U.S. DEPARTMENT OF EDUCATION

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NATIONAL MATHEMATICS ADVISORY PANEL MEETING

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THURSDAY,
JUNE 29, 2006

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CAROLINA INN, PITTSBORO STREET
CHAPEL HILL, NORTH CAROLINA
1:00 PM

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PANEL AND EX OFFICIO MEMBERS PRESENT:

LARRY R. FAULKNER	Chair
CAMILLA BENBOW	Vice Chair
DEBORAH LOEWENBERG BALL	Member
A. WADE BOYKIN	Member
FRANCIS FENNELL	Member
DAVID GEARY	Member
RUSSELL GERSTEN	Member
TOM LOVELESS	Member
LIPING MA	Member
VALERIE REYNA	Member
WILFRIED SCHMID	Member
SANDRA STOTSKY	Member
VERN WILLIAMS	Member
HUNG-HSI WU	Member
DIANE JONES	Ex Officio Member
GROVER WHITEHURST	Ex Officio Member

PANEL AND EX OFFICIO MEMBERS NOT PRESENT:

NANCY ICHINAGA	Member
ROBERT SEIGLER	Member
JIM SIMONS	Member
DAN BERCH	Ex Officio Member
TOM LUCE	Ex Officio Member
KATIE OLSEN	Ex Officio Member
RAY SIMON	Ex Officio Member

STAFF MEMBERS PRESENT:

TYRRELL FLAWN	Executive Director
DIANE MCCAULEY	
IDA EBLINGER KELLEY	
JENNIFER GRABAN	
ALYSON KNAPP	

P-R-O-C-E-E-D-I-N-G-S

DR. FAULKNER: Let me welcome everyone. I'm Larry Faulkner, and I'm Chairman of the National Mathematics Advisory Panel. Vice-Chair is Camilla Benbow sitting to my left. I would like to welcome you all to this open session where we will be taking public comments.

The panel has been meeting in Chapel Hill for the last two days, and we have been very pleased to have been here and are grateful for the hospitality of the University of North Carolina. Chancellor James Moeser is with us, and I would like to ask him to stand and receive our thanks. We appreciate that very much.

We came, in fact, to Chapel Hill, because we're trying to use the occasions of our meetings around the United States to highlight locales that symbolize high educational aspirations, and the University of North Carolina certainly does that. We're very pleased to be able to take advantage of the opportunity to be here.

We're about to go into public comment. We have gone through a process whereby the people who would like to speak have made themselves known and asked for time, and we're going to make that time available. The order in which people arrived at the sign up table to be here this afternoon is the order in which they will present. Each presenter will have five minutes. We will hold strictly to the five-minute limit.

There's a moderating light right up here that operates in colors of green and yellow and red. When you begin, the timer will be started. You will have a green light for three and a half minutes. With a minute and a half to go, you will have a yellow light, and when it goes to red, you're dead. And we will -- we will enforce the red light so you need to wrap up -- start wrapping up when you go to yellow and be finished when red is there.

Panel members may ask questions, but we don't have facility here for lengthy debate and people shouldn't expect that. The purpose of the session is for the panel to receive the views and information that people want to convey.

I want to highlight particularly the position that I will strongly defend here and that is, the panel has been constituted to speak as a panel. We don't speak as individuals. So we won't individually answer questions that are addressed to us as individuals. And I -- I think it's very important for everyone to understand that that's true.

The session will be videotaped and photographed. If anyone presenting, or in the audience is uncomfortable with that procedure, they're asked to speak to one of our National Math Panel staff members, Anya back here, or people at the table can receive that comment -- people at the table outside.

The last thing I'll mention is that we have a signer working over here and also over here. We're glad to continue with the signing process for anyone who needs it. If there is no one who needs it, it's not necessary for us to continue it. So I want to ask if people desire that we continue the signing process, if not, it looks as though we can discontinue it.

All right, I think that is the way it will work. Jennifer is going to call out the order of speakers. Is that right?

JENNIFER GRABAN: Everyone should have a card -- a numbered card and I have a list of those people. As Larry said, say your name and organization.

DR. FAULKNER: Okay. That's true. Now when you come to the microphone, self-introduce, please. Give us your name and organization.

Okay, one panel member is joining us by telephone. We've got to get that hooked up. Okay, I think we're ready to go. Speaker Number 1. Sit in front of the microphone.

BEN KLEIN: My name is Ben Klein. I'm the Dolan Professor of Mathematics at Davidson College. I'm also the Governor of the Southeastern Section of Mathematical Association of America and a consultant for both EPS and College Boards. I'm here, however, to present testimony from Professor James E. Schultz who is the Robert L. Morton Professor Emeritus of Mathematics Education at Ohio University. They'll be some pronoun use in what I say. "I" won't always mean "I." I, meaning, Professor Schultz.

Thank you, Dolan Professor of Mathematics, Ben Klein, of Davidson College, for agreeing to read my testimony and to Jennifer Graban and the organizers of this meeting for providing this opportunity. I wish the distinguished panel well in this effort, which is so important to the future of our nation and the millions of children who will be directly impacted. My own experience -- now that is Dr. Schultz' experience -- includes five years of mathematics teaching in high school, 25 years in departments of mathematics, and 14 years in colleges of education. It also includes short term teaching mathematics at every level from kindergarten to advanced calculus and frequent observations of urban, rural, and suburban schools throughout the world, as well as authoring or co-authoring 18 textbooks for three major publishers, refereeing articles in eight major journals; and in 1989 NCTM Curriculum and Evaluation Standards. From this perspective, I wish to share several observations and then several recommendations.

First, collaborations like the work of this panel are exactly what is needed. While successful collaborations between mathematicians, mathematics educators and classroom teachers are possible in doing this, energy is often wasted on nonproductive efforts, such as arguments of those addressing the challenges of mathematics education.

Observation two: Our organization is a major impediment to developing a sound mathematics curriculum. Some programs seem to ignore the importance of basic skills while others are obsessed with them. What we hear from some today sounds too much like the opening of the novel *Hard Times* in which Dickens describes the classroom of 1854 in this way. Now what I want is facts. Teach these boys and girls nothing but facts. Facts alone are wanted in life. Plant nothing else and root everything else. Dickens aptly pointed out the negative consequences of this approach.

With an emphasis on algebra, attention to probability in statistics is lacking. Even within algebra exponential functions with important application in the everyday lives of all students are often neglected. Students who struggle for weeks to factor binomials too often are not introduced to the concepts of correlation and exponential functions, which have major applications to their health and management of money.

Observation four: Though according to U.S. Census figures, 25 percent of the U.S. population lives in rural areas, this segment of the population is often overlooked when education -- educational changes are proposed.

Observation five: Technology, which supports computation and enhances concept learning and provides new approaches to problem solving, is now readily available. Just as this technology has changed the way in which we teach square roots, trigonometry, and logarithms, technology which already exists in the form of handheld computer algebra systems should, in fact, impact the way we teach students to manipulate algebraic expressions, solve equations and find derivatives and integrals.

As an algebra teacher in high school -- again, that is Dr. Schultz -- saw the deficiencies in students emerging from middle school. As a calculus teacher, I saw the deficiencies in students emerging from high school. As a teacher of methods courses for prospective teachers in colleges of education, I saw the deficiencies in students emerging from courses taught in departments of mathematics. Students are taught to manipulate symbols for fractions, algebraic expressions, and derivatives with virtually no understanding of the underlying concepts and how to apply them. One member of this panel has reported that in the case of dividing fractions, this is true even for an astonishing number of American teachers.

And now some recommendations. First, avoid the negative impacts of the “nothing but the facts” approach to teaching. Two, what is needed is a balance, or better yet, best of both worlds approach of skills versus concepts. Look to the future needs of students who will have increasing availability of technology so they will know how to use it appropriately. Avoid the extremes of ignoring them or blinding them, depending upon them. Do not let the curriculum for college bound students in science and engineering drive what is done for all students, including those who do not intend to go to college. Five, sound mathematics should prevail at all times, but not at the expense of ignoring individual differences or the varied cultures that impact learning. In particularly, do not forget rural students. And finally, endorse a broad curriculum including, in particular, exponential functions and probability in statistics. And be sure to call for a wide range of assessment practices that align with this curriculum built positively on the panel's wide range of expertise in achieving mathematical power for all students in a technological society. Thank you.

DR. FAULKNER: Thank you, Professor Klein and thank you, Professor Schultz. Are there questions or comments from the panel? Thank you. That takes us to speaker two, I think.

BROR SAXBERG: I'm Bror Saxberg from K12. Thank you for the opportunity here. I want to comment on how clarity about foundations for math learning affects those of us who create materials and support in mathematics.

I'm the Chief Learning Officer for K12 Inc. It's a six-year-old company that develops many elements for a child's learning, textbooks, online materials, teacher training and more. We work with tens of thousands of children in both virtual and classroom public education settings across the U.S. Our books, online lessons, and training address not only math, but also science, language arts, history and more.

My own early training was as a scientist. I'm an Oxford trained mathematician and MD, PhD from Harvard and MIT. This background gives me an unusual perspective on the world of curriculum development where things are a little different. In medicine, over the last 70 years, a body of biological sciences did clinical work. This has had a profound impact on medicine. Training as a physician means training, in part, on the science behind treatments. Physicians are expected to understand and respond to new science in their own areas. Companies in the medical world work with the same science that guides practitioners, bringing products from the lab out to clinical settings. Randomized controlled trials play a key role in improving care, even complex branches of medicine, like psychiatry. Medical professionals have no problem understanding that treating each individual is still an art. There are widely accepted measures for symptoms and outcomes in many key areas. There's also a clear understanding that a measured symptom, like high blood pressure, may be caused by a number of real clinical problems. Treating symptoms is not the only goal. Central, professional, scientifically grounded organizations have been key in determining safe and effective treatments.

With a relatively clear scientific consensus, a new biomedical company can figure out how to compete. The company needs to appeal to buyers who understand science and who are willing to shift suppliers, even pay more to get more effective new therapies with fewer safety issues. Everyone is focused on finding treatments that improve key outcome measures. Medicine is not perfect. Still, contrast medicine with public education. In education there is a gap between the cognitive science of learning and practitioners in schools. Teachers have little to no training in learning the science. Teachers, administrators, and textbook committees are not expected or required to follow other science in their areas. Buyers in education are generally not informed about relevant learning science. Curriculum developers are not likely to supply what customers do not demand. There's little motivation in the market to take successful learning science out of the lab to full-scale implementation. Educators are often suspicious of randomized controlled trials. One senior superintendent told me, "If you think it's good enough to try, everyone should get it. If you don't think it's that good, then no one should get it." If clinical care had chosen that path, who among us would be here?

Each state defines it's own widely varying measures of learning outcomes. State decision makers tend to care only about their states’ outcome measures making it difficult to aggregate outcomes. Many practitioners confuse symptoms, for example, low math scores, with the actual problem that caused the symptoms. Instead of facing tough issues around concept and skill gaps, they may repeatedly practice test items because that gets scores up. Imagine if your doctor brought out the leeches because that will bring that blood pressure down.

Until this panel, there was no central professional, scientifically informed resource to evaluate evidence and determine what constitutes effective math teaching in curriculum. As a result, educational publishers and curriculum developers may find it simpler not to focus on improving children's outcomes. With a lack of agreement on what works, with conflicting outcome measures, and with widespread distrust of controlled randomized trials, why do all the hard work? Simple enough to tweak what has come before, throw in a few engines and buzz words and put the product in the marketing spin cycle.

To achieve better results in math education we need effective tools. Practitioners, decision makers, and buyers need to use the underlying learning science and we need randomized trials.

At K12 we're trying to follow these principles, but principles like these need wider recognition and acceptance. We welcome the crucial effort by this panel to articulate the key guideposts to the research about math education. This will help us to work and, in some cases, compete with each other in ways that lead to more effective and efficient progress in math mastery for America's children.

We look forward to assisting this panel however we can. Thank you very much.

DR. FAULKNER: Thank you, Dr. Saxberg. Are there questions or comments? Thank you.

MS. GRABAN: Speaker number three.

MIRIAM LEIVA: I am Miriam Leiva. Welcome to my Alma Mater. And I am Distinguished Professor Emeritus of the Mathematics Department at the University of North Carolina in Charlotte.

I come to you representing my own experience of over 40 years in the classroom. And part of the 40 years have been spent at university classrooms in a mathematics department preparing teachers.

I will not stick to my remarks, because they're longer than five minutes -- I think -- but I will -- you will have a copy of it.

Thank you for what you are doing. What you are doing is going to impact millions of students, but most of all, the army of teachers that are right behind those students. So I realize -- we all realize the importance of what you are doing and we are here, because we feel like together we can help the students and their teachers.

I am the President of TODOS: Mathematics For All. In addition to being a mathematician and math educator, I am also an English language learner. You can tell my southern accent as well as my Caribbean accent from Spanish.

We advocate for an equitable, high quality, rigorous mathematics education for all students, in particular, Hispanic Latino. Other students from groups that are under -- who -- who -- students who are often in the low end of the achievement gap -- on the wrong side of the achievement gap. We represent Native-American students, African-American students, and many other groups.

I have a detailed bibliography that spells out the research that backs all the remarks I'm making.

Because the time is limited, I would like to just focus on number -- point of discussion C, from the report that you have to issue to the President, according to the Executive Order, which is the process by which students of various abilities and backgrounds learn mathematics.

All students -- all students, regardless of size, color, shape, ethnicity, or what kind of accent they have, physical challenges, every one of them deserves equal access and the highest quality of mathematics that we can give them. It means that suitable accommodations must be made for their learning. It means that we have someone here to take care of anyone in the audience that couldn't hear. It means that we need to make accommodations for their time -- extra time, extra efforts. We need to do that because every student must have an equal opportunity to learn challenging and rigorous mathematics from a qualified teacher that takes care of, not only the mathematics content, but also all of the needs of the student, which include culture, background, which include language, experience and previous knowledge.

When dealing with a diverse population, I will focus on one area to give you the example about the processes in which we can maybe assist all students, and that is problem solving. You know our students can leave classrooms and they could know all their facts and they could know things, they could differentiate and integrate backwards and forwards, but what is really important is, what are they really taking out of the mathematics classroom and they need a tool. And that important tool that we can give our mathematics students is problem solving, to be able to take a problem and to be able to read, interpret it and I mean read it and interpret it, because you know that our students -- and teachers will tell you our students have difficulty reading problems with words. It doesn't matter what language they have. It could be their first language, but as a teacher of over 40 years, I can tell you that the majority of my students here in North Carolina couldn't read very well. And it is not because they were second language learners. My students will tell me, when I ask how did you do it, they'll say well I add, subtract, multiply, and divide until I get the answer in the back of the book. That's well -- that's out of the paper here but -- and, of course, these are -- and some of the other international comparisons tells us that the United States students -- our students -- are in the lower end -- they're below average from all of the other countries. Why? It's not a problem of one set of students. It's a problem of United States students. They are not able to do the problem solving process of reading, interpreting problems, reasoning, solving, deciding if it makes sense, and being able to explain why. Which is why we need mathematics as we go out into the world, so we can solve problems, the heavy emphasis being on reasoning and being able to communicate and collaborate. They need to do -- students need to do exercises on real life, because in real life there are no exercises. They are word problems. Therefore, communication has to be really important in what we do in mathematics. Communication takes many moves and that language of mathematics is words, syntax, grammar. It's graphically symbolic. Students whose first language is English have difficulty. There is a problem on a test here in North Carolina that talked about toll-ways. Hey folks, there are no toll-ways in North Carolina. So there was a problem with the problem not with mathematics. I mean, the mathematics of the students was okay. It was the problem.

Here are my recommendations and you will have --

DR. FAULKNER: You're already over time.

MIRIAM LEIVA: I am already -- and you will have a copy of my recommendations.

DR. FAULKNER: All right.

MIRIAM LEIVA: Thank you very much and thank you for what you're doing and for what you will have to endure over the next few months.

DR. FAULKNER: Questions or comments of Professor Leiva?

DR. LOVELESS: Larry.

DR. FAULKNER: Yes.

DR. LOVELESS: Miriam, if you can just -- you alluded to this earlier, that the actual research points that you made will be available to the panel?

MIRIAM LEIVA: They are and I have an extensive bibliography, but in particular about the points that deal with the fact that the gap is widening, not shrinking, and our status in the international competitions as well as nationally, plus what the research says about what we need to be doing to take care of that.

DR. FAULKNER: Other questions or comments? Thank you, Professor Leiva.

JENNIFER GRABAN: Speaker number four.

KENNETH W. HUMPHREY: Distinguished panel, my name is Kenneth W. Humphrey. I'm from Morehead City, North Carolina. I'm going to say I come from the real world. I'm the manager of marinists.

I'm reading this on behalf of my friend, Mr. Jack Fretwell, President and owner of Starboard Training Systems in Reston, Virginia and also a software developer.

I'm reading this for Jack. He could not be here today.

The title of his proposal is "Doing the Homework".

The math advisory panel is chartered to make recommendations for the best use of scientifically based research to advance math education. Unfortunately, this charter may limit in the one area that offers the very best promise for extensive, and relatively quick, advancement.

Because they are new, we are just beginning to explore the potential impact of personal computers on math instruction. Relatively less research exists today to recommend their application, yet common sense and observation of computer technologists' effects in all other areas tells us that there's a tremendous possibility maybe at hand.

We wish to take the opportunity today -- and this is Jack Fretwell's paper -- to comment on these possibilities and to ask that the panel's charter be extended to include them in your deliberations.

As to any good math student, one rule stands above all others for maintaining success in math, doing the homework. Whether you're born with a personal liking for math or lucky enough to have a teacher who makes it interesting, you still have to do the homework. And while a good teacher may be able to make math class a little more fun, the best way to make it something to look forward to is to show up with your homework done, and by the way, done correctly.

The overriding importance of homework tells us a lot. It tells us that students who practice activities at home may deserve as much attention as the teacher's teaching activities in the classroom. Teachers won't argue with this. They'll be the first to agree that if they can assign as much homework as students needed, and if they could rely on that homework to be done, their students would be getting all As. But, of course, it doesn't work like that, does it?

Students have only so much time for math homework and only the best students routinely have time enough. The rest accomplish what -- what -- what they can while wrestling with great uncertainty at times under great frustration. As these frustrations increase, productivity declines. The situation calls for a clear solution. Number one: One solution is to provide more time for homework. Number two: Decrease uncertainty about how to do that homework. And three, decrease frustration due to repetitive failure.

One solution for a struggling student is a tutor. Typically, tutors help with the homework and try to break things down into simpler steps and concepts. Tutors also help relieve frustration by providing encouragement and satisfying feedback. Good tutors work students. Good tutors work, and students like working with them.

Software is a technical solution that may be compared to an effective tutor. Software can be instructionally efficient, meaning more learning is accomplished in less time. Software may also be engaging, meaning that students may choose to spend more than usual amounts of time working with it. Also software can achieve clarity by presenting material in smaller, more understandable, increments. It can also offer wide varieties of examples and presentations. Software can provide exercises of varying degrees of difficulty taking things step by step, if necessary. It can provide immediate feedback. It can let learners work at their most effective pace. The list goes on and everything adds up to more success and less frustration. What is envisioned is curriculum related software that teachers may assign as an alternative to traditional homework. Problems are provided along with help screens, definitions, examples, and tips for solution. There is also plenty of immediate feedback and positive reinforcement. Effective software will enrich the homework experience and students will make more time available for it. On the other hand, effective software will also be efficient and students may find that less time is required to achieve the very same learning goals.

Providing the software described will take a huge effort. Some of it already exists, but mathematics, as we know, comprises a mountainous area of study and when it comes to instructional software the time to support it. We are still in the foot holes of educational math software. However, many hands make light work. As much as any other subject of learning, math consists of identifiable topics and sub-topics addressed topic by topic by a great number of developers, the task of developing instructional software is --

DR. FAULKNER: Mr. Humphrey you need to wrap up.

KENNETH W. HUMPHREY: Thank you. And in summary, the additional thoughts, particularly educational software -- this will take just a second -- implementation can begin quickly, effectiveness is easily tested through measurable software, revision is based on measures of effectiveness to make it easier, and dependency on teachers with a strong math background is somewhat reduced. Student progress is easily tracked and analyzed.

DR. FAULKNER: We're going to have to stop right there. You can provide that testimony if you would like to stay after. Let me ask again, your name is Humphreys?

KENNETH W. HUMPHREY: Kenneth W. Humphrey.

DR. FAULKNER: Humphrey?

KENNETH W. HUMPHREY: Humphrey, yes.

DR. FAULKNER: Okay, and you were testifying on behalf of Fretwell?

KENNETH W. HUMPHREY: Jack Fretwell, yes, sir.

DR. FAULKNER: How do you spell it?

KENNETH W. HUMPHREY: F-R-E-T-W-E-L-L of Reston, Virginia.

DR. FAULKNER: Okay, any questions or comments? Okay, let's proceed.

JENNIFER GRABAN: Speaker number five.

ANNE CATLLA: Hello, I'm Anne Catlla and I'm speaking on behalf of Cathy Kessel and the Association for Women in Mathematics.

The Association for Women in Mathematics represents a broad spectrum of mathematic community, both woman and men, from the United States and around the world. Our purpose is to encourage women and girls to study and have active careers in mathematical sciences and to promote equal opportunity and equal treatment of woman and girls in mathematical science.

We are pleased that President Bush and Education Secretary Spelling recognize the importance of strengthening mathematics education and have shown this by appointing a National Mathematics Advisory Panel. However, we have serious concerns about the panel that is currently constituted. We would prefer to see more mathematicians and more than seven women on a panel of 17. Our greatest concern is that its Vice-Chair, Dr. Camilla Benbow, is best known for the hypothesis that there are inevitable gender differences in favor of males at the highest level of mathematics performance. This hypothesis has already done serious damage. Furthermore, there is substantial evidence against it. Citations supporting those statements are provided to the panel.

In 1980 Camilla Benbow and Julian Stanley published an article in *Science* reporting large gender differences in "mathematical reasoning ability." Their evidence is scores on the SAT taken by seventh graders as part of a talent search for a program at Johns Hopkins University. In their conclusion Benbow and Stanley explicitly favored, "the hypothesis that accepts differences in achievement in and attitude towards mathematics result in superior male mathematical ability, which is probably expression of a combination of both endogenous and exogenous variables." The results about this article was that Dr. Benbow and her colleagues accepted 20 years later -- headlines suggested that mathematical ability was determined at conception. Newsweek asked, "Do males have a math gene?" Time reported that a new study says that males may be actually abler to learn mathematics than females. Scientists have asked, "Are girls born with less math ability?"

A 1986 study documented the negative impact of this on the expectation of both girls and their parents with respect to their achievements in mathematics.

Critiques in Benbow and Stanley's work became a small history in psychology. We consider only one issue on which all sides agree. If, indeed, there is an innate gender imbalance in mathematical ability, then it should be roughly constant over time, but the available evidence does not support this.

The male to female ratio of Hopkins Talent Students -- Talent Search participants with scores over 700 has declined. In 1983, Benbow and Stanley reported a ratio of thirteen boys to one girl between 1980 and 1982. Hopkins researchers reported that the average was 5.7 to one between 1984 and 1991. Six years later in 1997, Julian Stanley reported this ratio as four to one. In 2005 Hopkins researchers reported this ratio as three to one. This reflects, for example, about one-third of the PhD's in mathematics now go to women.

Despite these changes, the 1983 thirteen to one ratio, together with Dr. Benbow's subsequent work, is still cited in the national media and works through general audiences and in academic writing. We hope that the National Mathematics Advisory Panel will debunk the myths about mathematical ability and it's relationship to gender, ethnicity, and race. We are concerned that Dr. Benbow is so closely identified with her 1983 statistics and hypothesis that her presence on the panel signifies a perception or in reality a bias against women and girls. The panel's charged with fostering greater knowledge of and improved performance in mathematics among American students. It would be unfortunate if the impact were just the opposite. Thank you.

DR. FAULKNER: Thank you. Can I have your name, please?

ANNE CATLLA: Yes, my name is Anne Catlla.

DR. FAULKNER: How do you pronounce -- how do you spell that?

ANNE CATLLA: First name A-N-N-E. Last name, C-A-T-L-L-A.

DR. FAULKNER: Thank you very much, Ms. Catlla. Do we have questions or comments? Thank you.

ANNE CATLLA: Thank you.

JENNIFER GRABAN: Speaker number six.

JANIE ZIMMER: Honorable members of the National Mathematics Advisory Panel, thank you for the opportunity to speak to you today.

I am Janie Zimmer, speaking on behalf of the National Council of Supervisors of Mathematics, or NCSM, an organization for leaders in mathematics education. In this address I would like to discuss three critical needs in the mathematics education of our youth and of the future of our country in the global society. One, the absolute need for equity, two, the need to deepen the content knowledge of teachers, especially elementary and middle school teachers, and three, the need to give more time to current research based mathematics programs to provide continued evidence that they can make a difference in children's knowledge and understanding of mathematics.

First, as we look at the needs of our students in mathematics, we want to be sure to include every student. Students come in many shapes and sizes. Many of our students are very bright and very motivated. It is fun to teach them, and we can take them to very high levels of mathematics achievement. The issue of equity, however, poses a challenge to schools to establish these same high expectations for all students and to find ways to give, when necessary, the appropriate support to assure that every student is successful in reaching very high expectations. The challenge of equity includes changing the strong erroneous belief of those who think that rigorous mathematics is for those who have the math gene. Rather, we must all support the strong belief that mathematics is for everyone and that every student can be successful in learning high levels of rigorous mathematics. This includes those students who seem unmotivated, who have physical or learning disabilities, who are native speakers of other languages, who are economically challenged or who have families unable to provide support. How do we motivate these students? How do we support them and help them to be successful? How do we reach students who struggle or drop out before they even get far enough to take algebra, much less AP Calculus?

One of the charges of this panel is to look for processes by which students of various abilities and backgrounds learn mathematics. NCSM, wholeheartedly, supports this goal.

Second, I would like to share with you some comments communicated by a third grade teacher in a geometry workshop last week. "I have to tell you," Charmaine said, "I have always been a math dummy. I don't know why I signed up to take this mini course, but I'm glad that I did. I always sort of got by but never knew what I was doing. In class I try to teach what I am supposed to, but I just follow the book. In this workshop I am just starting to understand how these concepts fit together and how it relates to what I do. Why weren't we taught this way? I would surely be a better teacher."

NCSM, as an organization of leaders in mathematics education, has a major focus on working with teachers in providing professional development. We find great gaps in mathematical knowledge and understanding, especially among elementary teachers. Many teachers can teach the rules, and rules in algebra are very important, but we find that these teachers do not know, and cannot adequately explain, the concepts and logic behind the rules. They are unable to value the student thinking, not from a lack of caring, but from a lack of experience in their own mathematics education.

In providing professional development, NCSM believes that mathematics content should be the focus and elements of evidence based effective pedagogy should be provided within that framework. By modeling teaching strategies while teaching mathematics content, then reflecting and addressing the research behind the strategies, we give teachers understanding, both of the mathematics content and of effective strategies for teaching it.

Finally, there are many researched based programs and efforts currently available to strengthen mathematics teaching and learning, particularly, at the elementary and middle school levels. When these programs are appropriately implemented with adequate teacher development, they seem to be working. They show evidence of higher student achievement, especially in areas where students traditionally underachieve. We need to insure sufficient time is given for the changes already being implemented to take hold before moving in a different direction.

In looking at lessons learned from the math the International Mathematics and Science Studies. I would note that Japan and other high achieving countries have a practice of allowing at least ten years for a practice to take hold before looking to change it.

As a panel you have a very critical charge to set a direction --

DR. FAULKNER: You need to wrap it up, please.

JANIE ZIMMER: -- and to make recommendations that will be sure that no child is left behind. NCSM asks that you consider the issues in this address and invite you to call upon us to help inform your work or to provide support in any way that we can. Again, thank you for the opportunity to address the panel.

DR. FAULKNER: Thank you, Ms. Zimmer. Are there questions or comments from the panel? Thank you.

JENNIFER GRABAN: Speaker number seven.

MIKE MAGGART: Thank you for the chance to be here. My name is Mike Maggart and I'm a former high school math teacher and the founder and CEO of a company called Classmate Math.

The reason that I would like to speak to you today is to tell you about my experience working in the field of technology in math education, specifically, in the area of individualized instruction through interactive audio and video. I would also like to highlight the importance of recent advancements in content delivery that have the potential to revolutionize our educational system in math.

My experience in the field of technology in education began about ten years ago when I was teaching math at a high school in Houston, Texas. I was frustrated by the fact that no matter how much time I spent tutoring my students, it was never enough. So I looked to technology to provide the kind of unlimited individualized instruction from my students that I could never provide on my own.

The concept was simple. Instead of writing a textbook for the printed page, I wrote a textbook for the computer and this allowed me to put a teacher inside of the book. In other words, every example problem in every lesson in the book, instead of being written out, is a video of a teacher, at a white board, presenting the problem available at the click of a button. Every assignment, instead of a long list of problems with no instruction, is a series of problems that have buttons for hint, the answer, and an animated audio explanation. Of course there are many other features to the program, but the heart and soul of the concept is simply to give students access to their own highly qualified math teacher on demand.

If you would like to see how a textbook with a teacher inside works, feel free to go to www.classmatemath.com and log in with the following information: User name, math panel; password, classmate.

After nearly a decade of development, we now have over 400 lessons covering pre-algebra through Algebra 2, and the program is used by hundreds of schools and tens of thousands of students throughout the country. During the 2003-2004 school year, a study of our model was conducted by Project Grad, a national non-profit organization whose mission is to help raise graduation rates among disadvantaged students.

Two hundred and eighty-one inner-city Algebra I students in Houston used Classmate Math for a year, and their performance on the Stanford Achievement Test was examined to determine gains or losses. At the beginning of the study, 51 percent of the students involved were two or more years below grade level in math. After using Classmate Math for a year, only 14 percent were performing at this low level. The average gain for the students using the program, 20.3 months, was more than double the expected gain in 10 months. A complete summary of the study can be found on our website at Classmatemath.com.

This fall Price George's County public schools in Maryland will be implementing our program with 7500 of it's lowest performing algebra students who may be at risk of failing Maryland State Algebra Exam that is now required for graduation. I would encourage the panel to keep an eye on this implementation.

In just the past year the speed of the Internet in most schools has finally improved to the point where audio and video content can be delivered online. This has greatly facilitated the process of delivering a teacher to every student on demand.

Another advancement in technology that has revolutionized the world of individualized instruction is the video IPOD. The core of our program -- the example videos of the teacher at a white board and the practice problems with animated audio explanations can be delivered on an object that fits in the palm of your hand.

I would encourage the members of the math panel to go to the iTunes Music Store and type in Classmate Math to view our demo lessons that can be downloaded from the music store and delivered on the video IPOD. Imagine a world where instead of paying $50.00 to $100.00 an hour for a private tutor, a student can download the teacher for 99 cents.

The major point I would like to make here today is that after thousands of years of teaching math in the same exact way, either with a teacher in front of a classroom of students or with a private tutor for the privileged few, technology is now evolved to a point where we can deliver a highly qualified teacher to every student on demand. And with the severe shortage of qualified math teachers in our country, the timing could not be better.

As a former math teacher and the son of a math teacher as well, I'm committed to doing whatever I can to help improve math education. I believe that your work over the next 18 months is incredibly important, and if there's anything I can do to help the panel gain a better understanding of the role of technology as a solution to the poor performance of our students in math, please don't hesitate to contact me. I will also be here for the rest of the afternoon if anyone has any questions, and I have a video IPOD with me if anyone would be interested in seeing what a math lesson looks like on the video IPOD after the session. Thank you.

DR. FAULKNER: Thank you, Mr. Maggart. Questions or comments?

DR. LOVELESS: I'm curious. How did you pick the teachers who are featured in the videos?

MIKE MAGGART: Well, the first one was easy. It was me. I developed it for my own students, so the most logical person to choose was me; and the only person willing to do it, actually, at the time. The other teachers are -- they're both young teachers, but with -- between five and ten years of experience, so these are teachers who have a lot of energy, are youthful looking, and are willing to shoot three years worth of videos to put every example problem on video in the book.

DR. FAULKNER: Other questions or comments? Thank you, Mr. Maggart.

JENNIFER GRABAN: Speaker number eight.

LINDA ALSOP: My name is Linda Alsop and I'm a classroom teacher from Flemington, New Jersey.

And as an early child educator with 25 years of classroom experience and currently a student support math teacher K through 4, I am just really honored to be here.

I would like to just quickly comment on just two important trends that I've noticed that have influenced my instruction. One is the importance of constructing parts to whole relationships in the early acquisition of number sense. My second point has to do with time constraints of classroom teaching.

During my own teaching experience, I've learned that the reason why so many of my 4^{th} and 5^{th} grade students -- support teach students -- had difficulty understanding fractions, was because their understanding of parts to whole relationships was not firmly in place. Upon further analysis, I discovered that my students did not understand addition because they didn't grasp the parts to whole relationships involved with subtraction. Students need to understand how parts relate to the total, and this needs to be foundational and a focus of early childhood educational programs. When symbols are introduced prematurely and children calculate according to a set of procedures, they lose the sense-making meaning of mathematics and are encouraged to think about math in terms of a prescribed procedure.

Having taught back in the day when a hurried math lesson consisted of flash cards and pages and pages of calculation drills, I have to say that there was very little time to even develop problem solving. Only the mathematically precocious would ever attempt the challenge of problems in a typical math class.

One hundred eighty hours, that's the maximum amount of time that a typical elementary math teacher has with his or her students in an entire academic year. A student's conception of patterns in the parts to whole relationships form a foundation of mathematical understanding similar to the foundations of a house. The skills, practice and procedural fluency form the walls. If a mason builds a faulty foundation, even if the carpenter builds perfect walls -- quick recall of facts, which many of my support students have -- the house is doomed. Likewise, if a student's mathematical foundation is strongly built around rich discussions and reflections using wonderful manipulatives and open ended problems, if the walls are not hammered into place with a meaningful practice makes perfect emphasis, then children do not feel quick recall and efficient strategies to -- needed for higher level problem solving. Both the mason and the carpenter are integral builders of a well-designed house. One hundred eighty hours, the scope and depth of mathematical understanding cannot be attained in 180 hours alone.

The bottom line is that we, as educators, need to motivate our students to find the joy of learning so that they take math everywhere with them and use them all the time. Children, parents, and administrators need to buy the whole house. Parents helping their children completing their homework and in learning their facts and the administration by encouraging ongoing training for teachers to delve deeply into mathematical investigations and by giving teachers more time to think about and explore the thought processes of your students.

As a student support math teacher, our team taught this past year in an heterogeneous 4th grade classroom, including eight Title I support students, those who tested below proficiency on the New Jersey math.

These are just a few bullets of some best practices that worked well in my class. Number one, invite confusion as a necessary part of the lesson. When children are encouraged to discuss about what is making them confused, that confusion begins to dissipate. We need to build confidence in our math phobia American culture. Number two, conduct individual interviews after each assessment. These allowed us the opportunity to celebrate skills, concepts and strategies learned for each child as well as to pinpoint areas to work on. Having access to a computer assessment desk in the classroom gave us the ability to quickly design prescriptive practice for each student. Number three, use well thought out plans that highlight enticing open math problems that directly correlate to our standards. Create games, rap songs to remember key mathematical language. Incorporate interactive technology and utilize small group instruction to differentiate various levels of needs. In doing this, the children bought into the house.

The goal is to build math stamina and perseverance that takes part in the adventures of problem solving. The classroom teacher, Elaine, and I, encouraged this by sharing with our own students the feelings of frustration in relation that we had when over the weekends we were actually doing some Algebra II and really high-level math problems in our graduate level classes. The teacher --

DR. FAULKNER: You need to wrap up.

LINDA ALSOP: -- bought into the house. We also gained support from parents who helped us. As a result, the kids tested really well, off the charts. The success for me, though, was that when we gave them a summer packet, they actually looked really excited about problem solving over the summer. Thank you.

DR. FAULKNER: Thank you, Ms. Alsop. Questions or comments? Thank you.

JENNIFER GRABAN: Speaker number nine.

KAREN NORWOOD: Good afternoon. My name is Karen Norwood and I'm the Associate Professor of Mathematics Education at North Carolina State University where I have been for the last 18 years. Today, however, I am speaking as a representative of the Benjamin Banneker Association. I am the President of Benjamin Banneker.

For those of you who are not familiar with my organization, we are an organization of mathematicians and mathematics educators who act as advocates for the mathematics education of African American children. We just celebrated our 20^{th} anniversary this year.

The Benjamin Banneker Association recognizes that the work of the National Mathematics Advisory Panel, empowered by the President, as an important one and would like to offer all of our support and resources to assist in that work. We would like to call the panel's attention to two recent national summit experiences, which have resulted in the reframing of the multi-dimensional nature of black student achievement. Outcomes in mathematics, these were the NSF funded summit organized by the National Association of Black School Educators and the Benjamin Banneker Association held in Washington, DC in April of 2004. Some of you were there. Another NSF funded initiative was the First Annual Research Symposium optimizing mathematical achievement for all students organized by the Maryland Institute for Minority Achievement in Education in September of 2004. The conclusion reached at both of these summits were that the optimization of African American student achievement is hindered by fundamental forces, which include faulty notions about African American students and their experiences, resistance to equity notions and reform (because of the protection of privilege), confusion about the nature of the mathematics and the mathematics teaching, and, lastly, misinformation and miscommunication between various stakeholders.

Similarly, findings from the Maryland symposium echoed the challenge of having teachers question and reform their existing pedagogies and the need for research to include a critical social and political inquiry as an essential component of the mathematics reform. As a result, the Benjamin Banneker Association has written an Algebra position paper, which can be found on our website www.bannekermath.org.

Practitioners within our organization have also echoed the need to address the gap in quality of instruction for African American students. African American students receive, in comparison to other groups, and the persistence of policy factors like tracking, inequitable resource allocation in special education classification, which disproportionately impacts access an opportunity for our children.

Additionally, the mathematics education community has largely failed to systematically utilize research on exemplary instruction for mathematics education for African American students and students from different cultural backgrounds.

We understand that the panel will be examining how research might best be used to guide the teaching and learning of mathematics. We believe that it will be necessary for the panel to examine more closely how research might build on what has been learned over the last two years regarding issues in the school of mathematics of African American children. We offer our greatest support to those for your important efforts. Thank you.

DR. FAULKNER: Thank you, Professor Norwood. Are there questions or comments?

DR. FENNELL: Just one question. Where are the proceedings from the research meeting in Maryland and the other one in DC? Do we have access to those or could we get them?

KAREN NORWOOD: I can get you access to the information. Send me an email, Skip. I will get you the details. Thank you.

DR. FAULKNER: Thank you, Professor Norwood.

JENNIFER GRABAN: Speaker number ten.

GENEVIEVE KNIGHT: Mathematics Panel, my

name is Genevieve Knight. I have been very been very active in the mathematics community for over 45 years. And on tomorrow I will retire after 44 years of teaching on a commission level.

DR. FAULKNER: Tomorrow?

GENEVIEVE KNIGHT: Tomorrow, yes, sir.

DR. FAULKNER: Well, congratulations.

DR. FENNELL: Mr. Chairman, that's not quite accurate.

GENEVIEVE KNIGHT: What's not quite accurate?

DR. FENNELL: Well, aren't you starting anew somewhere else?

GENEVIEVE KNIGHT: Oh.

DR. FENNELL: Yes.

GENEVIEVE KNIGHT: As of August, I will be the Belk Endowment Professor of Science and Technology at Fayetteville State University.

DR. FAULKNER: Thank you for being with us. I think you should proceed.

GENEVIEVE KNIGHT: Listen to the voices of the people whose jobs are to align school mathematics with research, to plan instruction, to teach all students in a diverse society, and to make decisions about assessment in variation of student learning materials, activities, programs, et cetera.

At the first panel meeting, concern was voiced about the meaning of algebra and research. Yesterday there was an exchange of ideas between and among the subcommittee members about the nature of research and as well as the learning and teaching of school mathematics. How will this report differ from efforts in the past?

The mathematics education community has been working collectively to contribute individual research based documents to a performance based mathematics education philosophy, content, staff development, assessment, virtual material technology, and the list goes on. Elements from both the cognitive and effective domains.

An important voice is missing from the formative discussion phase of the mathematics panel, the voice of the teacher. The educative process is a continuous all over a -- all over a lifetime. There are no gaps in the learner's press for knowledge, understanding, and success. Formative education is all one system linked to experiences and interaction with real world activities.

Mathematics content and research findings are necessary in mathematical learning, but not sufficient to determine and guide mathematics education in the Pre-K - 12 arena. Recall the reaction to the exemplary elementary mathematics programs. The research mathematics community voiced their concern due to the lack of the input for the research mathematicians. The National Mathematics Panel appears to like the membership voices' informative input of the people who must implement the intended school mathematics curriculum. Currently, in this room there are people who will suffer the backlash from society when students will receive certificates of attendance 12 to 14 years in school and must seek alternate routes to high school graduation because they cannot pass the algebra component of the high school graduation exit tests.

Arithmetic is the foundation of algebra. Algebra begins with the pre-school students. Notice the NCTM standard number one addresses the issue of algebra.

It is important that the voices of all mathematics teachers be heard. Teachers from all ranks, sections of the country, culture background and experiences are an integral part of the process. For it is what the teacher knows and is able to do that shape and guide the curriculum in school mathematics.

Recommendations: A working group composed of teachers of mathematics be formed and given a meaningful charge. All other professional mathematics of education related organizations have developed guidelines and programs. Invite them to engage, collectively, in providing an input for the best practices and activities for all students to learn, understand, enjoy, and use mathematics, a special focus on algebra. Thank you, very much.

DR. FAULKNER: Thank you, Professor Knight. Other questions or comments? Thank you, very much.

JENNIFER GRABAN: Speaker 11.

RANDY HARTER: Good afternoon. I'm Randy Harter, K-12 Mathematics Specialist for the Buncombe County Schools in Asheville, North Carolina, Director for the American Mathematics Competition AMC 8 Exam in North Carolina and President-Elect for the North Carolina Council of Teachers of Mathematics.

At your first meeting Mr. Siegler made reference to the work Jim Hiebert and Jim Stigler and their identification of the United States as a real outlier, internationally, in it's failure to integrate procedures and conceptual understanding.

In 2001, the Mathematics Learning Study Committee stated in *Adding It Up* that mathematics learning has often been more a matter of memorizing than of understanding. Later on the same page, "The overriding premise of our work is that throughout the grades, from Pre-K through eight, all students should learn to think mathematically."

In 2005, *The Common Ground Report* identified as their three foundational premises, computational proficiency, careful reasoning, and the ability to formulate and solve problems.

My concern is that our long-standing traditions and culturally based instructional practices and the unbalanced emphasis on mathematics as procedures, in most K-8 classrooms in this country, have inhibited the development of reasoning and problem solving.

The result has been that mathematics, for most students that come through this system, is a set of procedures.

A significant study by Jo Boaler, now at Stanford, came to a similar conclusion for students in England. She said, "Students thought that success in mathematics involved learning, rehearsing, and memorizing standard rules of procedures. They did not regard mathematics to be a thinking subject.” One student's comment was typical. “In math you have to remember. In other subjects you can think about it." While this particular study of Boaler's was in England, there's evidence that the same problem exists in the United States.

In May 2001, I attended a week-long workshop on problem centered mathematics at the North Carolina Center for the Advancement of Teaching. The workshop was organized by Learn NC. It's an organization on this campus that develops web-based resources for teachers across the state. I witnessed there a clinical interview of an eighth grade student who, earlier that same month, had scored at level four -- the highest level -- on the North Carolina end of grade test. She was at the 76^{th} percentile.

I remind you that North Carolina is a state that has performed relatively well on the National Assessment of Educational Progress relative to other states. And our gains at grades both four and eight are unmatched. So if there are problems in North Carolina, it's safe to assume that there are similar problems across the country. In one task the student was asked to find the length of a fence that would be required to enclose a 23 foot by 32 foot rectangular pool surrounded by a walkway that was three feet wide. Her first response, after drawing the pool and the walkway, labeling her diagram was to multiply 23 by 32 to get 736. Realizing that she had not dealt with the walkway, she said, "I'm going to try -- I'm not sure, three times three equals nine." Finally, after being asked where in her diagram the fence would be and responding that it would be around the outside, and drawing these nice straight lines around her figure, she added three to the length and width and multiplied 35 times 26 and reported that 850 feet of fencing would be required. This student's in our top quarter. The video transcript and students work during this interview are available at Learn NC's website.

My question is, “What meaning had this student given to perimeter and area and to addition and multiplication?” In the debriefing that followed the interview, Grayson Wheatley, Professor Emeritus at Florida State University, who has conducted hundreds of such interviews, reported that the student displayed a procedural orientation to mathematics that he finds typical of most students who have experienced traditional school mathematics curriculum in this country. He said most students will be procedurally oriented, as she was, and to me this is serious indictment of the curriculum, and the reason I am here this week. The kind of instruction that she has had in school has led her to be procedurally oriented.

DR. FAULKNER: You're going to have to deliver your message right now.

RANDY HARTER: So she does all these computations with some numbers and that's not what mathematics is all about. In further analysis, Wheatley stated that, "What is lacking is a sense making orientation. For this student procedure is the math. Her procedure blocks her thinking." Math for such students, like those in Boaler's study, was not about sense making, so we all know that procedures are essential in mathematics. The question is, “How do we get students to a point where they develop accuracy, efficiency, flexibility, and meaning in a computation?” What I've come to believe very strongly -- this is my last sentence -- is that students must keep a sense-making prospective in every aspect of the mathematics and that computational fluency will develop out of that orientation. I believe there is an important implication here for curriculum instruction in professional development and such. Thank you.

DR. FAULKNER: Thank you, Mr. Harter. Questions or comments? Thank you.

JENNIFER GRABAN: Speaker 12.

HYMAN BASS: Thank you Mr. Chairman and to the panel for this opportunity to address you. My name is Hyman Bass from the University of Michigan. I'm a research mathematician who specializes in various branches of algebra and I've spent the last several years collaborating with educational researchers at Michigan, focusing mainly on the nature of measurement of mathematical knowledge needed for teaching.

I want to offer the panel some brief perspectives on three things: One, the nature of algebra in school curriculum; two, how the panel will proportion it's attention to issues of equity and mathematical enrichment; and three, a brief comment about the norms discourse and reasoning with the panel.

First, about algebra. Algebra is rightly seen to be a central concern in mathematics education, for example, because algebra, it's content, it's methods and it's symbolic language are foundational to all of mathematics and science. Secondly, algebra is a gateway subject through which many, far too many, students fail to pass with -- foreclosing further access to technical fields and with all the economic and other consequences. And third, the students who are thus disempowered are disproportionately identified by race, ethnicity and socioeconomic status.

This is not a new problem and concern and there are several competing hypothesis implicit in new curricula, standards, and assessments about how best to intervene on the problem. Much of the debate about these alternatives have, inappropriately in my view, been framed as an argument about what algebra really is. And I would like to propose a reframing that I suggest will help clarify the discourse.

So I see two prevailing views of what algebra is. First, the traditional view, which I'll call symbolic algebra. This view emphasizes the systematic use of symbolic notation for variables and functions and the rules for their use and manipulation sometimes referred to as generalized arithmetic. A function is generally presented by a formula -- Y equals F of X-- expressing a relationship between two numerical variables. This view emphasizes the coordinate plane and graphs the functions, equations and inequalities. Detailed treatment is generally restricted to linear functions and lines, two linear equations and two variables and quadratic equations with, perhaps, some discussion of exponential functions, an integer or, perhaps, rational exponent. And there is also some treatment of formal arithmetic of rational expressions.

The other view, which is sometimes called patterns and functions in algebra, and which I'll call algebra as modeling, is relatively new curricular environment in which some educators have had algebra to take up residence with some new neighbors. There are motivations which have certain plausibility flow from some popular and compelling slogans about mathematics and it's role in the contemporary world. One is that mathematics is the science of patterns or that the notion of function is one of the central concepts of mathematics or that the world is now saturated with data and a primary role of mathematics is to find patterns in, or if you like, functions to model these data. For example, students in such a curriculum regime typically encounter a function, even a linear function, not as given by a formula, but rather as an inferred pattern in a sequence of numerical or geometric data. In other words, it's the product of a process of mathematical modeling.

While some deep truths lie behind the slogans, I mentioned previously, the curricular incarnations given to them by some educators have, appropriately in my view, been the subject of vigorous debate. It is not my purpose here to argue the pros and cons of these two views of algebra, but rather to make it clear that they represent two different mathematical subject areas, each of which can present substantial and legitimate mathematics, but not the same mathematics. The feud over which one has the right to be called algebra seems to be a pointless, legalistic debate. It's implied effect is that validation of one perspective is at the cost of displacing the other, a result that is neither necessary or desired.

I would say that preparation for university level mathematics definitely requires fluency with symbolic algebra. At the same time, mathematical modeling is increasingly important and an increasingly important context of mathematical applications and students should be exposed in developmentally appropriate ways to its methods. This is a complex curricular challenge and likely requires deeper thought and research than it has so far been given. My second point has to do -

DR. FAULKNER: It's time for you to wrap up, actually, so you're going to have to be very succinct.

HYMAN BASS: Okay, sorry. This is about equity and my equity issues are referred to the persistent achievement gaps in mathematics and science along the race and class lines.

The problem -- this problem, with all its economic and social consequences, is, perhaps, the most urgent and, yet still intractable problem facing American education. My concern is that this issue is too bleakly represented in the National Mathematics Panel and the rhetoric of its charge and its discourse so far and in the profile of its membership. In contrast with this, the panel's membership includes strong representation and advocacy with special mathematics enrichment programs for gifted students. One risk of such programs and related practices, such as tracking, is our notoriously unreliable, often inequitable, ways of identifying gifted and more accomplished students and the often invidious effects of those otherwise characterized. Let me --

DR. FAULKNER: I'm going have to --

HYMAN BASS: Sorry.

DR. FAULKNER: -- break you off. I think if you have a statement, that we would like to receive it.

HYMAN BASS: Okay.

DR. FAULKNER: Are there questions or comments relating to what Professor Bass has had to say? Thank you, Professor Bass. Oh, Dr. Wu.

DR. WU: You didn't get your third point. Do you think you can summarize it in two sentences?

HYMAN BASS: Let me make one sentence about it. I was impressed by the discussion of evidence and norms for making claims in the panel and I would urge that those norms be applied when -- in particular when making criticisms of federal agencies or professional organizations and specifically, for example, NSF EHR. I would urge that any criticisms that are made be specific to a particular document or a particular action and not to the organization, as such, and that any such evaluation be supported by evidence.

DR. FAULKNER: Yes, Wade.

DR. BOYKIN: What is your take-home message for us on the achievement gap point you made?

HYMAN BASS: I don't have a solution to propose. What I was hearing about the -- what I see is a tension between these two orientations on the panel that -- I want to emphasize that I'm very supportive of enrichment programs. As president of the American Math Society, I protested the end of the young scholars program at NSF and helped fund a program to support such things. On the other hand, I don't want to see encouragement of practices in that direction that would undermine attention to improvements in equity.

DR. SCHMID: You are on the advisory committee of a particular curriculum that was lavishly supported by an NFS EHR, a curriculum that takes a somewhat extreme view on -- it simply deviates from past practice. It deviates from practices in high achieving countries. Do you see any kind of evidence that supports the effectiveness of this particular curriculum?

HYMAN BASS: I haven't seen evidence supporting the effectiveness of any curriculum materials. I'm not sure -- in fact, the NRC recent report suggested that we don't even have methodologies for answering questions of that kind, because of the factors that influence outcomes are so complex and variable. But I will say that that curriculum -- I assume you're referring to Connective Math -- represents the, sort of, algebra is modeling interpretation of algebra. I don't view it as extreme. I think it's a coherent treatment of that. It departs from traditional practice. It's not my own mathematical orientation. I can see a place for those ideas. I emphasized the word "developmental" when I spoke because I would see those ideas as having some validity much later in the curriculum that they are now. I think that the resources for doing it properly are not really in place.

DR. SCHMID: Yeah, I was actually talking about the K through 5 curriculum.

HYMAN BASS: Oh, you mean investigations?

DR. SCHMID: Well of course, I agree with you that I am not aware of evidence for or against the effectiveness of programs of this sort. The reason I am asking is that, if a program deviates sharply from past practice and deviates sharply from practice in high achieving countries, shouldn't there be scientific support for such a program as introduced likely in your school?

HYMAN BASS: I've taught calculus for many years and I have never known a calculus book not to be criticized by its users. I have not seen any efforts to ban their use by any university. Teachers and practitioners are at liberty to make decisions about that. I have serious misgivings about some of the early versions of investigations.

One thing that I didn't have time to come to was there's a kind of fallacy and a lot of discourse in mathematics education that teaching certain content implies certain pedagogical practices, like many people have the view that if you teach long division, that means students are going to be exposed to long pages of drill work. That’s a non sequitur, and some of the people that instituted these alternative emphases on mental mathematics have neglected some of the more traditional emphasis on basic skills. I'm personally opposed to that and I voice such criticisms to the people developing those curriculum.

I don't see the appropriate action to be national intervention to ban such practices, but rather to communicate with the people who designed them and try to persuade them. They have been adapting, I think.

DR. SCHMID: I don't want to continue this discussion. I just want to be very clear that I'm not advocating that or anything.

DR. FAULKNER: Liping.

DR. MA: I appreciate your discussion about two different kinds of algebra you have noticed. I was wondering, are you aware of more writing or literature about further discussion of these two kinds of algebra and the relationship between them. I really want to know more about it.

HYMAN BASS: There's a strong movement in the field that favors much more mathematical modeling in the curriculum. It's considered to provide much better motivation, mathematical problems in so-called real world context, which the premise being, that somehow this will be experientially meaningful and this will attach more mathematical meaning to the problems they have to work on. The problem -- it's like the difference -- people think that estimation should occur earlier before exact arithmetic, because estimation being only approximate is easier. In fact, the reverse is true mathematically. To do an intelligent estimation, you really have to have good command of exact calculation. To do serious modeling to put mathematics in context is a very valuable, but also time consuming and labor intensive kind of instruction. If you want to do it seriously, you have to pay attention to the integrity, not only of the mathematics, but of the context. And if it's done too early, it tends to be a frivolous treatment of the context and a disconnection from the mathematics. I think it's important, but you need more knowledge-based resources in order for the instruction to occur.

DR. MA: Is there any literature available that discusses in a more detailed way, instead of a few minutes of presentation?

HYMAN BASS: There is an extensive literature on mathematical modeling. There is a study from the International Commission on Math Instruction about to appear based on an international conference on modeling that addresses this.

DR. MA: Thank you.

DR. FAULKNER: Vern.

MR. WILLIAMS: I have a question. You mentioned equity. I would like to know your personal belief on the following: Do you think, given an excellent math teacher, that blacks and Hispanics can handle the traditional way that algebra is taught, and girls?

HYMAN BASS: I believe given an excellent math teacher, all students can handle any mathematics taught with integrity. The main thing is it should be substantial mathematics with attention to all the things that have been mentioned earlier, including computational proficiency, conceptual understanding, problem solving skills, the ability to write and speak about mathematics, as well as the ability to use abstract ideas and notations.

I think all of the students you mentioned can learn those things given the opportunity to work with a good teacher.

MR. WILLIAMS: So we really don't need to change the definition of algebra or to change algebra for minorities to learn algebra? In other words, they can learn traditional algebra. We don't need to really change it into something else so that minorities are more capable of learning it. Do you agree with that?

HYMAN BASS: Well, I'm not completely comfortable with the way you frame that question. I tried to point out that there are two conceptions -- curricular conceptions of what algebra is that we have available in the schools now. Studies suggest that what actually happens in most classrooms is traditional teaching and student achievement outcomes are not very encouraging in that regard. –The question is, –“What should students be learning?” And I think that what you're calling traditional algebra is what I call symbolic algebra, is important and all students should learn that. It's foundational to all the mathematics and science and it's a real gateway subject.

On the other hand, the other conceptions of algebra, I don't think that probably they should not be called algebra. They should be called something like modeling or algebraic modeling, whatever, that also has important learning objections and we need to better understand where and when and how that should be taught.

DR. LOVELESS: Larry.

DR. FAULKNER: Yes, go ahead, Tom.

DR. LOVELESS: To the point that classroom instruction is dominated by traditional teaching, in the last -- since 1992 on the main national -- 4th graders have gained approximately two years in mathematical knowledge in terms of their test scores. How much of that would you attribute to the dominance of traditional teaching?

HYMAN BASS: I don't know. I'm not the author of these causal efforts. In education, the attempt to say that sometimes a student test outcomes are the result of curriculum, of instructional practice, of standards of NCLB. You can try to build models. You can do the research on that. Those are interesting questions. I don't claim to be in a position to infer.

DR. FAULKNER: Were you finished?

HYMAN BASS: Yes.

DR. WU: A minute ago you just said that the traditional way of teaching algebra has not lead to a very happy outcome. Do you attribute that to be curriculum of traditional algebra or are taking into account, perhaps traditional algebra and facts or the teaching of the facts?

HYMAN BASS: So what you just said is an example of what I consider to be confusion between content and pedagogy. I didn't talk about traditional ways of teaching algebra. I talked about traditional ways of teaching. Algebra can be taught in a wide variety of styles, including what a lot of people might call instructiveness methods. You can still teach any subject matter using those ideas. So the mode of instruction and the way mathematical ideas are presented can be quite variable and still be teaching traditional algebra. So I wasn't saying that the traditional ways of teaching algebra -- I don't think there's any intrinsic traditional way to teach algebra. There are some traditional practices of -- kind of -- didactic direct instruction formats, which could be applied in any subject area, but the subject doesn't require the pedagogy. That's the point I was making.

DR. WU: I just to make sure that this engagement between what you call the traditional method in algebra and the outcome is not a curriculum. I mean, do you think the traditional way of teaching algebra has not produced good results so far? I think I quoted that correctly.

HYMAN BASS: I didn't make it a specific reference to algebra in that statement, but I ,if I recall correctly, I said that in most classrooms, the teaching methods observed are essentially traditional. And if you want to look at, for example, other kinds of outcomes, Tom is right to point out that there are some indicators of some improvement. I don't think you are in a position to make some claim that therefore, traditional methods of teaching are a solution or maybe something that's not deserving of curriculum consideration.

DR. WU: No, I wanted to clarify what you were saying.

DR. FAULKNER: I might point out that there's also a matter of preparation for algebra.

HYMAN BASS: Right. Right. I agree.

DR. FAULKNER: Are there other comments or questions? All right, thank you, Professor Bass.

JENNIFER GRABAN: Speaker 13.

JAMES R. FRYSINGER: Good afternoon. I'm James R. Frysinger. My area of interest is metrology. And I'm at the College of Charleston in Charleston, South Carolina. And I own a consultant company in -

DR. FAULKNER: Pardon me. Would you give me your name again?

JAMES R. FRYSINGER: James R. Frysinger.

DR. FAULKNER: Frysinger. Okay. Thank you.

JAMES R. FRYSINGER: I'm grateful to the panel for this opportunity to express my views that the content area in our schools that it's getting short stripped. My background includes five years of public high school teaching and 13 years of college teaching, specifically introductory service courses in physics and astronomy at a relatively large college, The College of Charleston.

My students there major in many fields, including visual arts, business, pre-med, humanities language, and human science. Regardless of major, a significant portion of these students cannot use a ruler and cannot use a protractor. They lack the decent feel for the size of common units of measurements, yet the students that are at our college have a math and verbal SAT scores averaging about 1250.

Our school children are not being sufficiently and correctly trained in measurements. They do not receive enough practice, which should start in kindergarten, in making and using measurements. Measurement is now taught as an academic topic in the mathematics courses, but seldom employed there or in other courses, as a common practical tool. Measurement is not a math or science topic. It is a language that transcends discipline boundaries.

No longer do most students take a course such as shop or home economics in high school that routinely puts mathematics to use. Conversely, due to the fact of increasing competition, the price paid for imprecise understanding of measurement in our nation's businesses can be severe. Profit margins depend on precision and accounting for materials, as well as facility and the use of measurement by its workers. Global competition and increased dependence on the economy of scale demand greater precision and thus greater measurement skill. We are moving from a two millimeter fit to a six centimeter economy.

Our mathematics curriculum has become a kilometer wide and a millimeter deep. An example of that is the teaching of measurement used. Some three decades ago our schools started in earnest to teach all students to use the metric system, anticipating that in several years our country would be metricated. Unfortunately, political maneuvering by a few small groups led to the halting of public metrication leadership by our government.

Way back in 1893 our government threw away it's national yard, pound, gallon and most standards and defined those units in terms of metric units, but in 1988, 95 years later, Congress declared the metric system to be the preferred system of measurement in the United States and directed the federal government to finish metricating itself while casting the public adrift to defend for itself.

I draw here from my experience now in consulting for industry on metrication of their businesses. Driven by competition that contract a man to home or abroad, industry has continued unevenly toward metrication. Industry is also hampered by the quality and type of measurement training that our students are receiving. States such as South Carolina are forced to provide supplemental measurement and metric training past high school to attract modern factories. Lacking a strong signal to the federal government's various agencies, schools continue to teach both the metric system and the increasing obsolescent set of units rarely used outside the United States. The time spent on teaching measurement gets diluted by the two-prong approach. Time is wasted on trying to teach conversion between these units when it would be better spent developing a good feel for the metric units by using them in all school curriculum.

The best foreign language classes teach conversation comprehension before they teach translation and we should do the same when teaching measurements. Students are quickly confused by the two-prong approach. I have seen students pick up a dual scale ruler and use the inch scale as if it were a metric scale, for example, by carrying 13 tick marks past the four mark and calling the measurement 4.13 centimeters. This is not an isolated instance. Ironically, with this dual unit training our students understand and use the simpler metric system better than they do our old complicated units, but even there they do not measure up.

When we first started toward the national metrication 30 years, 75 percent of the world's people were metricated. Today 96 percent are metricated and the remaining four percent, we in the U.S., are undergoing the factor metrication as I speak. The Olympic games are now broadcast in the U.S. in metric units without translation.

The new shingles I put on my house a month ago were metrically designed, sized, and built by an American company. Our regional GAF plant had discontinued its non-metric line. My new American made stove and thermostat I put in my house last week could be set and used in degree Celsius and I do.

Forty-six states now allow metric only labeling on all the retail goods sold in the state level jurisdiction. The U.S. Department of Education needs to exercise leadership and send a strong message to the states that they should focus time and effort by teaching only the metric system. Any skills in using other units that are lasting through the years could be picked up at home or once the student firmly grasp the measurements as a special topic, such as we teach the quaint constructions of Shakespearian English.

The U.S. Department of Education, the National Academies, and other federal entities need to send a strong message to oversight organizations for math, English composition, social studies, art, and foreign languages to get on board --

DR. FAULKNER: Time to rap up.

JAMES R. FRYZINGER: -- and train our students to properly use metric measurements. We need to prepare our students for the world as it is now and as it will be when they graduate, not the world that once existed when their parents graduated. Thank you for letting me speak.

DR. FAULKNER: Thank you, Mr. Frysinger. Questions or comments? All right. Thank you.

JENNIFER GRABAN: Speaker number 20.

DR. FAULKNER: Number 20?

JENNIFER GRABAN: We had some people that did not show up that were pre-registered. We wanted to allow them to go first if they showed up.

DR. FAULKNER: Thank you.

ALDEN DUNHAM: My name is Alden Dunham. I live in Chapel Hill. I'm a retired foundation executive. I'm going to talk about teachers. And in so doing, I'm going to, actually, read a letter that I wrote about three or four months ago to Erskine Bowles, the new President of the University of North Carolina System.

Dear Mr. Bowles, You're off to a great start. I particularly want to commend you for tackling the serious problem of the quantity and quality of school teachers and to make a constructive suggestion.

First, a word of background. For 25 years I handled educational grantmaking in both the school and higher education levels at Carnegie Corporation of New York. I was deeply involved with just about every reform agenda that came along from Clark Kerr's Carnegie Commission on Higher Education to Jim Hunt's National Board of Professional Teaching Standards. Jim and Bill Friday have been friends for many years.

Much of my work focused on relationship of education to the economy, in particular math and science education and the shortage of qualified teachers. The current crisis -- and it is a crisis -- is not new. Every proposal now talked about has been tried before. Reform with the teacher education, alternative roots to teaching, standards, accountability, charter magnet schools, new curricula, different forms of school organizations, special programs for minorities, in-service workshops for science teachers (NSF poured millions in the summer workshops), closer ties between universities and schools, countless commissions and task forces. I know, because I funded much of this.

The problem, nothing has changed the system. Lots of good projects but nothing sustainable. The current teacher shortage is the worst in history, but there is no shortage. Why, because states keep lowering standards to fill the classrooms. All at the very time we want higher student achievement. Lowering requirements to bring out of state teachers to North Carolina is typical.

Jim Hunt's National Commission in 1996 set 2006 as the year when every student in America would have qualified teachers in the classrooms. His agenda to reach that goal sounded good, but has not succeeded. We are worse off in 2006 than in 1996.

Quality and quantity are going down. What to do? The old agendas are not sufficient. We need really fresh thinking. My proposal: Take the best teachers in the state, put them together with the best curriculum and through distance learning(TV, computers), provide excellence and equity to every classroom in North Carolina. Much of it will be interactive. Traditional classroom teachers become tutors, facilitators, coaches and gain in-service training themselves. Start with math and science at the high school level and gradually move down the grades into other subject areas. Will it work? Bits and pieces are already in place, but not as a mainstreamed delivery system. Much of the training in industry in the military is done through technology. One-third more learning in one-third less time at one-third less cost is the mantra. It's time that the use of technology for productivity gain in the rest of the economy is applied to labor intensive education where costs keep escalating faster than the inflation rate. So it's productivity as well as an education issue. What about the money? It would be a lot cheaper than the President's proposal and in my view much more successful. Newton Minow's book, *A Digital Gift to the Nation* puts forward an interesting idea: take money from the auction of the electromagnetic spectrum -- a huge amount -- and turn it back to schools and universities for the educational use of the airwaves.

What I'm proposing is clearly a political minefield. The educational establishment would fight it. Real leadership like that, which you could provide, would be necessary. The university schools of education would have to change their missions to bring technology to the forefront of the delivery system rather than as just an add-on tool for classroom teachers. I would love to see North Carolina take the lead in this kind of dramatic leap into the future. Sooner or later the advance of technology will clearly make obsolete current educational practice. It will happen in the schools, and it is already beginning to happen in higher education. Within 50 years, I think residential colleges and universities will be gone.

By the way, I have tried this out on my friend Jim Hunt who said, "Provocative. You may be right. I want to think on it." That's one provocative proposal. I have one other that I'd like to suggest.

DR. FAULKNER: But your time is up.

ALDEN DUNHAM: Yes, this will take two sentences. Your focus is on research. I for one, having worked with James Comet, former President of Harvard, who took a very dim view of educational research, I support that dim view. He wanted to know what the educational equivalent of H2O equaling water was. The point being, that be cautious -- be cautious about reliance upon the social and behavioral sciences. I think the future research in education is going to be tied in dramatic breakthroughs in neuroscience. Thank you.

DR. FAULKNER: Thank you, Mr. Dunham. Are there questions or comments here? Thank you.

JENNIFER GRABAN: Speaker 21.

DONALD BURDICK: My name is Donald Burdick. I'm a Senior Scientist with MetaMetrics Corporation, a developer of the quantile framework for mathematics.

In 2002, I retired from Duke University

after a 40-year career as professor of math and statistics. Since retirement from Duke, I have been volunteering at Lakewood Elementary School, which is located near the campus. My purpose today is to describe, in some detail, my experience as a volunteer and to conclude with a question or two for the panel's consideration.

I've just finished my third year as a volunteer in third and fourth grades at Lakewood Elementary. Typically, I go there for one hour a week and present a lesson to the whole class, which usually involves dividing the class into teams for competition in math games. While we have no controlled experimental results to back us up, but the classroom teacher and I feel that this activity works. I have fun, the children have fun, and while having fun they are engaging in and thinking about mathematical concepts and procedures. The students have scored well on their mathematics section of the North Carolina end of grade tests. We have also arranged some between class competition at Lakewood Elementary, and next year I am hoping to organize interscholastic competitions between elementary school classes.

My question is this: Are there other competitions of the sort that I've described going on around the country and, if so, how can we get together? I have done some search on the Internet and have yet to find anything quite like what we're doing at Lakewood Elementary.

A second question concerns the potential resource represented by the grandparent generation to which I belong. It is a mostly untapped resource, I think in large measure because of inter-generational barriers of terminology. If you ask a member of my generation, for example, what skip counting is, I think you will generally get a blank stare, but the clouds quickly evaporate when you can call it counting by twos or threes or fours or fives. This is, I think, illustrative of something that is easily overcome, but while it remains, it is a barrier that is kind of in the way of using what I think is a potentially valuable resource. I am happy to conclude my comments with time remaining.

DR. FAULKNER: With green time remaining.

DONALD BURDICK: Green time remaining, yes.

DR. FAULKNER: Your name is Burdick?

DONALD BURDICK: Burdick, B-U-R-D-I-C-K, Donald Burdick.

DR. FAULKNER: Well, thank you, Dr. Burdick. I appreciate you being here.

DR. FENNELL: Larry.

DR. FAULKNER: Yes, you have a question?

DR. FENNELL: I think Vern should respond to him relative to math council.

DR. WILLIAMS: Actually, I was going to see you afterwards and give you some advice on that.

DONALD BURDICK: Wonderful.

DIANE JONES: I'm not sure if you're aware of the Mathematics Olympiad.

DR. FAULKNER: Wait, don't leave yet. We still have questions.

DONALD BURDICK: The competitions that I have discovered are typically of this problem solving. It's, basically, kind of an individual performance and it sort of favors the ones who are doing well, the elite, so to speak. The games that we've been playing are team competitions; the whole class participates. It's very much in keeping with the No Child Left Behind. One of the advantages of a team competition is the social interactions. The weaker students can learn from the better ones, but they still are very much involved because when it's their turn to make the move, it's their responsibility and so their -- so their -- Oh, by the way, classes are, essentially, entirely minority and Hispanic. We've just had good success with this.

DR. FAULKNER: Comments? Wait, we're not

done yet.

DONALD BURDICK: Oh, not done yet. I'm happy to stay as long as -

DR. LOVELESS: You might -- you might, also, look into -- Robert Slavin developed a program, I think it's called Teams, Games, Achievements or Tournaments, Games, -- Teams, Games, Tournaments -- that's right TGT and there is research to --

DR. FAULKNER: What's that name, Tom?

DR. LOVELESS: TGT, Teams, Games, Tournaments.

DR. FAULKNER: No, I mean if you were going to do a web search, what would the name --

DR. LOVELESS: Oh, Robert Slavin, S-L-A-V-I-N, John Hopkins -- Johns Hopkins.

DONALD BURDICK: V-I-N?

DR. LOVELESS: Yeah.

DONALD BURDICK: Thank you very much.

DR. FAULKNER: Anyone else? Thank you, Dr. Burdick.

JENNIFER GRABAN: Number 22.

IRIS WEISS: Good afternoon. My name is Iris Weiss. I'm the President of Horizon Research, Incorporated, a small firm here in the Chapel Hill, North Carolina specializing in research in math and science education, and I have been at this for lots and lots of years, more years than I sometimes care to remember.

I want to return to the theme that the panel talked about yesterday of evidence. As Russ Whitehurst noted yesterday, the panel is charged, not just with synthesizing what is known, but also with making recommendations for improving mathematics education. And the panel has emphasized the importance of basing those recommendations on the available evidence or the transparent process and clarity about the quality of the evidence on which particular recommendations are based. At the same time, panel members who have had an opportunity to dig into some of the research that you are going to be looking at, have alerted you that the evidentiary basis of -- not to set you up on some evidentiary base -- my characterization of the research base in these areas of education is that it is like Swiss cheese. There are more holes, unfortunately, than there is cheese.

And while I agree with the panel members who have noted that no one will be well served by a litany of we don't know much about "X" and we don't know much about "Y." If that is, in fact, what you find, I hope the panel will use that information to make recommendations for what needs to be done to improve the evidentiary base.

As I understand it, the panel has a subcommittee working on standards of evidence to apply to the existing research. And as a part of that work, is described a hierarchy of evidence. I urge you to go further than criteria for judging the qualities of individual studies and describe your vision of the kind of evidence base you would like to see, not the findings -- I hasten to add -- that you would like to see, but the kind of evidence base that you would like see that would give you confidence in the recommendations.

I suspect it would not be a handful of studies, however well designed, that showed that a particular practice is more effective than an alternative, but rather a series of well designed studies in a variety of context that address not only if the practice works but also how and why the practice works, for what outcomes, for whom and under what conditions.

It seems clear to me, and I think it's clear to many of you, that we need a much better education research system -- and I use the term loosely -- if we're going to generate the knowledge needed to make steady improvement. As we've heard over the last ten years, medical research is often held up as an example for education research. And I had that in mind when I read not too long ago a statement from a medical professional that cautioned us that some conclusion he was about to state was based upon only 20 well designed studies. So we should be very cautious in generalizing -- using that finding.

Now anyone who has ever looked at education research base knows that we don't have 20 well designed studies of anything that we did, but when we find the use of randomized control studies in medical research as the "gold standard" for judging whether something is effective, we sometimes forget to also note all of the earlier work that takes place in medical research before designing -- deciding -- excuse me -- to conduct a randomized field trial in the first place. Moving too rigorous too soon, and in the wrong places, will not get us very far. As an extreme example, I was once asked to evaluate the effectiveness of a project where a member of a faculty member would visit an elementary classroom once a semester and I was asked to look at the impact on teaching and learning. Well, spending my time and taxpayer money showing that something that couldn't possibly work, did, in fact, not work did not seem to be a high payoff and we chose not to do it.

Well, what would it take to add to the knowledge base in a more deliberate systematic and efficient way. Here is some initial thoughts from someone who has been both a producer and an avid consumer of education research. Many of these are not original to me, but I want to get them on the record anyway. Focusing a great deal of more research on problems of practice and policy comes quickly to mind, so does a great deal more money for research. Calls for higher quality research are pretty hollow if there are not adequate resources for such studies. And it seems pretty clear that we need a much bigger effort at developing valid measures of the dependent variables and the mediating variables that we hypothesize are in play. The fact that many studies, including ones that I, myself, have conducted, have used really weak measures, like teacher perceptions of their own content knowledge in a value of impact on professional development. It's not because we're stupid. It's because the measures that we need do not exist and few evaluation studies that -- few evaluation studies have the time and the resources to develop and validate their own instruments.

It always makes me nervous when panels like this review research because I already know what you're going to say about a lot of the work that I and my colleagues have done, and all I can say to you is, it's our fault. We know better.

There also needs to be much more serious attention, I believe, to addressing school and district concerns about research. As a commentary in a recent issue of *The Journal for Research and Mathematics Education* notes, "We have simultaneously given schools incentives to be consumers of research and disincentives to participate in research."

DR. FAULKNER: Ms. Weiss, you're going to need to wrap up.

IRIS WEISS: Oh, okay. Schools are increasingly being asked to use effective research based practices, but the pressure to meet adequate field progress means that they don't have the time, the discretion to do research, and everyone wants more research findings that they can use, but everyone wants that research done in someone else's backyard.

I had other things that I would have liked to say, and I did prepare written remarks.

DR. FAULKNER: If you have the remarks, we'll be happy to have them. Questions or comments? Tom.

DR. LOVELESS: Could you elaborate, just a little bit more -- thank you for your comments, by the way -- could you elaborate just a little bit more on -

- maybe even name one particular area of either policy or practice that really demands more research right now?

IRIS WEISS: Yeah, effective use of professional development money. It is incredibly expensive to provide continuing education for teachers. Right now professional development is going for remediation of what we didn't get right in the first place and continuing education. And we don't have the luxury to -- we kind of diddle around at the edges. We need to be a whole lot more efficient and effective and simultaneously, I believe, but again we don't know a lot. Deepening teacher content knowledge, helping them understand student thinking, helping them understand how the materials that they're asked to use help students develop understanding. There's a lot of myths -- well meaning -- but not well informed and it's not the fault of the practitioners. It's the fault of our educational research enterprise and the people who make decisions about funding.

DR. FAULKNER: Valerie.

DR. REYNA: I have a question of clarification. You mentioned spending -- how professional development money can be spent. How do you disentangle that from on what? How do you evaluate the question of how professional's money be spent, if you don't know what it's being spent on. It doesn't seem like that would be -- how would you answer such a question without specifying the nature of --

IRIS WEISS: I think you would have to specify the goal of professional development and then see if it's effective. But someone mentioned earlier issues of scale. We tend to do experiments -- or what count as experiments -- on things that can't possibly be sustained and then we find out that something that school districts can't afford actually works.

DR. FAULKNER: Other questions or comments?

DR. FENNELL: Larry, just one relative to professional development -- kind of a general response back to Tom. Are you suggesting in the arena of mathematics specific examination of, say, the math science partnership initiative, both Department of Education and the National Science Foundation or did you have something else in mind?

IRIS WEISS: Are you asking me or Tom?

DR. FENNELL: I'm asking you.

IRIS WEISS: I think that we need to be doing all of the above. And one of the problems right now is when we do research/evaluation, the "it" that we're measuring is not well defined, so when we find out that something works, we don't really know what "it" is. Every study uses it's own measures, so it's hard to aggregate knowledge and say this is better for this outcome then this other thing.

As someone mentioned, it takes time for interventions to -- to have a chance to get the bugs out and work and we've tend to be too impatient to give anything a chance. So, basically, we find out that nothing works, because nothing had the time to be fine-tuned to work.

DR. FENNELL: Well, I'm asking that because of the demise of what was the Eisenhower knowledge years ago that supported a lot of professional development around this country, and one of the errors in that -- in that move was we didn't -- take what you just said -- we didn't track, we didn't -- we didn't do a systematic evaluation of that program and so -- right -- it got away, frankly, because there was no evidentiary basis. And now we're a few years into something a little similar and something a little dissimilar in the name of math science partnerships around the country at the state level. I suspect that the same kind of care that we didn't have, if we're not careful, we're going to be in trouble with that, too, which is why I'm trying to push that in the direction of math in your comment. Thank you.

DR. FAULKNER: Diane.

MS. JONES: I have a question about where and how evaluators are introduced into the process and see if you have any recommendations on -- in that regard. My own experience is that all too often evaluators are hired at the end of the study to analyze the data and draw conclusions. Do you feel -- if that's the case, and if so, I mean, do you think it would be helpful to bring evaluators in on the front end of projects and if so, how would you recommend the agencies that fund this kind of research to better integrate input from evaluators?

IRIS WEISS: So in the idea of evaluation thinking would be introduced right from the get go in the design critique, because there are things that are known. So if I were to see another project that said I want to have stem faculty come once a semester, I could maybe inform those people that that is not a high percentage strategy and in -- especially in the math science partnership we're bringing in people who are not familiar with professional development, there's even more reasons to bring to bear the research that we have and so evaluators would play that role. Evaluators can play a form of the evaluation role.

I'm not 100 percent convinced we have the right formula for evaluators in the summit of evaluation role in that right now typically the summit of evaluation is conducted by someone who is hired by the project. And if you're hired by the project, you can be fired by the project. We have on occasion the curricula projects and those people have never asked us again. So there are real disincentives to being honest in that situation.

MS. JONES: If I could just follow up, because we are very interested in an effort -- in an effort separate from the National Math Panel, we are interested in looking at evaluation and across stem programs and you're aware of that effort.

The other question is, is it more practical to involve evaluators at the project level or at the program level?

IRIS WEISS: I don't believe that it is an either or question. I think that it is helpful to have a program evaluation. I would say, designed from the get go so that people will know what data they need to collect with common instruments and aggregate data and, if there's a decent design, begin to accumulate knowledge about what works under what circumstances -- knowledge that we desperately need.

Project evaluation is needed as well, both before feedback to that project, but also, unless a program has every iteration -- every project doing precisely the same thing -- and rarely is that the case -- then there are unique elements. You need target populations; you need goals. And if there is not a project evaluator there, then those get missed.

DR. FAULKNER: Tom.

DR. LOVELESS: One of the deficiencies in the research on professional development is really structural in the sense that we can never get to the question of where the rubber meets the road. We can never ask the question, how does what a teacher goes through in terms of professional development affect how much students learn? And there are real barriers there. Some of them are contractual -- don't allow test scores to be attributed to individual teachers. There's also a problem just in terms of teachers who, quite rightly, are suspicious of researchers coming in and trying to tie something that's not achievement, but simply their actions. Could you comment a little bit about that? And in your own research, how have you tried to break through that?

IRIS WEISS: We have tried validly and never succeeded. You're quite right. But I think the federal government has leverage here. I have been a critic of the practice of the federal government paying stipends to teachers for professional development. I think that's a district and stated responsibility. But if the federal government is going to provide big bucks to school districts for professional development, then that can come with some strings and one of the strings can be a decent evaluation design. One of the problems we have -- again, going back to the randomized field trials -- is that school districts hate the idea of randomly assigning teachers to do something and not do something and especially if it's for multiple years. If you try to pick up gains in students, you have to give the teachers an opportunity to factor what they've been learning and that takes lots of years. So we have the methodology in place. We haven't had the political will in place to do it. And among other things, this whole notion of random assignment of teachers and telling teachers within the school don't talk to your colleagues because it will contaminate our experiments, teachers laugh when you say that because we spend most of our time asking them to be part of the learning community.

DR. FAULKNER: Thank you very much, Ms. Weiss.

JENNIFER GRABAN: Number 23.

ROBERT YOUNG: Hello. I just found out about this panel this morning, so I don't have a written document.

DR. FAULKNER: What's your name?

ROBERT YOUNG: Robert Young. So if it's inappropriate for me to speak as a result of that, please tell me and I will -- I will sit down.

I am a Professor of Industrial Engineering at North Carolina State and I just wanted to briefly talk about a couple of things.

If you look at labor statistics that are projected out from the U.S. Department of Labor, we see a huge need for engineers in the future and business people. But if you look at the need for mathematicians, it's pretty level at about 3,000 a year. If you look at 2012 for engineering, it's about 268,000. For people with business degrees, it's probably three times that. But if you look at mathematics and the teaching -- and I've been looking at math high school textbooks -- they're really written by mathematicians and really for mathematicians. And one of the issues, which continually comes up with my colleagues and with my neighbors and with their children is, why do I need to learn this? What's the point of all this? How can I use this, and where is the rationale for this? And I think we need to be able to provide an answer besides, so you can help your children with their homework.

And so what I want to just point out to you is that, there is a lot of rationale out there and, I think, that we are not using it in designing textbooks. That rationale exists in engineering schools around the country and it exists in business schools around the country. And I think that one thing I would like to suggest, and the only reason I'm here, is that you consider creating incentives so that colleges of education and colleges of engineering and colleges of business will get together and write textbooks. The education people can provide the rationale and how these things need to be organized. Lord, I know that the textbooks I write for university students are not appropriate for high schools and middle schools, but I do know that the rationale I can provide a student when they say, why do we need to learn this, is quite good. And the rationales that I see in the textbooks, I can't find any connection to. I have a textbook here.

This is a D*iscrete Mathematics 3 Application*. It's the only one I could find. A third of it is devoted to Aero's Theorem. How many here know what Aero's Theorem is? Anybody? How many have ever used it? I've talked to my colleagues around the country -- and I work with people in Europe, South America, Asia, everywhere -- and I can't find a single person that's ever used that.

DR. LOVELESS: Hundreds of hands just blew up.

ROBERT YOUNG: And so now I'm going to be a high school teacher and I'm required to teach a third of this book and a student says, "Why do I need to know Aero's Theorem?" What can a teacher do? Well, they look in this book and they say, "Well, there's an example in here where you and your friends are going to decide which place to go to for lunch." Now come on, okay. There are other examples through this.

Now what I'd like to leave with you -- this was written by some of my colleagues at Wayne State University. A friend of mine who is the department head of engineering -- one of the schools there -- and the other one is a college of engineering faculty member. And they got together through accident -- through working with some teachers who said we need some rationale and this gives rationale. Multi-criteria decision analysis, important topic, how to choose a college. That's a good example. Risk analysis. How much deductible should you get on your car when you buy insurance?

These are the kinds of things I think we need for rationale and not things which no one can connect to. To me, that's one of the issues. You're trying to interest these kids in mathematics, but they can't see in any way, shape, or form how this pertains to them or how they would ever use it, and their parents can't provide them an answer either. And I think that's what we're missing.

And so what I would like to leave with you is, I think that you have the power -- Department of Education, The National Science Foundation -- they have tremendous amounts of resources. You have faculty in universities at education colleges, business colleges, science colleges, engineering colleges and they respond to funding. You put forth an RFP and you say you all get together, we want curriculum developed in algebra, whatever level you want, and we want rationale and examples that make sense from your experiences in business and in engineering and it does several things. We have a rationale --

DR. FAULKNER: You need to wrap it up.

ROBERT YOUNG: -- and then I will -- and then give students a sense of what they're going to do if they go into business or they go into engineering, and we need a lot more of these people in the future. Right now we're not producing them. That's all I have to say.

DR. FAULKNER: Thank you, Professor Young.

Diane.

MS. JONES: Just so that you know you're not alone. We heard the same comment from teachers of English, teachers of history, teachers of art, teachers of music. I mean, I think, it's not just in mathematics where we hear this, that, you know, students are constantly asking, "Why do I need to learn this?" So it's not just in mathematics. We hear the same frustration in other fields as well.

DR. FAULKNER: Okay. Thank you, Professor Young.

JENNIFER GRABAN: Number 24.

SUSAN FRIEL: I have come prepared with handouts. My name is Susan Friel. I'm a Professor of Mathematics Education at UNC Chapel Hill. I am a curriculum developer.

DR. FAULKNER: Friel, F-R-I-E-L?

SUSAN FRIEL: F-R-I-E-L, yes. I am a curriculum developer and have developed -- been involved in a number of curriculum projects, many in statistics education, and more recently, over the past ten years, I'm an author on one of the middle school curriculums. I'm actually here today to talk more about early childhood education. That may sound like something -- sort of an oxymoron, but once you've seen a 6^{th} grade student do something in mathematics, and you wonder deeply how it started, you go back, and I went back to K-2. So I would like to talk a little bit about some issues relating to early childhood mathematics and your work.

My first point is, the content of algebra in the early grades needs to be constructed in a way that lays the ground work for later work in middle and secondary grades. I would like to pull on the history of statistics education for just a minute. When that became K-12 strand, what was defined as what was needed in the elementary schools was pushing down certain skills and so we teach and how to make graphs and how to fine mean, median, and mode. We do not teach how to think statistically. We do not focus on statistically literacy.

Fortunately, there are some people now doing research in this area who are looking at how young children come to understand key, grounded ideas in statistics. The same thing can happen in algebra if we aren't careful. The North Carolina study has pushed down simple linear equations in the 4th and 5th grade at this point in time without thinking about what it is we want to build for understanding. So what would that understanding look like?

It's interesting that the latest JRME article features a research study looking at, does the equal sign matter, looking at middle grade student's understanding of algebra in relation to their understanding of the equal sign is a relational operation that's suggesting certain actions. They found that it makes a difference.

Interestingly enough, Carpenter and his group have worked with early childhood -- worked in K-12 -- K-5 to focus on key ideas that are grounded at algebra concepts, one of them being understanding the equal sign and also working with properties -- so I would suggest that there are places to go to think about what we might do with that. In addition, there are some other work that is being developed through cases looking at algebraic reasoning in the middle grades. Case studies often provide access to student reasoning in ways we have not been able to think about before. I add -- I attach a one-page document on the possible case study references.

I would also like to focus on early childhood mathematics literature that should be reviewed. I have attached a two-page bibliography of some suggestions but not all of them. I would like to suggest that we need to focus on identifying the contents that is grounded in essential conceptual understandings as a piece of what we want from our elementary curriculum. We need to recognize the children develop mathematically. I want to highlight the work done by Wright and his group from New Zealand and Australia, and also Dutch materials that have come out.

I would like to suggest that one of the contributions the committee might make that might make a difference is to articulate trajectories that address both content and the development of learning.

And finally, I have highlighted a couple additional curriculum materials that are now available that are from researchers Jerry Pusen and also from Sharon Griffith and Robin Case.

I would also like to consider the importance of the issue of mathematical press as we look at the nature of the way people come to learn and what we chose as the problems they will use if we use problem based curriculum. We can't expect children to make sense of it if a teacher cannot push the mathematical agenda from that content. And the whole notion of what is it that we're trying to accomplish mathematically, when you look at a particular problem and work with it with children. I work with a middle grades teacher in Ohio who never goes into the classroom not being clear about the mathematical agenda for that day. He is purposeful and intentional. All his interactions with students are purposeful and intentional and things happen in that class when that happens.

And finally, I would like to highlight that we consider characterizing the content through concepts that are necessary to learn by examining tasks and sequences of tasks. The task of which students engage determine what they learn about mathematics and how they learn it. Not all tests are created -- not all tasks are created equal and different tasks will provoke different levels and kinds of mathematics and student thinking. And for example, I raise cognitively guided instruction, which was mentioned yesterday as a curriculum area, but I want to highlight that that is focusing on the characteristics of tasks that are very important. It is not a curriculum itself, but is raising key issues with respect to tasks.

I would also like to highlight another program, Algebra I, a process approach that was developed in Hawaii in which the design and the sequence of the task grounded -- were grounded in a research project looking at curriculum development. And they are not pages of drill and practice, but there are a number of times that students experience different kinds of problems that raise different sides of a conceptual understanding that they must address.

There are other materials that we have available that we could look at the task and sequence the task and say what are the mathematics that we are after. I don't think we can come back and lay down a set of concepts without thinking carefully about the subtleties of those concepts and what we are trying to develop with them.

I've given you two pages of resources. Any references that I have made are either on those two pages or I have written in the first two pages that I have done here, but I hope you'll take a look at them. I know that I have worked in the early childhood area for about ten years now as a reaction to what I have seen happening in the middle schools. Thank you.

DR. FAULKNER: Thank you, Dr. Friel. Questions? Liping.

DR. MA: Yes, would you please say more about algebraic thinking -- reasoning. What means by algebraic reasoning versus other reasoning?

SUSAN FRIEL: That's a lovely question. When I think of algebraic reasoning, I think of reasoning and being able to generalize about situations. And so when I'm looking at the early childhood literature that I'm talking about right now -- Carpenter, Franke and Levy materials -- they are talking about students being able to make generalized reasoning about what is the commutative property and why does it happen. What is the associative property and why does it happen as groundings to what we're working on.

DR. MA: You mean that algebraic reasoning, right?

SUSAN FRIEL: I mean it at the beginning of algebraic reasoning. It's grounded -- beginning algebraic reasoning.

DR. MA: Thank you.

DR. FAULKNER: Tom.

DR. LOVELESS: The algebra program that you referenced out, the process approach from Hawaii, has there been a rigorous evaluation of that program conducted and could you share the results of that?

SUSAN FRIEL: Actually, I think the person who is responsible for writing it is following me very shortly, and so you might ask him about those questions.

DR. FAULKNER: Skip.

DR. FENNELL: Just to let you know, we did begin discussing the notion of algebra over the last couple of days and did mention, as recently as this morning, the work of Carpenter and his group, so --

SUSAN FRIEL: Good.

DR. FAULKNER: All right. Thank you very much, Dr. Friel.

JENNIFER GRABAN: Number 25.

SID RACHLIN: Good afternoon. My name is Sid Rachlin - it's R-A-C-H-L-I-N. And I'm the one you're going to ask the question of, Tom, about Hawaii algebra, but you don't get a chance to ask it yet. It will take up my time if you do.

I'm reminded of -- you get to a certain age, and you start thinking back to a lot of different things. And one of the things I'm reminded of is a comment that Tom Cooney made one time about the study of teaching and teaching in mathematics. And his comment was, "You'd be able to do a study of teaching without any students being in the room." And so as I was watching the panel starting to leave, I started to think about my own comments and what the reaction to those comments will be.

The other thing that I was thinking about were two other pieces. One was, yesterday Professor Wu had us think about fractions and talked to us about whether the teaching of fractions is done in an appropriate way and what's the meaning of rational numbers and what that has to do with algebraic reasoning. Another thought that I had was about a keynote session I had seen one time that was on the use of cooperative groups. And it had four speakers who were presenting and they were talking about the value of cooperative learning as a way to get across instruction, and each of them lectured us about what the value of cooperative learning was. So when it came to the question and answer time, I rose and asked them why, if they felt that was the way people learn, they would bother to go do a lecture to us, and the answer was, well people came to hear me talk and there wouldn't be enough time for that, the arguments a teacher would give when they say why they won't do it in their classroom. So I have to bend a little bit and go along with my own beliefs. And one of my beliefs is that you learn through problem solving and you introduce the situation through problem solving. So I thought I would go ahead and break what's been the way things have run this afternoon by giving you a problem to solve and then follow up with your problem, so I'll use some of my time for you to work the problem. And this is a problem that actually came from a middle school textbook that was pulled out of a textbook about 30 years ago. And it is a middle school text that, in the section that I'm pulling the problem from -- there's a lot of fractions -- I did it for Professor Wu -- and the section is titled, "Subtracting Fractions With Equal Denominators." So that's the topic.

In the back of that section is a whole bunch of problems for kids to work and on every one of those problems every fraction has -- is already in lowest terms and you're to subtract the two fractions and just get an answer from them. I looked in the back of the book, and in the back of the book, I looked at the answers that were there. All the odd answers are in the back of the book. And so I pulled out the answer 2/13. And so my problem for the panel is for you to just give me any problem that might have been in the book where you have two fractions with equal denominations, when there is lowest terms whose difference is 2/13. And I'll give you a couple minutes to give that a try within my time limit.

DR. FAULKNER: We're here to hear from you not to respond to tests.

SID RACHLIN: That's what the teachers tell me, too, so I understand that.

DR. FAULKNER: Your light has turned to yellow.

SID RACHLIN: All right, so I'll go on then. And some people might try to try that, others will say, maybe we need criteria for how the panel is selected and do we understand what the issues are in mathematics and then that's not a major problem. That would be something that would be easy to deal with right away.

For me, what I've been doing over the last -- well, since `69, I have been working in high school, middle school; I have taught some at the elementary level; I was a community college math department chair and have been in math ed positions since then. And my dissertation research -- what I wanted to get at was some of the discussion yesterday about the nature of research talked about the studies as if studies are individual pieces rather than a body of knowledge. And so one of the questions is, as you're looking at studies for me, my studies have been done with small numbers of students. They've been done videotaping. If you go into our basement, you'll find videos that are on pneumatic, that are on beta and that are VHS, so it goes over time. The number of hours of videotaping that has been done is in excess of 500 hours of videos interviewing students and the way they think as they're working in mathematics. And so I'll take a couple of minutes just to describe some of those types of studies --

DR. FAULKNER: Your time is up.

SID RACHLIN: Okay, then I won't.

DR. FAULKNER: Is there any wrap up comment of two sentences?

SID RACHLIN: I can do that for you. In terms of wrap up, one of the things that was missed yesterday in the discussion was the notion of retention. As you're looking at skills, the real challenge with skills is not just authenticity, but also how is that retained over a period of time. And in algebra that's been one of the major problems that it's not a question of whether something was ever a skill for a student, it's whether a skill when you hit the community college, when you hit Algebra II and what are the types of evidence we have on it that retention has occurred.

DR. FAULKNER: Questions or comments? Tom.

DR. LOVELESS: Evaluation.

SID RACHLIN: Within the Hawaii Algebra Project, one of the things that it was built on were a series of video interviews that were conducted and they were conducted before there were any curriculums being done through an NIE study. It was a poorly conceived study, but one we learned a lot from. And poorly conceived in that it was back in the beginning of the `80s and what the attempt was to look at ways students think when they're doing algebra. And we were looking in particular at minority students, black students versus white students and what was their thinking as they completed an algebra class. There were ten hours conducted with each student.

The reason it was poorly designed was because in order to get the white student to be participating it was randomly -- they were randomly selected. To have a matching number of the black students selected, they were anybody that we could find within the school setting was included in the study. When we actually looked at their thinking, the thinking that was done was equivalent, you know, you couldn't find differences in the way they approached problems or tried to approach problems, where their difficulties were and where their strengths were, but part of the reason for that was the selection process of how they got into algebra. So the studies that were conducted over the next series of years from the Hawaii Algebra Project were ones in which the setting where each day students -- in Hawaii at the university there's a laboratory school that must match the state's population in ethnic background, sociological background, and IQ. And the studies that were conducted there were ones of each day interviewing students to find out, as they were taking algebra, what they understood and redesigning the materials around some constructs that are, actually, described in some papers I left at the front door for you.

You want some more data than that, and the more data that I have, Tom, is actually done by school districts, not by the program. The program was designed as a professional development program for teachers so that there would be a curriculum that matched what was done. It's never sold commercially. It is still available at the University of Hawaii and currently it's being used by technical schools in Singapore for the technical -- for students in Singapore. The --

DR. LOVELESS: If I could just interrupt you.

SID RACHLIN: Yeah.

DR. LOVELESS: So if I understand you correctly so far, the one evaluation that was conducted basically found no effect, but you question the design of that evaluation?

SID RACHLIN: No, that was done not on our materials. That was done using any curriculum -- we were trying to get baseline of what people understand.

DR. LOVELESS: Has there been an evaluation of your program?

SID RACHLIN: There has been. The evaluations of our program, again, were all interview based. We had one study that was done -- it's done by districts. In Colorado -- there was a study done in

Colorado where they gave us a book room where we could hook up cameras -- a camera from the ceiling and a camera face on. They decided that all students in 8th grade should be learning algebra. We were brought in to prepare the teachers for that. They included special ed teachers and included the substitute, so that everybody had the same professional development before the year started. But for the students, they walked into that class not knowing they were going to be coming into an algebra class, because last year they just had whatever 7th grade math was.

At the end of that, there was a study done with the Orleans Hannah Test and they decided that they would treat this as a pre-algebra course for kids who were unable -- when it showed up on the Orleans Hannah that you were ready algebra, they would use the test that was given by the high school to all students to decide if they could go into geometry and that was the test that discerned whether or not the students were learning algebra. And if someone didn't pass Orleans Hannah, they would provide them pre-algebra. The data from that's described in that piece.

And then the other study that is -- that was done by the Charlotte-Mecklenburg School District is one that I haven't been able to get in writing. All that I have been able to get is when they're speaking -- to speak about the study, because they keep their data very close to home. And that study was a study of a comparison in classes, so it's a larger scale study. It was done, and one would show for them that at the end of the program, the 9th grade black male student and the 9th grade white male student were within three to five percentage points on the end of grade test in the Hawaii Algebra classes. In the other classes the differences between that population was about 25 or 30 percent. So that, for them, was significant, but it was -- this -- the program was designed in a heterogeneous setting. Sometimes when it's being used, it's being brought in and used in settings where people have already been failing algebra. So those -- I don't have studies for how success is in those types of conditions. It has really been a heterogeneous condition.

DR. FAULKNER: Thank you very much, Mr. Rachlin. I appreciate that.

JENNIFER GRABAN: Number 26.

JOHANNA MAYNOR: My name is Johanna Maynor. I'm an American Indian of the Lumbee Tribe from Robeson County, North Carolina. However, I teach and work in Durham, North Carolina at this point.

I have a BS in Mathematics and a Master's Degree in Curriculum Instruction. I've been fortunate enough to teach mathematics to students and teachers in different parts of the country, most of which were minority areas.

Being a minority, myself, the achievement gap is of great concern to me. Out of this growing concern, I have spent the past five years studying how students learn mathematics and implementing two different mathematics curriculum. The first of which is the traditional curriculum, which has been, and is being used, in classrooms across America today as has been in the past. The second is a standards based curricula, which was developed based on the national standards as outlined by NCTM and it focuses on the understanding and applying of mathematics rather than memorizing it.

Let's face it, the way mathematics is being taught in this nation has served a few of us well, but all students do not learn the same way. Those of us in this room have been some of the lucky ones. We were great memorizers and hopefully most of us developed some sort of conceptual understanding or made connections with the mathematics we were learning. However, think about those who were less fortunate than us. They were not good memorizers and therefore failed miserably.

Math is still being taught this way in

classrooms all over the nation, which is one of the many reasons we don't and won't measure up mathematically as a nation. Our people can't compete. If it didn't work then, what makes us as a nation think that teaching traditional mathematics is going to work now. We have to change how we teach mathematics in order to reach everyone, not just a select few.

The school where I teach in Durham has implemented both curricula for eight years, which presented the opportunity for me to gather the necessary data and prepare the achievement of students from both curricula. What I found was that in the year 2000-2001, 153 minority students enrolled were enrolled in courses beyond Algebra II. In this current year our minority enrollment had rose to 234 students. Now this is upper level mathematics courses, courses above Algebra II, which was a 53 percent increase since the onset of the standards based curriculum.

Not only has minority enrollment increased, but total enrollment has as well. Three hundred and ninety-one students over all took upper level math courses in the year 2000-2001. This year the enrollment was 631 students at my high school, 61 percent increase.

When Algebra I EOC scores were compared, traditionally -- speaking with the traditional students -- 39 percent of those students scored three's and four's, but 19 percent only scored one's. Now let's look at the tradition -- the standards based curricula when the algebra I EOC scores were looked at there, 76.6 percent of those students scored three's and four's and only .98 percent -- before any student completed the four-year cycle of the standards based curricula, 74 percent of the students taking the AP exam -- and I'm talking calculus -- received college credit. Since the onset of this curriculum, not only has the enrollment increased -- overall minority and anyone else, but at this point we have 91.5 percent of those students receiving college credit.

The quality of mathematics education in America is of great concern. I realize, as stated yesterday, that the way mathematics is being taught is only one variable in mathematics education, but a very big one. I also realize that the work I have done is specific to one school, which is predominately minority. However, also as stated yesterday, if we find something that levels the playing field on a small scale, shouldn't that be compelling enough for mathematics educators to really examine how and what mathematics is being taught all over our nation? What if we taught reading the way we teach mathematics? By the time we're in 7th grade, we would probably be able to talk about the words and, or, the, of, is. Possibly writing sentences in high school, maybe paragraphs in college.

DR. FAULKNER: You need to wrap up here.

JOHANNA MAYNOR: Is it any wonder why we are not competing as a nation mathematically? Thank you for your time.

DR. FAULKNER: Wait a few minutes.

JOHANNA MAYNOR: I'm so nervous.

DR. FAULKNER: Diane.

MS. JONES: I have a question. I was just wondering if you could tell us which curricula were you using in the traditional setting and which curricula in the standards based?

JOHANNA MAYNOR: The traditional curricula I consider is Algebra I, Algebra II, Geometry, Pre-Calculus and, of course, Calculus, in which has been the rigor for the nation as long as I can remember, which is probably a pretty long time. The traditional curricula, there are five -- I mean, the standards based curricula, there are five and all of -- there were five and I know that three of them have really, really, really had some staying power. However, the work is not -- we are getting the word out to the nation what this mathematics is doing. There are three -- I can tell you that the one I use is Core-Plus Mathematics.

MS. JONES: I'm sorry, what?

JOHANNA MAYNOR: Core-Plus Mathematics. It was written on the campus of Western Michigan University and it was funded by the National Science Foundation.

MS. JONES: I guess we're just -- and so for the comparison group, I think it's important information, so can you tell me the names of the other four -- standard basing -- can you tell me the name of the traditional that you were using as a comparison in curriculum?

JOHANNA MAYNOR: Okay. There are so many authors of traditional curricula. I can tell you that Prentice Hall is the book -- the traditional curricula that was adopted for North Carolina. And let's see, Sims is another standards based curricula. Core-Plus Mathematics is one. I wish I had my -- all that literature in front of me. I am not as familiar with the other standards based curricula as I am with the one that I have been implementing. However, I am a member of a national group called Compass that is a network that supports implementation and the development of the other three.

DR. FAULKNER: What's the name of your school?

JOHANNA MAYNOR: I teach at Jordan High School.

DR. FAULKNER: Jordan?

JOHANNA MAYNOR: Jordan High School in Durham, North Carolina.

DR. FAULKNER: Other questions here?

DR. REYNA: Larry.

DR. FAULKNER: Yeah, Valerie.

DR. REYNA: This is probably too detailed a question to answer here, in fact, it is too detailed a question to answer here, but we are accepting, as we mentioned to everyone -- information submitted to us afterwards. So I would encourage you to give us some details. And the kind of details that would be particularly useful -- to follow up Diane's question -- would be the following types of questions -- and we can repeat these, again, to you at some other point so you can write them down and all that.

How many students are we talking about? How were they selected, from what pool? How were they assigned to these different kinds of experiences? What's the measure about in a bit more detail? And then, of course, Diane's question, which is, you know, exactly what was compared?

Those kinds of basic questions will give us a big leg up on -- on being able to understand the implications of your results. They're probably too detailed to go into right now. You can send them to us via e-mail.

JOANNA MAYNOR: Okay. Thank you so much for your time.

DR. FAULKNER: Thank you, Ms. Maynor.

JENNIFER GRABAN: Speaker Number 27. She's the last one.

NANA ANOA NANTAMBU: My name is Nana Anoa Nantambu, -A-N-T-A-M-B-U. I have been listening to the descriptions as people coming forward to say who they are and what they're doing. I'm in Durham since December of last year because I'm displaced from New Orleans since Hurricane Katrina, and I'm very grateful to be here. The other thing I would like to kind of just give a little background, because my -- what I have to say is probably two minutes. I take this as an opportunity to just share what I'm sharing, because I was unaware up until Sunday that this was going on. And the person who invited me to come knew of my history of work in mathematics and asked could I come on her behalf. And then sitting here yesterday, I was moved to share this simple piece I'm to share.

I feel emotional, because I so identify

with the young woman who was before me. I can remember when my passion for making a difference was like that and probably in my older age, for whatever I look like, I've been on the planet 57 years, I can see that I have mellowed.

Anyway, I would like to thank the panel -- each of you -- for accepting the responsibility described in the Executive Order. As my mother would say, you've got your work cut out for you, and I lift you in prayer.

After several years of teaching developmental mathematics courses and a year of doing the undergraduate and graduate level teacher preparation courses in mathematics, I chose to leave the university and embark on an alternative approach to improving mathematics education.

On January 25, 1992, the Neighborhood Math Place, Incorporated -- NMP -- was born. It was primarily a response to the call to foster more positive results in the mathematics education of African American children. Yet for me personally it also represented an effort of self-determination in meeting the needs of the African American community.

From 1992 to 1996 the Neighborhood Math Place Center provided opportunities for mathematics learning and teaching for students and teachers alike.

In summary, services included five days of access to help to increase user's mathematics knowledge, skills and understanding, workshops to demystify math and foster a more positive attitude about user's ability to learn and do mathematics, ACT college entrance exam preparation workshops, activities to raise community awareness about the need for mathematics education reform and working with other organizations and individuals in the community to improve the lives of our children, families, community, and world.

The services of the Neighborhood Math Place touched more than 3,000 students and teachers over the four and a half years of operation, of which approximately 400 received repeat services.

Though the Neighborhood Math Place received funds through it's nominal fee for services, through local grants, and fund-raising drives, it did not grow financially in it's capacity as a business, which provided service in the teaching and learning of mathematics. The insufficient growth of the Neighborhood Math Place was probably due to a combination of factors. Yet the three most likely were the lack of outside funding, the absence of a business plan for the Neighborhood Math Place's development and my resistance as a director and primary teacher to charge service fees congruent with the market rate.

There are likely other community-based programs like the Neighborhood Math Place, Incorporated operating in the country and producing very successful results in student learning of mathematics, particularly for African American children. Like the Neighborhood Math Place during its time, these programs are not linked with the university, local, or state initiative that could potentially help them to produce the scientific evidence to assess their efforts. Such valuable information is lost that might distinguish the conditions of effort evidence that Mr. Boykin referred to yesterday, or clarify the interpretation based on human frailty that was expressed by Mr. Gersten.

The work of the panel will, ultimately, produce the information that directs funding streams and to the degree that the information on the work of successful alternative programming is missing, such programs continue to be among the neglected efforts that improve mathematics education.

DR. FAULKNER: Need to wrap up.

NANA ANOA NANTAMBU: Yes. One means by which this panel might produce something different is -- I don't remember her name -- said, one means is to recommend that there be an intentional effort made to identify successful community based programs that operate below the radar. And I further suggest that the panel recommend that such programs be financially supported to enhance the quality of their programming and to produce the scientific evidence that might encourage replication of their success. Thank you.

DR. FAULKNER: Thank you very much, Ms. Nantambu. Is that correct?

NANA ANOA NANTAMBU: Yes.

DR. FAULKNER: Questions or comments? Wade.

DR. BOYKIN: Would you say a little bit more about the activities that your program engaged in to demystify math for -- for the students.

NANA ANOA NANTAMBU: Well, one of the first things that was done, when the child came into the program, I asked questions about what did they think was their ability to do math. How good did they think they were in math? And in most cases, students didn't feel good about their ability to do math, and so a process was developed where they had an opportunity to look at where their thinking started from that they didn't have the ability to do math. That thinking was driving what they were actually doing. If we restarted and just gave them an opportunity to see another way of being in relation to mathematics, that that would change their thinking about it. So that was one of the pieces and another piece was just trying to give activities that allowed them to see a real world linkage to whatever was being asked.

I appreciated what the gentleman said, that wasn't easy work because I didn't learn like that, so I had to work real hard to help make those real world connections.

DR. BOYKIN: Thank you.

DR. FAULKNER: Diane.

MS. JONES: I don't know if this would be helpful, but there is -- there is one program in the federal government. It's not specific to math education, but they're working on developing evaluation methodologies that community based programs can employ with low cost but effective evaluation methodologies. To address one of your concerns, which is how programs get the funding, it's the Helping America's Youth program, which is an initiative of Mrs. Bush. Now they may have actually hired -- or contracted with a professional evaluation firm to help all of these community based projects develop evaluation methods that are low cost and appropriate to the kind of work being done. I don't have the web address, but if you go to whitehouse.gov and type in

Helping America's Youth, I think it will take you to the site and there could be at least some models that could be used to evaluate community based programs. And certainly we are taking notes of your comments that we need to support those programs.

NANA ANOA NATAMBU: Thank you.

DR. FAULKNER: Other questions or comments.

NANA ANOA NANTAMBU: Thank you.

DR. FAULKNER: Vern.

MR. WILLIAMS: Well, just a comment. You still have a lot of passion.

NANA ANOA NANTAMBU: Thank you.

DR. FAULKNER: I think that's true. We have seen quite a bit of useful testimony today. And I want to thank this group at large on behalf of the panel for sticking it out. This has proceeded -- sorry I have had to cut people off, but we've managed to get everyone in with four minutes to spare. Thank you all for being here. The panel, I think, has benefited from comments that have been made.

(The open session adjourned at 3:56 p.m.)