finally -- at the end of that some 10-, 15-year process, we had somehow then started holding kids accountable for actually learning at those high levels.

And toward the end of this conversation an African-American woman in the room, happened to be a parent activist from Boston, stood up after being very quiet the whole time and she said how dare you. How dare you wait until all those other things are in place to hold my kid to the same high levels of expectation as anybody else because for my son that will -- that day will never come.

And again, what that woman knew was what we too often forget. We would like to make this about linear, slow steps toward somehow, some day, somehow getting kids there. But we don't ever take those other steps until we declare a time certain we're going to do that, and that's what we ought to be doing with algebra.

Thank you.

MR. KEPNER: Thank you. One of the things that I would definitely want to focus on is the idea of the algebra, algebra fault, and the systems we can get in place in there. And one of the things that I want to start with is clearly talking about the idea we know that algebra is a gateway to everything.

One of their biggest challenges is getting earlier success in mathematics for children, the better chances of their success. And that means getting at why questions meaning. So when we're talking about whole number fractions, which I'll come back to, it's clearly a matter of knowing more than computing the skill, but getting a feel of the why and the discussion and the connections skills across that. And that means that we've got to work on the earlier parts leading up to the algebra, whenever that occurs as Kati was talking about.

One thing we certainly have to say, for the students that are ready, there should be no reason to hold them back. The opportunities the school has should available and students should be encouraged to take advantage of that.

This continued response on the equity side of making sure kids get mathematics is one of our biggest parts. Certainly the algebra project and the long

history we have of tracking settings where kids got into settings and were never able to get out is a serious problem.

One other side on the algebra that I do want to mention because it affects things in several climates, and that is a reason for getting algebra and making sure it's in the eighth grade is to ensure kids get to calculus in high school. And I don't see that as a strong reason for doing that. Some students, if they're ready and are likely to go that route, that is an important thing. For many others, there is not that rush that it has to be done at high school. In fact, it's a lot of debate and within the collegiate community many students who even attempt or get to a point of doing some reasonable calculus in high school end up repeating pre-calc or calc when they do go to college, either by their own choice or by placement settings. So that should not be a driving force that pushes all the way backwards for students who are probably not ready at that point in their eighth grade to do that.

One of the concerns I do have and, Kati, you know, your comment you made, certainly in our society, both from the adults talking to the kids themselves, a failure in an algebra 1 course is a very negative impact

on our kids in the sense of will they pursue it? And one of the challenges, and I think we've already started to talk about this, so if we can do more, inadequate intervention or assurance that the student has these prerequisites are our major problem in the school settings. So our challenge is can be make sure we're looking at that and not taking the solution that, unfortunately, many of our schools have at this point? This is where we have to look at it, is not completing that algebra 1 in eighth grade or whenever means taking it again. And I don't see that as very successful at this point in most cases because it does not -- by taking that same course does not help with the prerequisites that were seen in the first place. And it's certainly not very motivating to the individual to have to sit through that identical course again. So those are challenges I think we very much have to take.

A note: The algebra 1 course we're talking about often as a rigorous algebra course is often the not-for-credit, remedial algebra course offered at universities when students come out of high school. So again, that's a long way from eighth grade, but it's the same issue that has come up and comes back again. Even -- and that course is taken by students many of which

who have had successful records of high school mathematics and yet something is happening, so we have to work on that. So the rigorous algebra course should be available and ready to kids when they're ready for it, but it's clear the background should be there that we're able to work on in that process.

What is that mathematics? I think the National Math Panel, the critical foundations, did an excellent job of identifying the pieces needed for the algebra: the whole numbers, the fractions, decimals, and percents, and components of geometry and measurement. I think those are key, but that's not all of mathematics. And I'm concerned that too much of our discussion has become narrowly that mathematics is algebra, and that certainly is not the experience that most students should be thinking about with their use of mathematics. Algebra's a key part of it, but it's not the whole ball of wax and we have to be careful about that side.

Certainly the NCTM (inaudible) focal points, the principals and standards, documents from NCTM would do a lot more saying along with those our work -- particularly work in what I would call early algebra, but certainly more work in data analysis and probability

and a broader perspective of geometry and measurement than was identified in the National Math Panel report focusing on the algebra strand in particular in that sense. I'll give you an example.

In first grade a very common story might be something like this: Yolanda has five objects, whatever they are, five candies. Juan gives her some more. Now she has 12.

Students can solve that in many different ways. So as they grow with their understanding of number, counting, and early work in addition. They solve it with counters, tally marks, other ways. One of our jobs in this early algebra, getting them to write stories in sentences like, "5 plus what equals 12?" Those are things that we often have not done a good job of getting this early algebra considered. That can happen in the first through fifth, sixth grade, and look what it looks like in the standard algebra 1 book. It looks very similar. Our job is to get the kids thinking mathematically that way well ahead of time in there.

One of the comments I was making to Tom, I think this report, by taking that percent, really makes the point. I want to make the point 10 percent is too low. There are students that might be much higher in

mathematical performance as you were identifying it on NAPE, other things, that are in an algebra course where they don't have the sufficient thinking process, fluency around fractions, decimals, percents, and their connections to geometric representations that allow them to do well in algebra. So I think that the setting is one that we should be more cautious in there.

And as a classroom teacher for a good part of my time, and I'll ask Vern and we've already started to talk about this, the comment that within a class of 25, 30 as you were using as your model, only 2 students that are extremely far behind is totally unrealistic. I always had more than two in both directions in that way. So the challenge is serious for the teacher, but it's always been there for the teacher. And I think that's a problem that we have to consider and say how can we provide the professional development with materials that can help teachers do a better job of trying to cope with those students. And that's where the idea is the interventions come in I think that are very important.

Two ideas out of the America Competes outfit, certainly NCTM is how you support (inaudible) and I think they are a piece of the action. One, much stronger math instruction leading up to this point. And

the idea of the math specialists, people in the upper grades and into middle grades that get students thinking and doing significant mathematics in preparation for algebra. And then secondly, the funding around what you might think of as interventions, which can be done either prior to or parallel to, either as a second choice, or just in timing interventions to go along with an algebra experience. Thank you.

MR. WILLIAMS: I am so the wrong person to be doing this because I can't see.

Where to start? Well, I've been teaching math for a little over 35 years to middle school students. I decided to become a math teacher when I was in ninth grade, which, by the way, was when I took my first algebra course. So I keep hearing that the world will end if algebra 1 is not taken in eighth grade. I took it in ninth and ended up teaching algebra and geometry and above for about 35 years so far, so it worked for me.

But then I get comments that, well, you must have been one of these wiz kids because you learned algebra the old-fashioned way. And the "old-fashioned way," that was for elite students, that top 10 percent. Well, I was considered an average student, but I was

taught a real algebra course and I was taught the course when I was ready to take the course and it helped me tremendously in subsequent advanced math courses. So to this day, I'm glad that I took it in ninth grade when I was ready as opposed to eighth grade when I didn't have the proper prerequisites.

One thing I'd like to mention is this thing we keep hearing about called "equity." We need more students in algebra classes for equity reasons. Well, you've heard the phrase "fake algebra." Well, there's also something called "fake equity." Existing in a classroom, in an algebra classroom, and not learning algebra does not promote equity. In fact, it promotes just the opposite.

I would say equity occurs when the opportunity to learn algebra occurs. When a student is prepared to take the course and they are ready to take the course, the course should be offered at their school and there should be no discrimination as to who goes into the course if they have the proper prerequisites and can succeed in learning the material.

So the opportunity to learn is taken from students when they haven't been taught the fundamental prerequisites leading to success in a course, as listed

in the final report of the National Mathematics Panel. And I agree with the report in that both misplaced and prepared students are really not served properly when they are in these algebra classes because the teacher's going to do one of two things: either they will water down the course or they will run into trouble with administrators, who have made decisions five levels above the teacher as to who should be taking the course.

Also, offering algebra in your classroom is not the same as teaching algebra. I teach algebra. I don't just exist in an algebra classroom with a sign over my door that says "Algebra Class." I feel that I'm successful and my students are successful if they learn algebra, not that they simply exist in my classroom.

And I think, again, the teacher will either teach a pretend algebra course when they have these students, in other words, take the algebra out of algebra, or they will risk a poor evaluation from administrators. And I've been around for over 35 years and even though it's anecdotal, I've seen this happen where decisions are made five levels above, you end up with students in your class who really don't have the proper background to succeed. And when the grades reflect that, you are told by the administration that

you will change the way that you teach. You will somehow get these students through the course. And many teachers, especially the younger teachers, will simply change their course so that more students succeed even though they're not learning authentic algebra, but they do -- their grades do increase.

Sometimes teachers are asked to change their instructional approach. I've heard the term "teach smarter." You don't have this top 10 or 20 percent of the students anymore, so you will need to teach smarter. And that translates in my world into stop teaching algebra, teach something else. We're supposed to use games, manipulatives, group work, technology, everything that's available. And somehow that is supposed to shrink this seven-year gap of mathematical knowledge if you just simply do these things. You go to a few professional development sessions and learn new teaching techniques and somehow the students will, by osmosis, learn fractions, decimals, percent, all of the things that are prerequisites for the course and learn an entire year's of algebra. Quite amazing.

I think sometimes we simply redefine what an algebra course is so that algebra for all can truly exist. And a perfect example of that is the Maryland

State Algebra Data Analysis Test. A reporter sent me many of the released items a few years ago and asked me to compare the Maryland state test to the Virginia Standards of Learning Test. And I decided I would do the problems. So I started doing the problems and I got about halfway through and I couldn't stand it anymore. I felt like I was sitting there doing fourth grade, very basic, fake business math as opposed to doing algebra problems. But that's, I suppose, Maryland's definition of what algebra is at this point.

So I think we should set reasonable expectations and I think that was in the report. Enroll students in an algebra course when they are ready to take and learn algebra, whether it be in seventh grade, ninth grade, or any other grade. I do know of some very, very sharp fourth graders who are actually ready to do an authentic algebra course, but I also know of some eighth graders who are not and it could be for a myriad of reasons. Preparation, just maybe they weren't properly taught. But the fact is if they are taking algebra, they should also learn algebra.

It's also unreasonable to expect for all students to learn an algebra course in one year with as much as a seven-year knowledge gap. And as an algebra

teacher I don't want to be given the impossible task of teaching a real algebra course to students who are mathematically many years behind their peers. And I should not be expected to water down the course that I've been instructed to teach.

I've been teaching, again, for 35 years. I have a pretty high reputation at my school. And I always tell my students if they want to fire me, it takes about five years to fire a teacher. And I tell them I'll be retired by then. So if I walk up to an administrator after perhaps assigning students low grades and they tell me that you'll have to teach smarter, I can look at them and say you folks need to start assigning students smarter. But most teachers can't do that and will not do that. And what will happen eventually is, sooner or later, students will end up in a real mathematics course. It might be geometry, it may be algebra 2, it might be freshman in college. And if they don't have an authentic algebra course as a prerequisite for those courses, they will suffer throughout. And if you think we have a lack of engineering and science majors now, if this keeps up this problem may even get worse. Thank you.

MR. LOVELESS: If I could just respond very

briefly to the comments and then we'll open it up to questions and discussion.

The points that Kati makes, there is one point we do agree on and that is that there are more misplaced students than I've documented here. In the study that she referenced that we did for the Fordham Institute, we looked at the 90th percentile kids. And we did identify kids in the 90th percentile and these kids probably are prepared for an algebra class. We identified kids who are not enrolled in algebra classes; they're enrolled in those basic classes. So they're misplaced just as well, but we shouldn't, in fact -- but the number is smaller. It's like 30- to 40,000. It's not 120,000 and growing.

The point that Hank made I think is a very important one. We use the 10th percentile, which is a very conservative estimate of what this problem is. Kids at the 20th percentile aren't ready for algebra either and they're not at the 30th and they're not at the 40th. And if the typical third grader which is -- let's say these kids function at the third grade level, I think they really function at the second grade level, if the typical third grader can take an algebra class and succeed we really need to be getting algebra in third grade to most of our American kids.

But when we look at the other end of the pipeline, the kids who are graduating from high school, don't forget, half of those kids right now don't graduate from high school knowing algebra. I'd rather have that be our goal, 100 percent, all kids knowing algebra when they graduate from high school. Let's accomplish that first, it seems to me, before we have a goal for all kids to take algebra in eighth grade. Let's have a, you know, more reasonable goal.

And finally, in terms of professional development, I just don't know what that professional development would look like. Because I haven't seen the studies or the evidence that you can take children -- I was a teacher myself. I taught 10 years. I taught sixth grade. I just don't know how to take kids who don't know fractions, decimals, and percents, they haven't mastered basic arithmetic, and teach them algebra. I don't know how to do that as a researcher and I don't know how to do it as a teacher. So I don't know what the professional development would actually be.

So, we'll open it up to the floor now and you can direct your questions to the people at the panel or all of us. Just pick one.

MR. ALTMAN: Hi. I'm Fred Altman and I -- the disadvantage of misplacing the algebra students is evidence with my grandson, who took --

MR. LOVELESS: I'm not sure the mike is on. It is? Okay.

MR. ALTMAN: Okay. Who did take the algebra and is now in a high school calculus class. And he had to drop it because the level of functioning, a lot of the students couldn't solve the equation X + 3 = 6. You're not going to get much calculus that way, so it's just a disadvantage right away.

MR. LOVELESS: And I do mention that also in the report. I think that is one problem and I don't document it because you can only do so much with cross-sectional data. By the way, I don't document any harm coming to these kids for taking algebra either. All I do is document their existence in these advanced classes. You can only do that with NAPE data, but that is a problem.

If you have a fake algebra class and you graduate those kids from a fake algebra class, then you have to create a fake algebra 2 class and a fake geometry class because they keep going, and a fake calculus class. So this problem does compound itself as

those kids go up through the system.

SPEAKER: The lowest 10th of students enter kindergarten unready for kindergarten math. They enter first grade unready for first grade math. And at each grade, the schools mostly pretend to teach them grade-level math by emphasizing activities like do a class survey and make a bar graph.

States and the federal government encourage pretend math instruction when they give extremely easy exams, like NAPE or the Maryland algebra test. So my question is the California algebra exam, do you have a sense of the content of that? Is that a pretend algebra exam that encourages pretend math instruction or is it a real algebra exam that punishes pretend math instruction?

MR. LOVELESS: You're asking anybody?

SPEAKER: Anybody who might have a sense of the content of the California exam.

MR. LOVELESS: I have a sense of it, but I haven't looked at the exam. But I know some people who worked -- Jim Millgrim is one of the people. He worked on the exam. And there were other people at Stanford who worked on the exam. My guess is it's pretty much real. And the failure rate, by the way, is extremely

high on that particular exam. It's very high. I don't know the percentage, but I -- well, I'm not going to say, but I --

SPEAKER: In that case, why isn't that a good thing for the reasons that Kati said?

MR. LOVELESS: If they keep that exam it will be a good thing, but that's -- don't forget, California adopted -- when they adopted this eighth grade for everyone policy, they adopted that exam as their No Child Left Behind exam. Now, if they keep that exam, that's fine, but there are tremendous incentives for them to announce a new exam. You know, I wouldn't be surprised if there aren't modifications to the exam.

MS. BURKE: Hi. Amy Burke with Texas Instruments. All of you have touched on the foundational skills and how those are critical. And it seems to me we're having the wrong policy discussion about when to take algebra or when to put kids in algebra versus the resources. And I know Harry touched on the Math Now, which was never funded in America Competes. What kind of message can we carry forward to policymakers to really address the root cause of the problem versus talking about algebra eighth grade/ninth grade?

MS. HAYCOCK: Well, again, there's a tendency on everybody's part, I guess, to characterize what folks are saying. Nobody in this room, and that includes me, I suspect, thinks that it is desirable to put underprepared students into algebra. I mean, that's not what this is about. I think the question is when we'll get serious about assuring that our kids, like kids in other countries, are actually ready for a decent algebra by eighth grade and have a fair amount of algebra as they progress toward eighth grade. And there's a bunch of pieces of that. Much of the foundation work, I would argue, has been laid out by both NCTM with the focal points and the Math Panel. And if we act on that aggressively as opposed to just leaving it to chance, that's obviously very important.

But the second thing that we never, ever get serious about is the maldistribution of teacher talent, where we are assigning the kids who are entering kindergarten, first grade, second grade with teachers who have the weakest mathematic knowledge. And then when they don't perform so well, we blame it on their parents or their home lives, which is nonsense. So, I mean, these kids need better. They need more mathematics instruction. They don't -- they're now

getting less. And so we've got to get very serious about this issue of who teaches whom.

And again, I would argue, you know, I'm not a zealot around eighth grade algebra even though it may appear so here. I am a zealot around let's draw a line in the sand, let's say we got to get kids here, and let's back map and do that work. But we never, ever do that until we draw that line.

MR. WILLIAMS: I think it's more than just they don't get the best teachers. I think decisions many times are made at higher levels as to what the curriculum is going to be in those lower grades and how math is going to be taught in those lower grades by people who haven't seen a kid, probably wouldn't know what a kid looked like, in 20 years. And what happens is in many of the suburban school districts their kids get exposed to this horrible situation, also, but they go out and they get tutors or they have folks at home that can get them through those lower grades and actually learn the prerequisites for algebra.

So I understand what you're saying, but it's not just that those kids are sitting in front of a lousy teacher. I think it's the system, not just the teacher.

MR. KEPNER: And let me add, I think we're

probably both on the same wavelength. Talking about that good math early, from the kindergarten right on, is it something -- and I think the National Math Panel said it well, the NCTM documents I think from the beginning have talked about it, is making sure that the problem solving, the concepts, and the skills go together. Too often I think in what are sometimes situations the skills are isolated and the students don't know how to connect them to the ideas they have either in that strand or in a different part of mathematics. So from the very beginning, those problems, those stories, they can start something, but we do have to follow with the significant mathematics that goes with that, how the concept attaches to the application, the problem. And they come in many forms, the whole idea of this multiple representations. The graphs in here, how would they look if we tried to write them in algebraic senses? Students should see that early, from my first grade story on up through the early algebra. And if we don't have that coherence in it, then they become a lot of isolated steps to students. And I think that's maybe a major problem with some of our earlier curriculum, that the student perceives it as a bunch of isolated things, which don't get connected, they don't get reviewed.

MS. HAYCOCK: Let me, if I could, just piggyback on that just briefly. I spend most of my time with classroom teachers in schools. And when you all talk about there's a curriculum, there isn't. For most teachers the most they get, and I'm talking even about people who are brand new to the profession, they get a copy of the state standards, which last time I looked at them were pretty darn vague in terms of what kids need to learn, and a textbook. So you think about what does that mean for a typical seventh grade mathematics teacher?

What that means is the textbook's about this thick, right? There's 482 chapters and no teacher can actually teach all of that, even to kids who are well prepared. Okay? So what do teachers do? Well, some of them start at the beginning, race as far as they can, and just wherever they get that's what seventh grade math is. Some of them skip around, depending on what they think is important, what they like to teach, what they don't. Others do all the symbolic problems, none of the word problems.

There's no coherent curriculum K through eight. So if we're going to deal with this, we can't just say, well, the idiots are creating curriculum at

levels above teachers. Actually, in most districts, there is no math curriculum. There's just a textbook and these vague things called standards. And if we're going to get serious about this -- and I would argue it is not just about teacher quality. It is about curriculum quality as well. And we actually have to do that as a country and stop getting so nervous about it.

MR. LOVELESS: I would just add that if we fix the curriculum, it still doesn't fix the problem of having kids in algebra classes who don't know fractions. And if you teach an algebra class to the curriculum, you're not going to teach fractions. So when are they going to learn fractions?

MS. HAYCOCK: It helps -- what I'm talking about is that problem is created, in part, because we don't have a curriculum in the lower grades. So you don't get -- you get a lot fewer kids to eighth grade without those skills if you actually have a coherent curriculum.

MR. LOVELESS: I totally agree and I totally support that. But we still have this problem today and that's what this paper documents, of kids in an algebra class who don't know fractions. So when are they going to learn fractions? If you teach them fractions, you're

not teaching them algebra.

SPEAKER: Thanks. It's clear from the data that the students who are enrolled in the advanced classes benefit more than those that are not in terms of a grade level improvement, if you go by the NAPE scores. What I'm interested in, the data that's kind of lacking in terms of how do the bottom 10 percent that are misplaced compare to the bottom 10 percent that are correctly placed. So how do they compare?

MR. LOVELESS: We looked at that and we also looked at growth. Now, I hesitate to even talk about this because, see, the composition of those courses has changed, as I demonstrated, so much that you really can't draw conclusions from let's say the change from 2000 to 2005. In the misplaced kids who were properly -- the misplaced kids in these advanced classes and the kids who were properly placed, the 10th percentile kids in the basic classes, they both grew. The kids in the basic classes grew a tiny bit more, 2 or 3 scale points in terms of NAPE. But that's -- again, you can't attribute that to the classes because it's not the same population in 2000 and 2005. The composition of those courses has changed. So you need longitudinal data really to hammer down what you're asking.

But yes, we did analyze that. I didn't share it for the reason I just gave. I think it misleads people. It happens to work in my direction in terms of the argument, but I don't -- it's not good evidence. It really is misleading evidence. Because the composition of those courses, as I document, has changed so much, you're comparing the apples in 2000 are like oranges in 2005. They're not the same even though they have the same -- they look like the same in terms of the label.

MR. SHRAKRONY : Tom, I have some objection to the result of the study. First of all, what constitutes algebra in different states and different districts is not the same. Clearly, if you look at what is taught in algebra 1 at the eighth grade in Washington, D.C., is very much different of what's taught in general math in North Dakota, which includes much more algebra.

The other thing is that NAPE at the eighth grade level report the scale score for students who are taking eighth grade math, pre-algebra, and algebra. Without an exception, in all 50 states, plus Washington, D.C., plus the urban district, the students who are in algebra have the highest average. Next are the algebra 1 -- the pre-algebra and then the eighth grade math.

So if some students that you are pointing out

in the top -- in the bottom 10 percent do not know the mathematical concept related to fractions who are in algebra 1, then what do you expect of them who are in pre-algebra or eighth grade math? These students are not doing well whether they're in the eighth grade math or algebra 1.

The other point is that the algebra at the eighth grade level is very important for what students take in high schools. If you look at the transcript study, almost 80 percent of the students who end up taking trig or pre-calculus or even calculus are those who started their algebra at the eighth grade level. So it is an effective mean.

The important thing is that in our analysis of what we did when we look at longitudinal data is that the students who do not do well on the algebra portion of the NAPE are students who are lacking the prerequisites for it. And quite often, they are admitted to algebra 1 erroneously because the name sounds good to be in algebra.

My name is Sharif Shrakrony . I used to work for NAPE. I'm now with Michigan State University.

MR. LOVELESS: I don't see where anything you just said contradicts the study. I mean, the study,

again, documents the existence of -- you're quite right, 10th percentile kids are 10th percentile kids no matter what class they're in. And they are more likely to take lower level classes than higher level classes. But that doesn't refute the fact that the problem that's documented in this study, which is we do have 10th percentile students taking algebra, and that's what this study documents.

And they also have a certain bundle of characteristics which suggest that if, indeed, they are misplaced, that misplacement could cause them some harm. As Vern pointed out, these typically are not kids where the parents are going to, you know, helicopter in tutors to take care of this misplacement problem. These are kids who are disadvantaged and they go to disadvantaged schools. And that's what these data document. But everything else you've said I think is totally correct.

The only caveat I would add is that when we look at -- it really is not a good sort of causal evidence to look at kids who are in calculus classes and find out that, indeed, most of them took algebra in eighth grade, therefore, everyone should take algebra in eighth grade. It really doesn't comment at all, that evidence, on what happens when you take kids who are

unprepared for algebra and put them in an eighth grade algebra class. And that I haven't seen studied with the transcript studies.

MS. HAYCOCK: But once again, this -- there is no evidence in your report that suggests a harmful effect for these so-called misplaced kids. In fact, Bill Schmidt and his colleagues' study, which is I think probably the best available research, suggests just the opposite: that they are likely to grow more if they're put in an algebra class. And this is low-achieving seventh graders put in an algebra course are more likely to grow than if they're put in another year of general math.

SPEAKER: Can I comment on that?

MS. HAYCOCK: Certainly.

MR. WILLIAMS: They may be more likely to grow, but I don't think they're more likely to learn the algebra course. Also, I think, with no proof, of course, that there is harm. Because if you have two students at the same level, let's say they're both in that bottom 10 percent, and one is in a pre-algebra course and the other is in an algebra course, they don't learn any algebra, but the following year they take geometry, and it may not be an authentic course, whereas

at least the student in that pre-algebra course might take algebra in the future when they're ready to take algebra. But once a kid is in an algebra course and teachers are under tremendous pressure to have these kids pass the course, whether they learn the material or not, all of a sudden they have algebra under their belts, they don't know any algebra. So then two or three years later, when they're in an algebra 2 class or sooner or later they will encounter real mathematics, they are totally unprepared. And I just don't understand how you can say that these students are benefiting by existing in an algebra class in eighth grade and they may learn 2 percent more than the student who is in a pre-algebra class in eighth grade.

MS. HAYCOCK: They learn a standard deviation more. I mean, it's a huge difference actually. But don't get me wrong here. I am not arguing in favor of pretend algebra or pretend pre-algebra. All I'm saying is that there is no evidence that suggests that these kids are harmed.

I would also argue on the basis of looking at huge numbers, hundreds and thousands of high school transcripts as well as middle school transcripts, that the notion that kids are being passed through these

courses, they're all getting As, Bs, and Cs, wrong. Wrong. Lots of kids are failing the courses, right, and they're having to take them again.

Again, none of this is ideal, but let's stay where the evidence is. The evidence does not suggest that this is doing the harm to the kids that the claim here suggests it is.

MR. KEPNER: One thing I want to mention is that we really don't have a dichotomy. It's not the rigorous algebra course, as Vern's saying, or what's sometimes referred to as the general math course. There are very significant middle grades curriculum and middle grades, eighth grade programs that do significant mathematics. And for the students, preparing them for courses Vern is referring to, to me that's a critical place where they are connecting mathematical ideas across geometry, number and everything, and building algebraic ideas in preparation for that course. So we're not going from nothing to an algebra setting. And there is a -- good evidence of that.

The problem I think we have is titles on transcripts and stuff don't identify those courses from ones that may be a more traditional or "general math type." So I think there is a very strong middle part.

MR. LOVELESS: Just a quick comment on Bill Schmidt's study. Bill Schmidt's study was with 1995 TIMS data and it compared kids who took algebra with kids who didn't, controlling for initial test score. And he didn't have longitudinal data either. TIMS doesn't have longitudinal samples. That really is not strong evidence at all. And they're not the same kids.

MS. HAYCOCK: (inaudible) a lot stronger than was suggested here that they're getting damaged.

MR. LOVELESS: No, it just simply isn't evidence of what happens longitudinally. What are the effects of what we're discussing here? It's not good evidence.

MR. DANCES: Hi. I'm Terome Dances . I'm a retired math professor, and I guess maybe there should be a little perspective from colleges. Certainly at the universities the number of students showing up and not being able to add fractions is -- appears to be going up. And we see this in the students over in calculus and we see it in the -- well, certainly in my state of Maryland, there's -- over the past decade, as the state has changed the math curriculum to align it with the National Council of Teachers and Mathematic Standards, the number of students showing up in colleges needing

remedial arithmetic and remedial algebra 1 has gone up dramatically and much more so for minority students.

Now, from my perspective, a major problem with teaching algebra in grade 8 is that there's a sizeable number of grade 8 teachers who have K through 8 certification. They don't especially -- they may -- some of them know how to add fractions and some don't. Now, No Child Left Behind realized this and said that middle school math teachers must be highly qualified in their subject. The loophole is that they left it to the states to set the standards as low as they wish. Many states have chosen to use the practice to a math content exam. And the first rule in that exam is that the middle school math teachers may use calculators and which, namely, you may become a highly qualified middle school math teacher without knowing how to add fractions. So, to me, the first place to improve things is to insist that the states raise their certification requirements.

MR. LOVELESS: Hang on, just -- you're going to have to wrap it up quickly. In fact, I think that's a good -- you made several good points there. Comments from anyone?

MS. FRANK: I'm Charlotte Frank . I'm a

former math teacher, former math supervisor. I'm presently a -- I've had a whole educational career. I'm a former regent in New York State.

And I just want to say, we've all come to this meeting and we spent time getting here and we spent an hour here. What do you want to have happen? Because if I had taken this discussion, this could have been said 40 years ago, when I was still starting as a math teacher.

Now, one of the things, and it has to do with somebody called Ron Edmonds that had to say with high expectations what do we expect? And one of the things we found as a region policy-wise was that we had too many special ed kids, and mostly boys and mostly minorities, who were not taking any tests, no regents, nothing. After five years of intensive stuff, we had more special ed kids passing regents exams than had ever taken them five years before. And we can all shake our head, that's true, because we should be doing it differently.

I guess my question to this panel is we can talk about all these situations and they're not doing the right things and we need a longer school day and we need a longer school week, a longer -- of that stuff.

What would you like to have happen so that this panel and this meeting can make a change?

Obviously, you know, we could talk about schools of ed, we can talk about a lot of stuff. But otherwise, you're going to have another meeting talking about the same thing because we all have stories that say what works. We're here because we care. What are the three things that we should be saying and fighting for as the result of this meeting? Because you all know about what's happening in the schools and what's not happening. And you don't have enough time. I could go on endlessly as everybody else can.

MR. LOVELESS: Well, I laid out four things and those were my recommendations to have a realistic algebra policy: focus on learning, not course-taking, they're not the same thing; early intervention; assess, make sure the kids have prerequisites and assess whether or not they've mastered those prerequisites, especially for actions; and conduct -- we need much more research on effective interventions with kids who struggle at math if we want everybody to take algebra by eighth grade. So those are my recommendations.

MS. FRANK: The recommendations are for who? I have my classroom voice. I don't need a microphone.

MR. LOVELESS: They're for state and local policy makers in particular.

MS. FRANK: I've never lost my cafeteria voice. The issue is, all right, you say we should have more fractions. I mean, we should have. I mean, I know more adults, businesspeople, who said I suddenly understand why I took algebra. I mean, there isn't anybody who knows about baseball that doesn't understand a percentile. I mean, there are things.

So what you're saying is we should be learning more fractions?

MR. LOVELESS: Kids who take -- kids need to master fractions in order to take algebra, yes, I am saying that.

MS. FRANK: Oh, I see, you want --

MR. LOVELESS: But Charlotte, I didn't try to solve every problem with American education in this paper. I really had a much more limited question and a much more limited scope, and it was to look at enrollment in algebra. And I found all these 10th percentile kids in algebra. So the question is what do we do about that?

MS. FRANK: Just my response. Well, I would like separately another paper from you then that says --

- no, and one sheet, I can't stand big papers. Four bullets on each of these items. You're saying this is what has to be done. That's the what. Give us, each of us, four hows. Four bullets for the how.

MR. LOVELESS: You'll find it in the paper there. Pick up a copy and I tried.

MS. FRANK: I read the whole thing.

MR. LOVELESS: Okay.

MS. ROSEN: Linda Rosen . Hank suggested that there was no dichotomy. I'm going to suggest that there's actually a false dichotomy as I've listened to the panel.

And I think, Charlotte, partly in response, what I'm taking away from Tom's data is that we tend in this country to have black-and-white policies. So everyone shall do this by such-and-such a year. And what this data is suggesting is that that arbitrary date, whether it's two years or three years, is premature given the state of where most students are today.

We definitely, Kati, we need to do all the things about improving what they learn, but we can't wave a magic wand and increase students' knowledge who are now in third grade or fourth grade and fifth grade

sufficiently in time. We haven't figured out how to do that yet.

So it feels to me as if we need a short-term and a mid-term and a long-term set of goals. Maybe the long-term goal really is to have everyone in eighth grade take algebra, I don't know. I mean, this is the result of that research. Maybe that's true, but in the short term I at least observe that it's dangerous to making these pronouncements for everyone. And that's at least my takeaway message.

MR. LOVELESS: Well, I pointed out in the paper, in the discussion, in fact, this gets back to the California question, California does require all high school graduates to take an exit exam before they graduate from high school. That exam, the mathematics on that exam, is easier and lower level than this eighth grade algebra test. Now, that just doesn't make sense to me.

I think a more rational policy would be for California to have a high school exit exam, first of all, to change their exit exam and put real mathematics on it that tests mastery of algebra and geometry of every single graduate from high school. And again, that seems like a reasonable goal for me. It gives kids four

more years, meaning high school, to master those two subjects. And I would just prefer that as a reasonable goal and something that we can do, and we already have the apparatus in place, rather than eighth grade algebra for everybody.

MS. HAYCOCK: The one thing that may be worth adding about California, will make them seem less insane perhaps, is -- and that is if you look at the assessments in grades 2 through 7, the Mathematics California Standards Test, what you find is a steady increase in the proportion of the items on those exams that come from algebra strand. So at second grade it's 9 percent, third grade it's about 15 percent, and that goes up till the seventh grade exam. The sixth and seventh grade exams are somewhere, I don't remember the numbers, but between 40 and 60 percent algebra.

So, you know, lest you think that my home state is somehow, you know, completely insane, you need to know that this is actually a part of a decent set of standards of folks working very hard on introducing algebraic thinking much earlier. And this is what many people in the state believe will actually speed them along and making sure the kids actually master what they need to.

MR. KEPNER: Let me add to that, and I don't know how it's reflected in their assessment items in California in particular. But to people you talk to outside this room, I want to make the claim that the real reason for algebra is what? It describes the world. Are they able to use it to describe the world?

And too often, some of our discussion becomes internal mathematics, which is appropriate, but it's how well -- and I like the idea of the early algebra starts to build reasons for doing it. Are there problems that cause you to write expressions, to write functions? And to use it in ways that once you leave algebra class, you'll really remember that you're using it. Most adults don't think they ever used algebra after they left ninth grade and yet, you wouldn't believe the people who use spreadsheets. Now, what's in spreadsheets? A ton of algebra. It's not all of it. It's not all of it in any way. But it's a place where more people -- and I'm hoping our kids will realize when they leave a math class, the algebra goes with them.

MR. LOVELESS: Other questions?

MR. OLIVER: Yes, Doug Oliver . You mentioned that there was a propensity for young teachers or early career teachers to be in these mismatched classes. Does

that affect the high attrition rate of early teachers?

MR. LOVELESS: I don't know. I don't know. People who leave teaching say they're frustrated by a number of things. We did -- actually on the National Math Panel, I should mention, and I do cite some of this in the article, we surveyed algebra teachers nationwide. And we asked them a series of questions about what are the barriers to teaching kids algebra? And they said overwhelmingly, the number one response, is getting unmotivated kids. The second one most popular answer was that kids didn't have the basic skills to learn algebra. And I don't remember the third. But anyway, that is also cited in the report. But we surveyed -- like I said, we surveyed the teachers of algebra nationwide at all grades, including eighth through whatever.

MS. HARBINSON: Linda Harbinson , (inaudible) Maryland.

SPEAKER: Ma'am, can you wait for the mike, please?

MS. HARBINSON: I'm curious as to the panel's opinion on the use of calculators and whether that has contributed to students being less ready for algebra and not mastering some of the basics. Thank you.

MR. KEPNER: Let me indicate I don't think we have evidence that it's hurting, but I am concerned that often we don't use the calculators for the right things. In a math class, when a calculator is used, maybe appropriately, maybe inappropriately, the teacher's follow-up questions should get at the mathematics for which that calculator was an intervening part. The calculator should not be the whole thing. So I think a lot of the assessment people are trying to look at calculator-neutral, calculator items. That's okay in the assessment field of trying to make those decisions. They're tough decisions. But in the instructional setting it's helping a student learn where do I use it and how does it back up my mathematical thinking.

MR. LOVELESS: I basically agree with that. The research doesn't document a clear harm of mathematics use. Now, there was a recent study out of Vanderbilt, it came out in the last couple months, that did show that kids who have not mastered just basic computation skills can become overly dependent on calculators and that can retard their learning, but that's the only study like that. If you look at the whole corpus, the whole body of research on that, it's really a wash on calculators. No great help, no great

harm.

I think we have time just for two more.

MR. FENNERAN: Kevin Fenneran at the National Academy of Sciences. Kati makes, you know, the right ethical case for impatience. You know, we want to help people. These are young people that really need to learn math and we want to have them learn math as quickly as possible. You also cite Bill Schmidt and -- whose central critique of the way we teach mathematics in this country is that we pile everything on at once, that the curriculum is cluttered, and, therefore, it's ineffective.

And your recommendation for teaching people who might not be prepared for algebra, to have them do it anyway, and then also at the side be teaching them fractions, decimals, and so on, I just wonder if ethically it's the right thing to do. Pedagogically is it going to be effective? Can you really be teaching people fractions and decimals at the same time that you're trying to teach them algebra, never mind whether they have the resources and the people to do it? Is it really serving them well? Is that the most effective way to get them to learn algebra?

MS. HAYCOCK: You know, as I think we all

agree, we don't have enough research to answer all those questions. I can tell you that we've done some pretty close looking at a set of high schools that are unusually effective in taking kids who arrive behind to much higher levels of growth in terms of academic achievement. And in those schools, they are -- the pattern they use is put kids into the tougher courses, put a support course on the side that essentially provides some of the extra help that the kids need to succeed, and those schools are way more successful in getting students through with growth than their counterparts that delay entry. So -- but again, we need lots more research on this.

And nobody thinks any of these things is ideal. The question is both what do we do now with the kids we have? And I would argue that most of what we're learning suggests push them into the classes, put a support class on the side. Because if you put them in another year of general math, they will learn nothing. I mean, they just won't. And -- but while we do that, we've really got to get serious about what happens below. And I really do think that that's, in part, about making sure the kids who need them the most get very strong teachers, but it is very much in part about

decent curriculum, so we don't just leave teachers on their own to figure out all this stuff. And that's what we're doing now.

SPEAKER: (inaudible) --

SPEAKER: Sir, behind you.

SPEAKER: -- several years ago. The question I have is actually to Mr. Vernon -- or Mr. Vern. The recommendations that Tom put out, the thing we did with equity, we didn't really include the math teachers as much as I thought we should. Do you agree with his recommendations? And if so, all of them or do you have other things you agree with?

MR. KEPNER: Would you mention that one more time? I didn't hear part of that.

SPEAKER: Equity 2000, do you know that program?

MR. KEPNER: Right.

SPEAKER: They tried to produce algebra for underrepresented kids. A lot of the same things we're talking about here they were doing. And I was one of the researchers for that part. The group I thought we did not include enough was folks like yourself. I'd like your opinion on are Tom's recommendations what you'd recommend or do you have something else you'd

recommend instead?

MR. WILLIAMS: I think the recommendations are right on. I really do. And I would also add Jerry's recommendation that teachers who have an appropriate math background are assigned to not only algebra classes, but to teach math in elementary schools. Because I think that -- I know you mentioned -- one of the panelists mentioned a teacher problem. Well, that is a teacher problem.

Before I served on the National Math Panel, I really had no idea that there were eighth grade teachers in existence who could not add fractions. And it was a rude awakening for me because teaching in Fairfax County, we do -- we are outside of the norm as far as the quality of our teachers. But throughout the nation that problem does exist. So I would specifically add that to the list of the recommendations.

MR. LOVELESS: And I just want to say Equity 2000 actually had a lot of the elements, but -- at the high school level. I served on their advisory board and it -- but it was a high school program that such things as what Kati mentioned, double-dosing, double doses of math, having two periods of math. You have to buy time somewhere. And so these are the kinds of interventions

we need to be trying.

But again, I'm skeptical of putting this sort of eighth grade limit on it. It should be all the way through twelfth grade and more reasonable expectations.

MR. KEPNER: Let me add one thing to what I think Vern was saying in teaching. Certainly there's a lot of teacher quality problems we have to deal with because people are asked to teach the mathematics, that that wasn't their preparation and they've often been put into that setting. A part of it, in addition to knowing the content at that grade level and I think that's the most pivotal, but secondly, a good algebra teacher has to know where are my kids going with this algebra. So if they haven't had some look about what comes next in a broad view of mathematics, it's hard for them to keep their kids' eyes looking up and forward.

MR. LOVELESS: And by the way, I don't know where Minnesota and California plan on getting these algebra teachers because they don't have them. Thirty years ago, the typical eighth grade teacher had a secondary credential in the subject he or she was teaching. That's not true today. Most middle school teachers are elementary credentialed teachers. So where they're going to find these teachers once they triple

and quadruple the percentage of kids in algebra in eighth grade, I just have no idea.

And this will be the last question.

MS. KIM: Hi, everyone. My name's Melissa Kim . I'm a principal of a middle school. And I think the question that I walk away with is the question you just raised: What comes next? And I think in order for us -- our teachers to create this, you know, middle school pathway for math acquisition or whatever that may be, we need to expect something. And that's what I find to be exciting about algebra in eighth grade. Because from there, we can map backwards to say, well, what do we do with kids when they enter in sixth grade? What courses and what pathways do we put in place for them? And how is that different from kids who come in sixth grade ready for algebra then? So how do we schedule and make sure that those needs are met?

And I guess I also wanted to share that in middle schools all over the country, I know certainly in my school, our teachers are talking about this every single day. They're looking at the data that we get from (inaudible) elementary schools, they're looking at the data that our kids then grow into in high school to figure out how can we do our job better and how can we,

you know, creatively use our master schedules to better meet our children's needs. And I would urge you as parents and grandparents and members of the community to ask your principals of your local schools these questions and get them to explain why they do what they do and why they schedule the way they do based on what that data -- so that they are, you know, held accountable for having good reasons and thought patterns behind what they do.

MR. KEPNER: Let me take, from what you just said, you just brought up one of the most critical things being in a middle school setting is I see this as a tremendous opportunity for the teachers of math in middle school to get together with the high school staff and talk over what is this math all about. Where is it going, from our perspective? Because in too many U.S. districts, the middle school and the high school, even if they're just across the football field from each other, don't talk in that significant way that you opened up the opportunity.

MS. HAYCOCK: And I think we all -- what we're doing, also, is not only talking with the high school teachers, but I really do think middle schools can be the fulcrum which -- where we bend down to talk about

fractions because that's exactly what our teachers have pointed out as what, you know, causes struggle for our students.

And we should also recognize that, you know, when we go into middle schools and high schools, you're thinking about higher level science courses. The reason that they're blocked out of the lab-oriented science courses is because they don't have some specific math problem-solving skills that these science teachers also expect.

So I'd like to see how we as a nation, as a policy-making group, can think about what emphasis we could put into middle schools so that middle school teachers and leaders are expected to naturally extend that one hand down to connect with elementary school feeders as well as the high schools, so that we can create that bridge. And obviously there's a lot of research about that.

MR. LOVELESS: Well, thank you for that point. Our time is up. I want to thank the panel for their great remarks and thank all of you for coming. Thanks.

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