NATIONAL MATHEMATICS ADVISORY PANEL
STRENGTHENING MATH EDUCATION THROUGH RESEARCH

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MEETING

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Wednesday,
June 6, 2007

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Miami Dade College, Wolfson Campus
Building 3, Chapman Conference Center, Room 3210
300 N.E. 2nd Avenue, Miami, Florida 33132-2296

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8:50 a.m.

PANEL MEMBERS:
DR. LARRY FAULKNER, CHAIR
DR. CAMILLA PERSSON BENBOW, VICE CHAIR
DR. DEBORAH LOEWENBERG BALL
DR. A. WADE BOYKIN
DR. DOUG CLEMENTS
DR. SUSAN EMBRETSON (NOT PRESENT)
DR. FRANCIS (SKIP) FENNELL
DR. BERT FRISTEDT
DR. DAVID C. GEARY (NOT PRESENT)
DR. RUSSELL M. GERSTEN
MS. NANCY ICHINAGA (NOT PRESENT)
DR. TOM LOVELESS
DR. LIPING MA (NOT PRESENT)
DR. VALERIE F. REYNA (NOT PRESENT)
DR. WILFRIED SCHMID
DR. ROBERT S. SIEGLER
DR. JAMES SIMONS (NOT PRESENT)
DR. SANDRA STOTSKY
MR. VERN WILLIAMS
DR. HUNG-HSI WU

EX OFFICIO MEMBERS:
DR. IRMA ARISPE
DR. DAN BERCH
DR. JOAN FERRINI-MUNDY
MR. RAY SIMON
DR. GROVER J. (RUSS) WHITEHURST (NOT PRESENT)

STAFF:
MS. TYRRELL FLAWN, EXECUTIVE DIRECTOR
MS. IDA EBLINGER KELLEY
MS. MARIAN BANFIELD
MS. JENNIFER GRABAN
MR. KENNETH THOMSON
MR. ROBERT GOMEZ

I N D E X

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

CHAIRMAN FAULKNER: Good morning. I'm Larry Faulkner. I'm Chair of the National Math Panel and I want to welcome the audience to this session.

This is the open session of the seventh National Mathematics Advisory Panel meeting. The Panel was created by Executive Order of the President in the middle part of 2006, and we have been working away for a little over a year on the issue of how to better prepare American children for entry into and success in algebra. There is a set of issues that are laid out in the President's Executive Order that relate to that focus and a little beyond that. We are working on those issues.

Most of the work that we're carrying out is being done in committees, Task Groups, and is not in public, but the business of the Panel and final decisions are done in public session. At all of our meetings that are held around the country, we have carried out a public session, at least one, where we've taken public testimony on an open basis, which we will be doing here this morning, and also on a topical basis, in which we've invited particular speakers to talk about particular topics.

The Panel has put a great deal of effort into its work so far. It's charged by the President with delivering a report by the end of February 2008, and we're on a timetable to get that done. We still have several meetings ahead of us.

We have held the meetings around the country in locations that we mean to associate with high educational aspiration and attainment, and we're delighted to be at Miami Dade College, which holds a very high standing among the community colleges of this nation. It's a privilege for us to be here. It is also my pleasure to acknowledge the nice hospitality that Dr. Padron and his colleagues have granted us here at Miami-Dade.

We have signers available. You can see one working here. That service can be made available for this entire meeting, but we won't continue it unless there is a need for it. I'd like to ask if there is need for signing services?

(No response.)

CHAIRMAN FAULKNER: If not, then we will discontinue the services, and if the need develops during the course of the morning, we can restart signing services. Thank you.

Now, let me turn to our host. It's my pleasure to introduce Dr. Eduardo Padron, President of Miami Dade College (MDC). Dr. Padron serves as the chief administrative and academic officer responsible for the affairs of six campuses and several outreach centers, enrolling 165,000 students.

Dr. Padron came to this country at the age of fifteen, speaking little English and having limited prospects, but he transformed his life through dedication to learning. Education gave him the keys and he has made tremendous use of the opportunity that came that way.

Dr. Padron began his college studies here at Miami Dade College, he told me last night, when it was new and received his Ph.D. in Economics from the University of Florida. He returned to teach at the newly opened Wolfson Campus of Miami Dade and has spent more than thirty years championing higher education opportunity.

He also indicated to me last night that he had been President of this campus for fifteen years and President of the college for twelve. Twenty-seven years at the helm of an institution is a remarkable achievement.

Under Dr. Padron's leadership, MDC welcomes the largest enrollment of Hispanic students and second largest enrollment of black non-Hispanic students in the United States. He received the 2002 Chief Executive of the Year Award from the Association of Community College Trustees. He served on the

Greater Expectations National Panel that re-examined Baccalaureate education sponsored by the Association of American Colleges and Universities.

He served on the White House Initiative of Educational Excellence for Hispanic Americans, the Board of Directors to the College Board, also the American Association of Colleges and Universities, the American Council on Education, and the Carnegie Foundation For The Advancement of Teaching.

He is a founding member, former Chairman and now Governing Board member of the Hispanic Association of Colleges and Universities, a member of the Board of Directors of the U.S. Congressional Hispanic Caucus Institute, the Executive Advisory Board of the Harvard Journal of Hispanic Policy, and is a Board Chairman of the League for Innovation in the Community College; an active gentleman.

Dr. Padron has spearheaded the development of over 60 new degree and short-term programs in response to economic and workforce needs. He's unfaltering in his commitment to education as the key to realizing both individual and community potential.

Dr. Eduardo Padron, welcome.

(Applause.)

DR. PADRON: Thank you, Mr. Chairman, for those wonderful comments. Very much appreciate it.

And welcome to all of you and good morning. I hope you had a good rest last night.

We were very happy to have the opportunity to host you at the Freedom Tower. You know, Miami's a very new city and that's our most historic building, dating back to 1927. It's a precious historic building for us and has recently been donated to the college. So we have great plans for that building.

We are very, very flattered that this group has chosen our city to have your deliberations. Institutions in this area take this matter very, very seriously. And I can tell you that at Miami Dade we have known now for quite some time that mathematics is the most critical obstacle in the path to success of our students. And as I said yesterday, our faculty did not wait for them to be asked to do something. They came to me a few years back and said, "We need to do something about that," and they've been doing something. And thanks to your generosity today, they will have the opportunity to tell you what they've been doing.

We have a program, we call it the Quality Enhancement Program, which deals with issues related to the same that you are studying and deliberating on. And I feel that the faculty have come up to the table and are really making a significant difference in the way that we deal with these issues. We, as you know, especially serve a lot of minority students, low-income students. As a matter of fact, 58 percent of the students at this institution are low-income students. We're the largest recipient of Pell Grants in the nation, and about 38 percent of our students live beneath poverty.

You know the issues related to that and the lack of preparation that many of our students bring with them. About 80 percent of the entering students of this institution show deficiency in basic skills in at least one area.

So the challenge that we face every day in serving our students and helping them be successful is enormous. So when the President of the United States gives attention to this matter and brings a group of very distinguished scholars and others to the table to bring about solutions and find ways in which we can improve the way that we teach our students and the way that we deal with the learning process, it is very, very important. And this sanctuary requires that we do something and do it very, very quick, because our position as a nation depends very much on the work that you do and the work that we do to improve the performance of our students in mathematics.

So we are very, very appreciative of the work you do. We know that it takes time. It's a sacrifice for many of you. But it's something that is going to do a great deal for the nation, and we look forward to your deliberations as well as your conclusions, because that's going to help us be able to set and refine our agenda for the future.

So thank you, again. I want to present a token of appreciation on behalf of the institution to your Chairman who I have admired for many, many years, and have the pleasure now to personally greet him and welcome him to Miami.

(Applause.)

CHAIRMAN FAULKNER: Thank you, Mr. President, for the warm welcome and thanks to you and your colleagues for hosting us here. We admire the impact of your leadership and we admire what is happening here at Miami Dade College under your leadership.

We will now proceed with the session. We are now proceeding into the part of the meeting where we will receive testimony on an open basis. The people who will be testifying signed up in advance for this time. Our practice around the country has been to allow five minutes for commentary, and we will begin with Patrick Bibby who is the math department Chair here at Miami Dade College, and I'm not sure which part of Miami Dade College, but anyway, perhaps Mr. Bibby can explain that.

Patrick Bibby, please come forward, take a place here, turn on a microphone and let's proceed.

PATRICK BIBBY: Actually, I'm a mathematics professor at Miami-Dade's Kendall campus, and I'm not a department Chair.

My name is Patrick Bibby and I have been a mathematics educator for 44 years and spent the last 33 of those years at Miami Dade College. Three years ago Miami Dade successfully completed the process of re-accreditation by the Southern Association of Colleges and Schools. The Southern Association now requires its member institutions to submit a quality enhancement plan, or QEP, in order to be re-accredited, and the QEP must be a plan to enhance student learning. Miami Dade College took the bold step of choosing mathematics as its QEP topic.

In its two-year program, Miami Dade offers a wide range of mathematics courses from basic arithmetic and basic algebra through such courses as multi-variable calculus, differential equations and linear algebra. 64 percent of our entering students test into what we in Florida call college prep level math, for which students earn no college credits. 21 percent test into intermediate algebra, for which students earn three credits but these credits do not count towards graduation.

So only 15 percent of our entering students are able to start with a college level mathematics course. Our own data show us that the college prep math courses, intermediate algebra and college algebra are serious obstacles to graduation and program completion. For this reason our QEP focuses on these courses.

The strategies of our QEP involve initiatives in curriculum, instruction, assessment, advisement and support. These strategies include the following: One, frequent assessment, about which coincidentally, there is an article in the current issue of the Chronicle of Higher Education. Two, establishing a mathematics testing center on each campus to allow instructors to test their students outside of class. Three, e-mailing interim progress reports. Four, providing students with learning prescriptions that refer them to our support labs with directions to get help with specific topics. Five, creating advisement procedures that will hopefully convince students to take their first math course during their first semester and subsequent math courses in consecutive semesters. Six, providing supplemental instruction for college prep repeaters to help them with their study skills as well as course content. Seven, incorporating mathematics into other disciplines. Eight, upgrading our math support labs. And nine, establishing a training program for our math lab tutors.

As part of the QEP development process, we conducted an extensive review of literature and best practices that demonstrated that these strategies either enhanced student learning or improved student attitudes toward the learning of mathematics. We were in fact able to conduct our own in-house experiment, which demonstrated the positive effect of frequent testing.

Miami Dade has offered its math students support outside of class and beyond faculty office hours for the past 25 years. Our mathematic support labs offer one-on-one and small group tutoring, drill and practice software, DVD's, videotapes and plenty of practice problems. These support labs are open days, evenings and weekends. Math lab directors are salaried employees and the tutors are paid hourly.

Our new tutor-training program was recently certified by the College Learning and Reading Association. All of our tutors now receive seven hours of training in order to become more effective.

It seems to me that only the K through 12 students whose parents have substantial financial resources are presently able to get academic support, such as tutoring, that would benefit so many. Billions of dollars are spent each year by parents for private tutoring and for these profit-making learning centers that are so heavily advertised on daytime T.V., but only by parents who can afford it.

It would be a huge step forward in my opinion if on-site math support labs, as well as labs that might support reading and writing, could be made available at the K through 12 level, or at least at the 6 through 12 level. It is important that students who are struggling to keep up be offered this type of intervention. Without it they are more likely to fail, more likely to drop out of school, more likely to make bad choices, and more likely to become societal problems.

I thank you for your time.

CHAIRMAN FAULKNER: Thank you very much, Professor Bibby. Are there questions or comments from the Panel? Bert, please turn on your microphone and identify yourself. I've been asked by the transcriber for us all to identify ourselves at the beginning. So Bert, please.

DR. FRISTEDT: My name is Bert Fristedt. I'm on the Math Panel and I'm on the math faculty at the University of Minnesota.

I wanted to ask, how do you encourage the other courses to incorporate mathematics into their courses? Thank you.

PATRICK BIBBY: Mainly we do this through a process of linking courses. Now there is a limit to how much of this can be done. But we are actually part of a grant called Mathematics Across the Community College Curriculum. The process for incorporating mathematics into other courses is to have a math instructor team up with an instructor in another discipline and somehow link their courses. And it could range anywhere from a full-fledged learning community or maybe just a lesson or two.

CHAIRMAN FAULKNER: Skip?

DR. FENNELL: My name is Skip Fennell. I'm a member of the National Math Panel, and I teach at McDaniel College in Maryland, and I'm currently President of the National Council of Teachers of Mathematics (NCTM).

And my question for you is, relative to the large numbers of students who are enrolling in non-credit mathematics, are there particular areas of weakness, of deficiencies, that immediately rise to the top in terms of stuff that you wish they had when they came to you?

PATRICK BIBBY: I think to be well prepared for basic algebra, students need to be able to add, subtract, multiply and divide positive rational numbers.

MR. FENNELL: Thank you.

CHAIRMAN FAULKNER: Tom?

DR. LOVELESS: My name is Tom Loveless. I work at the Brookings Institution in Washington and am a member of the National Math Panel.

My question has to do with the high schools that feed you students. Have you had any contact with them to express your concern about the preparation of the students who come to you?

PATRICK BIBBY: As a faculty member I have not, but I know that our Chair is part of what's called a Bridges Program, which is establishing communication lines between Miami Dade and the Dade County public schools.

CHAIRMAN FAULKNER: Vern?

MR. WILLIAMS: Vern Williams, Panel member and middle school math teacher outside of Washington, D.C., Fairfax County. You mentioned outside testing centers.

PATRICK BIBBY: Yes.

MR. WILLIAMS: And I would like to know if it’s staffed by assessment specialists and what are the advantages?

PATRICK BIBBY: It’s staffed by a proctor. We haven't set it up yet. We are in the process of doing it. We are in the middle of our implementation of our QEP. Some of the things we have achieved, and others still need to be done.

But the plan is to staff it with proctors and to have students report there to take tests, either on the local network or paper and pencil. But they are going to be allowed to take their test outside of class where an instructor can do frequent assessment and not use an inordinate amount of class time to do that.

CHAIRMAN FAULKNER: Others?

(No response.)

CHAIRMAN FAULKNER: Thank you, Professor Bibby.

PATRICK BIBBY: Thank you.

CHAIRMAN FAULKNER: The panel may be following the roster of testifiers that's in Section 6 of the book. We have a couple of cancellations; number two, Superintendent Crew, and number three, Alberto Carvahlo have canceled. We're going to Steve Blumsack of Florida State University, Emeritus Professor of Mathematics. Professor Blumsack.

STEVEN BLUMSACK: Good morning. My name is

Steven Blumsack, Emeritus Professor of mathematics at Florida State University (FSU). I'm here to represent the new Florida Center for Research and Science Technology, Engineering and Mathematics of Florida State University.

The purpose of my attendance at this meeting is two-fold. First, to describe the nature and the priorities of the center to the panel, and secondly, to understand the priorities and progress reports of the panel to assist our center in establishing its long-term priorities.

For background, the center was formed in February, `07, just a few months ago, as a result of a solicitation from the Florida Department of Education (DOE). The center acts in some sense as an academic arm of the Florida DOE. Its existence is evidence of a strong interest and commitment of the State of Florida for extended education. It is a collaborative enterprise with participation from FSU's Colleges of Arts and Sciences, Education and the Learning Systems Institute. Its long-term plan will be established later this month by an International Advisory Board, including your very own Dr. Benbow.

There are currently four priorities for the center research. There are four projects that directly relate to mathematics. One project is to compare the effectiveness of three elementary school mathematics curricula in one of the districts in the State of Florida. Another is to evaluate the Texas Instruments Model Districts Program, an intervention to close the achievement gap in grades 6 through 12. A third project is to use an expert performance approach to relate teachers' knowledge to students' success in AP courses. And finally, the fourth project is to collect information regarding the current use of technology in middle and high schools in the State of Florida.

As I indicated, the center is very new. It started just a few months ago and its plan will be developed later this month. That's very convenient, considering that we have just been participating in this discussion.

Another priority is teacher preparation and retention. The center plans to adapt the U-Teach model of Texas to recruit math majors into teaching, as well as science teachers into science teaching. This approach is supported by the nationwide success of National Science Foundation's Scholarship Program, with which I'm very proud to have participated in the last several years.

A third priority is to assist the Florida Department of Education. It's important to note that

Florida is currently revising its K through 12 mathematics standards. These are modeled after the Focal Points of the National Council of Teachers of Mathematics.

Some specific activities that do assist Florida Department of Education are the following: We plan to rate these new standards, these new mathematic standards, using Webb's depth of knowledge categories. Secondly, we plan to develop an interactive standards database to align math courses with these new standards. It's one thing to have standards; it's another thing to actually implement them in the curriculum. We plan to review progress-monitoring instruments for the assessment of student learning and associated with that, to develop specifications for a progress monitoring reporting network to track student progress. We also plan to measure the effectiveness of various instructional strategies. Finally, we plan to develop a plan with the Florida Department of Education to increase the success of minorities and females in the STEM disciplines.

The fourth priority involves dissemination. Since we have just started, the amount of dissemination is rather meager at the point, but we have established a website and plan to conduct regional symposia for both teachers and administrators and to host conferences in the future.

I wish to thank all of you for this opportunity and for your attention this morning. We look forward to developing a symbiotic and collaborative relationship with the Panel to serve the students in Florida and nationwide. Thank you very much.

CHAIRMAN FAULKNER: Thank you, Professor Blumsack.

Questions or comments? Tom Loveless.

DR. LOVELESS: Tom Loveless, National Math Panel.

You mentioned, and perhaps this question I'm going to ask is premature. Please tell me if it is. You mentioned that you're going to do a study of three elementary textbooks, I believe?

STEVEN BLUMSACK: Curricula.

DR. LOVELESS: Curricula. Can you name them? Do you know what they are?

STEVEN BLUMSACK: No, I can't. We've identified a school district, but I don't know what the names of the curricula are right now.

DR. LOVELESS: Okay, thanks.

STEVEN BLUMSACK: You’re welcome.

CHAIRMAN FAULKNER: Wade?

DR. BOYKIN: Wade Boykin, Math Panel

member, Professor, Howard University in Washington, D.C.

You mentioned that one of the initiatives is aiming at closing the achievement gap. Can you tell us a little bit more about that initiative, please?

STEVEN BLUMSACK: To be more specific what the achievement gap is, it's by gender, ethnicity, income, the various achievement gaps that we see in Florida among different groups of students. Did I understand your question right?

DR. BOYKIN: My question is, you said you have an initiative to address closing the achievement gap. Could you just speak to what that initiative is?

STEVEN BLUMSACK: Right now we are just starting some conversations with the Department of Education in how to do that. So there really isn't anything specific to deal with right now. But that is certainly one of the objectives that we have during this first year.

CHAIRMAN FAULKNER: Bert?

DR. FRISTEDT: My name is Bert Fristedt. I'm a panel member.

I wanted to ask, since Florida's revising its standards now, does someone plan to put on the web page a series of sample problems designed to illustrate what is really meant by the standards?

STEVEN BLUMSACK: Yes, the current status of the standards is they have gone through a public discussion. I think that was closed as of March. Right now they're using the public discussion to refine what the standards are. And in the version of standards that existed for the public discussion, there were very specific examples in the standards.

The standards consisted of I guess three focal points per grade level, a little different than we had before. We used to have the standards were like middle school standards. Now they are per grade level. Now for each of the standards there are examples right next to them as to specific questions that do address those standards.

CHAIRMAN FAULKNER: Skip Fennell?

DR. FENNELL: Skip Fennell, Panel member and NCTM President.

I'm very well aware of what you've done with the Focal Points. I actually want to respond to Bert's question, because I think what he may be referring to is perhaps revised Florida Comprehensive Assessment Test (FCAT) items reflective of new standards, and I don't know whether you're in a position to talk about that yet.

STEVEN BLUMSACK: That is something I've

been looking at for the last month in Tallahassee. During the next three years, the FCAT, that's the statewide examination in mathematics, is going to be modified to align with the new standards. That is going to be a gradual process over the first three years.

I've talked with many people. It is not clear how this transition is going to work. We're going to have new standards, old courses and an old exam. Hopefully we're going to have some new courses and some modification of the exam. I actually have done a study of how the old exam, item by item, question by question, a sample test I've been able to get a hold of, how that aligns with the new standards. It is not so bad, but there needs to be a lot of work and people in Tallahassee are currently working on that, perhaps as we speak.

CHAIRMAN FAULKNER: Any other comments, questions?

(No response.)

CHAIRMAN FAULKNER: Thank you very much, Professor Blumsack.

STEVEN BLUMSACK: Thank you all.

CHAIRMAN FAULKNER: We now turn to Alcides Marin, a student from Miami Dade North Campus.

ALCIDES MARIN: Good morning. When I was

asked to volunteer to come, I wasn't sure what I was going to say. But I listened to everything that's been spoken this morning. I couldn't help think about the fact that math is that subject that got in the way of a lot of people wanting to accomplish a career. And I was thinking back when I graduated in 1989, at Cuban high school, I was just glad that math was over. I didn't want to know anything about it any more.

So I went to technical school, I became a welder, and that was the end of my studies. I didn't want to go back to school, probably because of math. So when I moved to South Florida, I came to Miami Dade North Campus initially for English. I wanted to learn English because it was important for my job, the job I was doing. That's the only thing I wanted out of it. So I finished all my ESL classes, and that was the end of it.

But I was encouraged by my English teacher to take a college placement test, and even though I wasn't very interested, I took it anyways. And when I got my results I scored really well for English. I was really happy about that. But in math it was really poor. My score was really low. And then I started wondering, if this institution that has done so well for me in English could do the same thing for me in math. And thinking back now, I don't think I could have made a better decision back then, cause when I enrolled and I started taking my math classes, I started all the way in the bottom, as one of my teachers refers to baby algebra. But it wasn't so baby for me. It was really hard.

As I went forward in this institution with the math department, I enjoyed all the facilities, the labs, the tutors and one-on-one, and even when it was still hard, it gives me hope or a light at the end of the tunnel that, you know, I can do this, a lot of hope.

And one of the other things I want to mention is the professors in the math department. All the professors that I had before have an open door for me, every time I have a problem or whatever. It doesn't matter what teacher it was, 2:20 or 11:05, they are always willing to help me and always encouraged me to come over if I have a kind of problem.

I'm happy to say now that I'm in calculus, which is pretty amazing for me because I was never good in math. But I think I've done, the best I could have with the help of the teachers and the school.

I think that the most important thing in a classroom is the ability of a teacher to be able to inspire you. And I think I've been inspired. I've been inspired to think in math beyond the numbers, more like into the grade and subject, the math and science, and how many doors it opens for you.

I’ve been studying for two years now, going on three years. I got better position at my job and I guess that management saw that ability I was getting, skills with math, so I'm into management. I'm really happy about that also.

So it's been paying back. That's what I wanted to say. And I really wanted to thank all the professors at Miami Dade and I'm really glad that you are doing this to bring more people and try to break this barrier for a lot of people who are trying to get where they want. And hopefully, in one and a half years or two, I can become a civil engineer, which is my goal. I always wanted to do things with construction, but math was there, you know, being that block that I couldn't break to get there. So I want to thank Miami Dade and thank you for your attention.

CHAIRMAN FAULKNER: Thank you, Mr. Marin. Math is important to civil engineering.

ALCIDES MARIN: It’s very important. I found out the problem when I got over there. I’m probably going to be a mathematician, because so much math I'm taking. It's everything involved.

CHAIRMAN FAULKNER: Are there questions or comments from the panel?

Dr. Arispe?

DR. ARISPE: I'm Irma Arispe with the National Math Panel.

First of all, I'd like to congratulate you twice, because you have both the hurdle of the language and the challenge of the math. And so I think though you give a lot of congratulations to the professors, you should congratulate yourself as well.

ALCIDES MARIN: Thank you.

DR. ARISPE: And second, I would like to ask how you would, as someone who has overcome the initial hurdle of math and being Hispanic, encourage other students to connect with teachers who would inspire them?

ALCIDES MARIN: Well, one of the things that teachers appreciate is when you put an effort. Every time you put an effort, even if you're not doing well, I notice in Miami Dade that when you put an effort you are recognized and you're told, "Don't give up. Keep on trying. Do it again."

And then that hard work, even though you might not be doing so well, is encouraged and that itself gives you strength to keep on trying. So I think that's important, that if you come to a classroom, do your best, do your homework, even if you forget it at the time of the test. Keep on trying and you'll be rewarded by teachers. They recognize that. They see that in you. They know when you're working hard; they know when you're not.

CHAIRMAN FAULKNER: Other questions or comments from the panel?

Vern?

MR. WILLIAMS: Vern Williams, Math Panel member.

I'd like to tell you that you said that your teachers inspire you; you inspire teachers like me. I want to thank you for being here today. I've been teaching 34 years and it's students like you who will keep me teaching hopefully another few more years.

ALCIDES MARIN: Thank you. Don't give up.

(Laughter.)

CHAIRMAN FAULKNER: Dr. Wu.

DR. WU: Hung-Hsi Wu, Professor of Mathematics at University of California.

Lots of people want to learn math, but not everybody wants to work hard. So do you have any particular advice you can give me so that I can tell the students to work hard?

ALCIDES MARIN: Well, if you feel that you're failing in some subjects, you need to get help.

At least in this institution, the North Campus, we have a lot of places. Take the time, and go by and ask for help if you need to. As you adventure yourself into math, you will start finding that it's fun. It's like a Gameboy or any other game. Because when you solve that problem that gives you so many headaches, it gives you such a pleasure. If they try and keep doing that -- as I was told at the beginning, because I said, "This is a long way to have to go," because I started all the way in the bottom. "This is really long until I get all the way to the end."

They said, "Take just one little bit at a time, little bits."

Try to make them see that it's a game. It is a game and once you complete the game you will feel satisfaction and that will inspire you to keep on trying harder and harder and harder.

DR. WU: But don't you have friends who just don't want to put in that much effort? Don't you have friends like that?

ALCIDES MARIN: The friends that I have, they're all committed to finish. We get together and study and stuff like that. I can think of someone that's maybe stubborn a little bit. Once you start doing well in the test because you're studying and they're not, they want to see what you're doing. They want to know what you're doing. They ask you. So they want to join you in the library for half an hour or an hour, sometimes, and that helps you improve.

CHAIRMAN FAULKNER: Any other questions or comments?

(No response.)

CHAIRMAN FAULKNER: Thank you, Mr. Marin. You're a popular guy with this Panel.

MARIN ALCIDES: Thank you.

(Laughter.) (Applause.)

CHAIRMAN FAULKNER: That completes the public testimony.

I neglected to do some announcements when we were in the introductory phase. Let me announce first of all, that one of our Panel members, Nancy Ichinaga, from California, has found it necessary to resign. She has communicated her resignation to me and I believe to the Secretary, and we are in the process of making that complete. She has found it impossible to travel to the panel meetings and finds the need to resign.

I also want to introduce Dr. Irma Arispe, who is on the end of the table here. She's already asked a question. Dr. Arispe will succeed Diane Jones as the Panel's ex officio representative from the White House Office of Science and Technology Policy.

I do want to acknowledge the contribution that Diane Jones made in the months of Panel work up till this point, more than a year. Diane Jones was representing the Office of Science and Technology Policy, was an active member, but she has just been announced as a new high level appointee in the Department of Education and has a new job and needs to focus on that. Dr. Arispe will be taking over as the White House representative.

Dr. Arispe currently serves as Assistant Director of Life Sciences and Acting Assistant Director for Social and Behavioral Sciences at the Office of Science and Technology Policy. She has a BA Degree from Trinity University in San Antonio, an MA from Catholic University of America in Washington, and a Ph.D. in Behavioral Sciences Health Policy and Management from Johns Hopkins Bloomberg School of Public Health.

I want to thank the public for participating in the testimony to this point. It has been valuable to us to hear testimony of the type that we've heard this morning, and we appreciate the personal effort that today's speakers have given to be here and to prepare their remarks.

That will conclude this open session of public testimony. The schedule actually says that we're going to have a break, but I think we're going to proceed now because we've only been in session a short time and we're going to go ahead and receive the reports from the Task Groups.

For the audience, let me say once again that most of the work of the National Math Panel is actually going on in committees. That's not an unusual circumstance, of course. We have the practice at every meeting of the National Math Panel of bringing back into the public eye and into public session a report of what is going on in the major Task Groups. There are five Task Groups.

One is associated with conceptual knowledge and skills. A second is associated with learning processes. A third is associated with instructional practices. A fourth with teachers. And a fifth with assessment.

We will now proceed to receive reports from each of those Task Groups in sequence. We'll start with the first, which is Conceptual Knowledge and Skills.

The members of each Task Group will go forward to the table and join the Chair as we receive the testimony, and Vice Chair of the Panel, Camilla Benbow, will oversee all of the testimony that we're about to receive, or these reports that we're about to receive. She has the chair. I'll take it back when she goes up there.

VICE CHAIR BENBOW: Skip Fennell is the Chair of the Conceptual Knowledge and Skills Task Group, and if you could perhaps introduce your fellow panel members.

DR. FENNELL: Good morning. We're here to update you relative to our work and we'll start with a listing of the Task Group that you can see, but then I'll also have my colleagues introduce themselves.

DR. SCHMID: I am Wilfried Schmid. I teach mathematics at Harvard University.

DR. STOTSKY: Sandra Stotsky, member of the Massachusetts State Board of Education.

CHAIRMAN FAULKNER: Larry Faulkner, Chair of the National Math Panel, but also President of Houston Endowment and President Emeritus of the University of Texas at Austin.

DR. FENNELL: Not at the table but who should be recognized is Liping Ma who is not able to make this meeting. Hung-Hsi Wu who has this sort of funny arrangement with our Task Group, so I anointed him as ex officio to our group. And Tyrrell Flawn who is our staff associate, who frankly we could not do without.

We'll proceed first of all by looking at the methodology through which our work has been completed. That has been through literature review, analysis of certainly all of the state curricular frameworks that, as people in this room know, continue to evolve as we just heard this morning, analysis of other standards, be they international and/or from local school districts, and analysis of textbook analyses.

Going on pretty much as we speak is a survey of approximately 1,000 Algebra I teachers around this country which will also contribute to our work as that data is received. Several of us were involved with the creation of the questionnaire for that group. We will also do an analysis of the math content from a variety of respected sources, including international groups, people who have spent time looking at content from the perspective of mathematics as well as mathematics education. Then we will do a synthesis of algebra topics, math skills and concepts that lead to this thing we call algebra at the secondary school level.

We have essentially three questions that our Task Group is dealing with, and the first question is, the major topics of school algebra. We're to the point of presenting that now formally and my colleague, Dr. Schmid, will do that.

DR. SCHMID: As a Panel we've been asked to make recommendations on the critical skills and skill progressions necessary for students to succeed in algebra and topics beyond algebra.

To do that we first need some understanding of what actually constitutes school algebra. So this is the purpose of this aspect of our report.

So broadly speaking, what did we do when one has to come up with the definition of school algebra? There is an element of professional judgment of what, let's say, we regard as the critical aspects, the critical ingredients of algebra. And then that judgment has to be validated by looking at various pieces of evidence, survey of curricula of high achieving countries, of state frameworks and also textbooks.

So in the broad areas we would say that school algebra major topics are symbols and expressions and elaborated to some extent, linear relations, quadratic relations, functions, the algebra of polynomials, combinatorics, and finite probability.

Now let's say when we try to validate this judgment of what constitutes algebra, it's fairly clear that there is broad agreement when you look at high achieving countries that this indeed is school algebra. With state frameworks, almost all of these topics certainly will appear in state frameworks. All of these topics appear in textbooks of Algebra I and Algebra II. And so what we should comment on then is to the particular items that, for example, do not show up in state frameworks and items that show up in textbooks, which do not show up here.

So first of all, we do mention the fundamental theorem of algebra. You will not find that in state frameworks. And of course, we are not suggesting that the fundamental theorem of algebra can be discussed in depth in school mathematics. Typically, that of course would be in Algebra II.

Textbooks do almost uniformly make some effort, and at least this aspect of textbooks generally is quite appropriate.

Certainly all the other topics you do find in state frameworks. If you look at textbooks you would see that there are a fairly large number of topics that are covered by textbooks that are not on our list. And the main reason for that is that even though these courses labeled Algebra I and Algebra II are primarily dedicated in practice to some element of an integrated curriculum, surviving even in these single subject courses. So you find a great deal of geometry in algebra. You find a great deal of probability, data analysis and a number of topics that one would clearly say do not properly fall under the label of algebra.

Now if you look at our list, of course there are some items that you would not call algebra that do show up. And I should comment first of all on let's say trigonometric functions on logarithms and exponentials. The reason for including those as topics of algebra is that while in algebra, especially Algebra II, there certainly is a substantial discussion of functions. These are examples of interesting functions, primary examples of interesting functions beyond polynomials and they do properly constitute such a subject matter for an algebra course even though it's not algebra itself.

Another topic that I want to comment on is the role of probability and data analysis. There is typically a lot of room devoted to those topics in algebra textbooks. Our view is that probability, and to some extent also data analysis, is an appropriate source for applications of algebra and an appropriate source of problems. That is the proper role of these topics in algebra and in that sense we include it in our list.

DR. FENNELL: Larry?

CHAIRMAN FAULKNER: Yes. I might comment

for the record here that when we've tried to put together this major topics list of school algebra, we're not distinguishing between Algebra I and Algebra II. We're just looking at the whole package of the two, what would traditionally be taught as two courses.

DR. FENNELL: Thank you.

The second question that our Task Group dealt with that you can see, what are the essential mathematics concepts and skills that lead to success in algebra, and should be learned as preparation for formal algebra course work. The work of the Task Group has taken it from at one point considering essentially a full-blown K through 7, K through 8 curriculum, to looking at a variety of options to that.

We have come to grips with what we, at least around the table, refer to as the critical foundations that lead to algebra, the must-haves, if you will, the priorities for, the prerequisite background. So while you don't see elaboration underneath fluency with whole numbers, elaboration will be provided in later documentation. But a clear, deep understanding of the important aspects of working with whole numbers that includes operations, place value, some work with positive exponents and so forth, are fundamental to algebra, as well as, and frankly just confirmed earlier this morning, work with rational numbers, and that's all aspects of rational numbers. We are certainly including fractions and both positive and negative integers and the like.

And going along with that, is our critical aspects of geometry that lead to algebra. So we want to make clear that this is not intended to convey a full curriculum. But these are building blocks that would lead to success in algebra.

DR. SCHMID: I should add that of course when our list of algebra topics was presented, the list is not an end in itself. What is certainly a necessary addendum is a discussion of how these topics fit together. Our final report certainly will provide that. A draft in fairly advanced stage exists.

We cannot present that here for obvious reasons, but certainly the topics of algebra is a list with a discussion of how various topics fit together, how they relate, and that is an integral part of our report.

DR. FENNELL: Both for the algebra question and for the essential concepts and skills question.

Our third question, does the sequence of topics taught at grade levels prior to algebra course work affect achievement in algebra?

These are considerations for our response. Clearly, one of those considerations is the whole issue of coherence across curriculum and what that means to lead toward algebra, hence, some of the decision-making we had in looking at the critical foundations that lead to algebra.

Other things that we're working on within this aspect of the report is the actual placement of algebra course work, whether that be at grade 8 as we're seeing more in growing numbers around this country. What we want to ensure is that students who are moving into algebra, regardless of grade, be it grade 8 or grade 7 or grade 9, have the background to meet the kind of success we heard about earlier this morning.

Then we have other issues that are frankly under investigation and need further research from the Task Group. But that's our take on the third question.

Another issue that has come through our Task Group that is perhaps a larger issue for the National Math Panel certainly is the issue of the mathematics background of middle school teachers. We know that in this country at this moment, the majority of people who teach middle school mathematics do not have a degree nor certification in mathematics. As we think about more students having access to algebra at earlier levels, including the middle school, this becomes a critical issue for all of us.

Another issue that this group is particularly concerned about, particularly with regard to algebra, is the role and the use of the graphing calculator. These are issues that are coming before the Panel in a variety of ways, but also came up within our own discussion.

Thank you very much.

VICE CHAIR BENBOW: Thank you.

Panel members, are there any questions?

Deborah?

DR. BALL: On the list of topics, you may have said this, but I assume when you listed the building blocks you meant operations with those. Fluency, I just wasn't sure exactly what fluency with the whole numbers means.

DR. FENNELL: That’s correct. Underneath that heading would be not only fluency with addition, subtraction, multiplication, division of whole numbers, but also the understanding and automaticity relative to basic facts in those areas.

DR. BALL: And properties and so on?

DR. FENNELL: And properties as well.

DR. BALL: And the other thing was, are you including practices with mathematics that make a difference for algebra, like representation, use of symbolic notation, some of those sorts of things, which are not exactly topical but are more mathematic habits and skills?

DR. SCHMID: Well, I think that certainly the proper use of symbols is a topic of algebra itself. Now there is a wide discussion of the extent to which, let's say, topics that are algebra should appear in earlier grade levels. I don't think we will make a statement one way or the other. But I don't think we are advocating that there should be a systematic attempt to put what might be called pre-algebra at earlier grade levels.

VICE CHAIR BENBOW: Bob?

DR. SIEGLER: So the goal of coherence strikes me as absolutely crucial.

CHAIRMAN FAULKNER: May I stop for a second? The transcriber has asked that people identify themselves, please. Deborah Ball was the last speaker.

DR. SIEGLER: I'm Bob Siegler, Teresa Heinz Professor of Cognitive Psychology at Carnegie Mellon University.

The question I was going to ask was about coherence, which everyone would agree is a crucial goal. I think with the vast number of topics that are included in most current algebra textbooks that constructing a coherent curriculum is a huge challenge for schools and for districts. I was wondering whether you'll be able to provide guidance for principals for constructing a coherent sequencing of the topics within algebra courses?

DR. FENNELL: Thank you for that. Do you want to take that?

DR. SCHMID: Well, I think this is an issue both at algebra and before algebra. As I said, there will be elaborative text connecting the various topics and to some extent that is at least an attempt to have some sketch of coherence for how various topics fit together. I don't think it can be the task of this Panel to provide more than that. I think that there will be certainly a sort of underlying hint of proper sequence of how things are connected.

One statement that I suppose we are able to make and are able to agree upon is that coherence will not happen unless there is a disciplined attempt to narrow the number of topics taught at any one grade level. Certainly I think that is being recognized. The task was very clearly identified by the study of William Schmidt and certainly the Focal Points also make that point. I have no doubt that that is what as a Panel we should recommend, among many other things.

VICE CHAIR BENBOW: Wu?

DR. WU: Hung-Hsi Wu.

I want to make a comment about what Dr. Siegler mentioned about coherence. I believe in the detailed report itself, that point is actually emphasized. What we call coherence of course is a general term referring to how the various parts of mathematics are inter-connected with a special emphasis on the inter-relationship of all the topics involved. The very grouping of all of algebra into four topics is in itself a statement of our coherence, that no matter how many things you do, you're under only basically four or five umbrellas. So I mean I think that that was in fact one of the emphases we gave to the managers on algebra.

The other point I want to make is that, again, it's in response to something said earlier about the use of symbols. I believe it poses a problem. I think in the forthcoming write-up on the critical foundations for algebra, one of the key issues about how to achieve algebra is the gradual use of symbols all through the early grades, unless that is done much more sophisticated, more demanding than just saying doing patterns. The use of symbols lies at the basis of algebra and that has to be done all through the grades, including the use of and the teaching of arithmetic and fractions. I think that indeed is a very good point that would be emphasized.

VICE CHAIR BENBOW: Tom?

DR. LOVELESS: Yes, I have a question. As you know --

VICE CHAIR BENBOW: Please introduce yourself.

DR. LOVELESS: Tom Loveless, Senior Fellow at the Brookings Institution.

As you know, there's a body of literature that shows a correlation between taking algebra and later success in college. And so this has led to the phrase that algebra is a gatekeeper as far as college success.

In your search of the research literature, have you uncovered studies that tell us what are the critical skills and knowledge that kids need to learn in order to be successful at algebra? Did you find any good studies that said if a child learns A, B or C at a certain age, that then success at algebra becomes more probable?

DR. SCHMID: No.

VICE CHAIR BENBOW: Are there any other questions of the Task Group members?

DR. WU: It’s not a response to the

literature. It's not the literature that Tom wants, but it's the issue of, not so much success in life, but success in the later pursuit of mathematics and science. And it's very clear. What skills are needed are pretty much predetermined, exactly the things we've been talking about, the coherence, the ability to reason, the precision. I think these will be emphasized in the report. That is pretty much a matter of professional judgment on the basis of the discipline itself, or the disciplines themselves.

DR. FENNELL: We also have data as reported this morning where 15 percent of the kids who come to Miami Dade College are ready to enroll in a math course without having to go through some sort of program to get them prepared for that. So I think there's a lot of information and concern that we have relative to algebra early, if you will. Algebra early, yes; but let's make sure they're prepared to do that.

VICE CHAIR BENBOW: Tom?

DR. LOVELESS: Well, just to make a point. Absent scientific evidence, I'm quite prepared to rely on professional judgment, especially since I suspect the degrees of my own in this case.

(Laughter.)

DR. LOVELESS: However, I would be more

comforted if at some point we do have some research that demonstrates our judgments are indeed correct. I hope that one of the things that our Panel will do is to recommend further research in this area so that we can try to demonstrate that.

DR. SCHMID: Well, something that does exist which I don't think one can label research, but nonetheless valid evidence, looking at practices in various countries, countries that obviously do well in international comparisons. I think there you will find an absolute consensus that certain skills are absolutely necessary, and that agrees very consistently with professional judgment of mathematicians, mathematics educators.

So I think that while there is nothing that you might call research meeting high standards, there is nonetheless a lot of valid evidence.

VICE CHAIR BENBOW: Tom?

DR. LOVELESS: I agree with you. The only problem with that research, however, is that if you look at the Trends in International Mathematics and Science Study (TIMSS) data you will also find countries at the bottom end of the distribution that are very low scoring that also have coherent curricula, and the kind of focus that the countries at the top do. So we can't just jump to conclusions based on that correlation.

So I do hope that we as a Panel encourage some, not correlational studies, but some scientific studies with some rigor, so that again, our judgment is verified.

DR. SCHMID: Well, I mean as a matter of logic, if we are talking about prerequisites for success in algebra, these are necessary conditions, and nobody suggests they're sufficient. So let's say, what we see in high achieving countries, if there is uniform emphasis on certain practices, the fact that countries that do not highly achieve use some of these practices as well, does not invalidate the evidence.

VICE CHAIR BENBOW: Are there any more questions?

CHAIRMAN FAULKNER: May I follow up on something?

VICE CHAIR BENBOW: Sure.

CHAIRMAN FAULKNER: I think Tom made an important point, but it will be a point that's made by other Task Groups, that we are charged in the President's Executive Order with examining the best available scientific evidence. What we find, of course, is that the availability of truly scientific studies bearing on very important questions of this Panel's concern, including the one that you focused on here, is lacking. One of the most important things that I think will come out of this Panel is to identify areas of future investigation that are well targeted to the most important questions that policy makers can ask.

We have, as a Task Group, made a substantial effort to try to generate through comparative studies a basis for making the recommendations that are made, but they can't rest on scientific evidence because that evidence does not exist.

Is that a fair statement?

DR. FENNELL: Correct.

VICE CHAIR BENBOW: All right. Well thank you, and I think we're going to have a short break now.

DR. FENNELL: I'd like to take this opportunity to thank all members of the Task Group, particularly Sandra Stotsky for her work in editing and getting us to the place where we're now able to move forward.

VICE CHAIR BENBOW: Thank you.

(Whereupon, a brief recess was taken.)

VICE CHAIR BENBOW: We would like to go to Task Group 2 now.

DR. SIEGLER: I am Bob Siegler.

DR. BERCH: Dan Berch.

DR. BOYKIN: Wade Boykin.

DR. SIEGLER: We are Task Group 2, Learning Processes. We have completed to date, principles of learning and cognition, mathematic knowledge children bring to school, math learning in whole number arithmetic, and social, motivational and affective influences on learning.

Goals and beliefs about learning. Children's goals and beliefs about learning are related to their mathematics performance. Children who adopt mastery-oriented goals show better long-term academic development in mathematics than do their peers whose main goals are to get good grades or outperform other children. They also are more likely to pursue difficult academic tasks. Students who believe that learning mathematics is strongly related to innate ability show less persistence on complex tasks than peers who believe that effort is more important. Experimental studies have demonstrated that children's beliefs about the relative importance of effort and ability can be changed, and that increased emphasis on the importance of effort is related to improved mathematics grades.

The Task Group recommends extension of these types of studies.

Intrinsic and extrinsic motivation. Young children's intrinsic motivation to learn, desire to learn for its own sake, is positively correlated with academic outcomes in mathematics and other domains. However, intrinsic motivation declines across grades, especially in mathematics and the sciences, as material becomes increasingly complex and as instructional formats change. The complexity of the material being learned reflects demands of modern society that may not be fully reconcilable with intrinsic motivation. The latter should not be used as the sole gauge of what is appropriate academic content. At the same time, correlational evidence suggests that the educational environment can influence students' intrinsic motivation to learn in later grades.

The Task Group recommends studies that experimentally assess the implications of these correlational results; that is, studies aimed at more fully understanding the relation between intrinsic motivation and mathematics learning.

Attributions. Students' belief about the causes of their success and failure have been repeatedly linked to their engaging and persisting in learning activities. Self-efficacy has emerged as a significant correlate of academic outcomes. But the cause-effect relation between self-efficacy and math learning remains to be fully determined as do the relative importance of self-efficacy beliefs and ability in moderating these outcomes.

And again, we recommend more experimental and longitudinal studies to assess these factors.

And then self-regulation, mix of motivational and cognitive processes, setting goals, planning, monitoring, evaluating and making necessary adjustments in one's own learning processes, and choosing appropriate strategies. Self-regulation has emerged as a significant influence on math learning. Although the concept appears promising, research is needed to establish the relation for a wider range of math knowledge and skills.

In the topic of math anxiety there is some fascinating research going on. This is another very promising area. Anxiety about math performance is related to low math achievement, failure to enroll in advanced math courses and poor scores on standardized tests in math achievement. It may also be related to failure to graduate from high school. At present little is known about its on-set or the factors responsible for it.

Among the risk factors for developing mathematics anxiety are low math aptitude, low working memory capacity, vulnerability to embarrassment, and negative teacher and parent attitudes. Again, we recommend more research, as well as developing interventions for reducing mathematics anxiety.

The last topic is Vygotsky's social cultural prospective which has been extremely influential in education and places learning as a social induction process through which learners become increasingly able to function independently through the tutelage of more knowledgeable peers and adults. Although this approach has some promise, there is a real shortage of controlled experiments and it's impossible really to evaluate the importance of this approach for math learning at this time.

This may be one of the more important aspects of this section of the report, because Vygotsky's theory has become immensely influential in the classroom. It's almost replaced Piaget as the God that many people worship in this area. The research support really isn't there for this belief, and we're going to make that point in the report.

Okay. So that's what we've been up to lately. What we're going to be doing is to draft new sections on fractions, on estimation, on geometry and algebra. We're going to complete already drafted sections that have to do with the differences and similarities, across race, ethnicity, social economic status and gender, a little section on neuroscience and a more substantial section on learning disabilities and giftedness. We're also going to add to and revise the drafted recommendations that we've been making.

VICE CHAIR BENBOW: Thank you. Any more comments from the panel before we go into questions?

All right. Wilfried?

DR. SCHMID: Wilfried Schmid, member of the panel.

Concerning what you talked about today, I mean the motivational aspects, et cetera, what policy recommendations do you think may be drawn from that?

DR. SIEGLER: Well, the one that I would rate most highly is to develop interventions aimed at reducing math anxiety. I think that's going to be a pretty clear recommendation. The research is really there that a lot of kids do less well in math than their knowledge would lead you to expect just because they become extremely anxious in testing situations or other pressure situations.

DR. SCHMID: Would you be more specific about the nature of intervention?

DR. SIEGLER: If I knew what the best intervention was, I wouldn't have to recommend the research.

(Laughter.)

DR. SIEGLER: We really don't know at this point what it would take. There are a couple of small studies out there that actually were done quite a number of years ago, one by a guy named Hembree, who points to ways that are beginnings. But the research base just isn't there, I don't think, to say at this point what would work best.

VICE CHAIR BENBOW: Doug?

DR. CLEMENTS: Doug Clements, National Math Panel and --

DR. SIELGER: We wanted to also address this question. This body of research has gone on for over two decades and it has produced I think some fairly stable findings, but curiously, much of the findings have not found their way into classroom practices. So somehow we've got to determine how we can cross this bridge and to see some of these kinds of insights, find a way into teacher preparation programs as well as into the classroom practices.

So some positive recommendation along that line I think would be important to also look into.

VICE CHAIR BENBOW: Doug?

DR. CLEMENTS: Doug Clements, panel and University of Buffalo, SUNY.

We heard the report from the previous group on coherence in mathematics and preparing for algebra. Because it's school mathematics, to me it seems that it's essentially important to also look at psychological coherence. I wonder if your group feels that what you've already reported, the number, and then these new sections that you're going to draft, can contribute to that work by looking at psychological coherence of these various ideas.

DR. BERCH: Well, I think to some extent we'll be treating a narrow aspect of that with respect to cognitive coherence, if you will. And I think it is an issue that we raised before that we think will be important for bridging what happens with both the first group, Conceptual Knowledge and Skills, the Instructional Practices group, and the Teachers group.

So to some extent I think as we are developing our recommendations, the aspects of this will emerge. But I think their full utility will depend on our further interactions to see, for example, how the comments we heard earlier about the logical coherence may cohere or not with children in terms of the sequences that they find easiest to follow as they're learning. That I think is a crucial bridging that needs to occur still.

DR. BOYKIN: Yes, I agree, this is a very important issue. And one part that's already emphasized in the section on cognitive processes and that maybe we should even emphasize more and talk about this constructive psychological coherence, is the relation between existing knowledge and learning. Because if you don't have the knowledge base, then you can't learn in a coherent way. You may be able to remember what you're told, but you won't be able to integrate it with the prior knowledge that you lack. And I think this is a crucially important point.

VICE CHAIR BENBOW: Are there any more questions for this Task Group?

Bert? All you have to do is say your name. You don't have to give us affiliation.

DR. FRISTEDT: So I can just start?

VICE CHAIR BENBOW: Bert Fristedt.

DR. FRISTEDT: Oh, I see.

I'm still a Panel member; haven't been dismissed in the last half hour.

(Laughter.)

DR. FRISTEDT: I have two questions.

Do you have any research concerning the effect of grading policies on motivation, that's question one. Question two; do you have any data on the extent to which a heavy use of mathematics in other courses affects the motivation of students to learn more mathematics in their math courses?

DR. SIEGLER: The issue of grading is interesting and complex. I don't think that a very clear picture emerges, certainly in the realm of intrinsic motivation. There is at least a body of work that suggests that a heavy emphasis upon grades, on those kinds of outcomes, can undermine a student's interest in a subject matter, that they come to see that they're doing the work less because they enjoy it, because they like the challenge, and more to get an A or to get a B and the work suggests in a sense that students that take that orientation and see teachers almost like human vending machines that dispense grades and that they're there for the grade and not for the learning, per se.

But also I think it's very clear that grades can be a proper incentive in combination with other forms of incentives, particularly as students mature and get into more complex material. Having that kind of carrot out there can certainly be one of several kinds of incentives that can drive higher performance.

VICE CHAIR BENBOW: Any more questions for this Task Group? Any more comments?

(No response.)

VICE CHAIR BENBOW: All right. Well, thank you for a nice report.

CHAIRMAN FAULKNER: All right, I'm coming back into the chair here because Vice Chair Benbow is part of the next group. Task Group 3, Instructional Practices, will now present its report.

DR. GERSTEN: We've made a lot of progress and we still have a long way to go, and what we are not going to do - oh this is Russell Gersten.

DR. GERSTEN: Russell Gersten, Chair of the Instructional Practices Task Group.

The panel members are Doug Clements to my left, Camilla Benbow to my right, Tom Loveless and Bert Fristedt, oh, and Vern, who has impeded vision from me.

As I said we've made a lot of progress and we have a long ways to go. This is what we're not going to do. The three topics we presented on in the Illinois meeting, we are working on refinement of all three of those papers. Some new studies have emerged in a couple of areas and we got excellent feedback yesterday. But we're not going to go back to those areas.

The other topic we're not going to talk about because it is only one-third done is learning disabilities. Actually, we found many more instructional studies on teaching students with learning disabilities than in teaching non-disabled students that met our criteria of the kind of rigorous experiments and quasi-experiments. I believe that's due to the fact the Office of Special Ed Programs has always supported this kind of research; whereas, other agencies such as National Science Foundation (NSF) and the Institute for Educational Sciences (IES) have at best erratically supported that type of research.

Be that as it may, we're still working on that and things have not cohered enough to present in that area.

So we're going to hear some about technology, the beginning of the work that Doug has begun, and then we'll move on to real world problem solving that also we're not going to cover because that's being kind of refined. And so then we'll do technology. Camilla's going to talk about the gifted synthesis, and Tom about explicit instruction and child-centered methods. And Doug is going to now in five minutes go through 20 slides.

DR. CLEMENTS: This is an initial draft and findings should be taken very tentatively. But I did try to make up in the number of slides for what I lack in coherence and completeness. So we'll see how we go.

The fundamental question that we're

addressing is what is the role of technology, including computer software, calculators and graphing calculators in mathematics instruction and learning?

We plan to have three sections of the final report; a description of the categories of the different software and hardware constellations, a synthesis of existing reviews different from most of the other panel members where we're struggling to find the research we'd love to have. This is an area in which there are so many overwhelming numbers of studies and reviews that a first section will be a review of reviews emphasizing that meta-analysis. And then finally, we'll do our own meta-analysis of a targeted question, which is of great interest to people, individual studies focusing on calculators and graphing calculators. That's yet to be conducted. So I'll very quickly go through several slides on the first two of these sections.

I won't give people time to read this, but what we will do is look at the categories of different software, typical pedagogies of that kind of software, and then the features that should be present or could be present that are research based that enhance the value of that software for teaching and learning.

Looking at the synthesis of reviews I want to start out with an important caveat, that many studies that are included in those reviews would have been omitted and not met our criteria for studies we would have included in our own meta-analysis. So we have to take with a grain of salt the effect sizes and the results of these reviews. Still in all, because they're so extensive, one would hope by virtue of the very nature of meta-analysis that they would give us some guidelines into what we're looking at.

So for instance, a very quick look at these things. If you look across all categories of computer-based instruction (CBI), you can find that when you see reviews that lump all subjects, mathematics and other subjects in together. You find a median effect size of .35 and you can see the pooled effect sizes from the different net analysis in the table there. If you look at those with mathematics only, the median is very close to the same thing. And if we look at problem solving, we have an effect size of about .22, smaller but still significant in most of these studies.

Other meta-analysis compared computer based instruction of all types again, to other interventions that are designed for individualization leading to conclusions that CBI is less effective overall than individual tutoring, but more effective than most other interventions. Or in another review, less effective than different accommodations for the gifted, especially accelerated classes for the gifted, but more effective than other interventions.

One other set of reviews by the same group compared it to other math interventions in general and found that it was less effective than learning processes, especially cooperative learning, but more effective than a change of mathematics curricula.

Other meta-analysis have looked by goal. When you separate out computation, the median effect size is .45. The concepts are the same. Problem solving is about the same as what we saw before, between .2 and .23 there. But the great variance that you see between meta-analyses and is certainly within the separate meta-analysis, suggests that other variables are very important. And so we'll be looking at contextual and implementation variables, such as contextual variables such as sub-groups.

In grade level what we see is no consistent pattern that CBI is more or less effective for particular grades. A slight tendency, we're going to have to look at this more closely, for children whose initial ability in mathematics is lower to have more advantage, to receive more benefit from CBI than other children.

Definitely a tendency for males to benefit more from computers and some hint that kids from lower resource communities may benefit more from computers than others.

Implementation variables are also important to look at. What they've compared is for instance, CBI used as a supplement to conventional instruction seems to be more effective than when it's used as a substitute for that, except in certain cases and I'll return to that later.

CBI use within classrooms seems to be slightly more effective, especially in the elementary grades, but possibly all grades, than CBI where kids move to a computer laboratory.

Researcher or teacher developed software is more effective somewhat than that developed by commercial entities. Software developed to address a specific audience is more effective than software developed in general.

Notice what's important here is we're just looking at relative comparisons. We find very few or no negative effects and most of these effects are actually significantly positive. We're just looking for a relative effect for guidance of implementations.

One of the big lacks of all this research that you can look at is nobody's talking about the implementation fidelity. It's very frustrating to look at these reviews and not know. There's at least one study, for instance, that shows that very often with a CBI type that's called individual tutoring, children are supposed to be on the software from anywhere between 20 and 30 minutes a day, but an average implementation is 10 minutes a week. That kind of implementation information isn't available in most of the research and could seriously affect what the effect size is of some of these interventions.

I think I'm running out of time. So I'll only say that and flash through slides on different types of CBI. Some general practice software, unsurprisingly greater in computation has less effects on concepts and application; positive on attitude. And we'll look at these specific contextual and implementation variables for each of these tutorial tools.

One of our largest reviews ourselves will be of calculators and graphing calculators. So I'll just take a second to say this has not been analyzed yet. These are very initial. But when we look at the meta-analysis you see a wide range of effect size, averaging to positive about the same as the other CBI categories, but very important for us to take a look at the different implementations.

So for instance, here's an example of K

through 12 calculators where if the children receive instruction with the calculator but then are tested without access to that calculator, you see operational skills which are defined in this meta-analysis as a combination of computational and conceptual knowledge to be .17.

Selectivity skills. Can the child select the right operation or strategy for solving a problem, to be .30; whereas, if they're tested and instructed with calculators, selectivity skills was non-significant but all other areas including the computational selectivity, problem solving and conceptual skills ranged from .33 to .44.

Let me skip to one more. Graphing calculators, very important for algebra. Again, take a look. Testing without the calculator; so they're taught with calculators, then those calculators are taken away and they're assessed. We find it's non-significant but still one of the few negative effects there on procedural skills, but a positive effect on conceptual skills. If tested with calculators, both are fairly large compared to the rest of the literature at .52 and .72.

I think I'll end there.

VICE CHAIR BENBOW: My role was to look at how do we respond to individual differences and specifically looking at the gifted population.

It's almost a truism that there is a wide range of achievement in any age group. One of the first studies that demonstrated this has shown that for example, 10 percent of high school seniors know more than college seniors four years later. So it just demonstrates the wide range. Also, I think if you're working in the gifted area, one has a wealth of experience here in terms of seeing kids being able to cover two to three years of a regular course in just one year. So there's a wide range of achievement and rate of learning.

I think the challenge in terms of instruction is how to be responsive to these individual differences so that all students make progress and can achieve their potential.

Now when you're speaking about the gifted, what the literature says that you need to do is you need to differentiate the curriculum by level, complexity, breadth and depth, and by pacing. There are four ways to differentiate the curriculum and they fall into four broad categories here, enrichment, acceleration, homogeneous grouping and individualization.

The amount of adjustment that is required for any child depends on the level of giftedness. And in most of the literature we have surveyed, people would say that the best combination is acceleration and enrichment working together.

All right, so we started to look at the literature, and there is extensive literature, many meta-analyses evaluating these methodologies and how effective they are for the gifted. I think you saw some of the results in the previous presentation. But as Doug mentioned, many of these are studies that are included in these meta-analyses don't meet the rigorous methodological criteria that the Instructional Practices Task Group put together. That doesn't mean that these studies are useless or that we can't gain anything from them, but they don't meet individually the rigorous standards.

When we then surveyed the literature we only found seven to nine studies so far that met these methodological criteria. I say seven to nine because we're still trying to figure out whether a couple of them meet or do not meet. When you group them into categories, we have found three studies that met our criteria in acceleration, two self-pace learning studies, two on enrichment and one that used a combination of methods.

Okay, so what are the outcomes? Now here if you look at acceleration on the effects of SAT math scores, we find that there really is no effect of acceleration on SAT math scores. This was from two studies.

If you look at individuals who are accelerated, these were individuals who took, for example, two to four years of mathematics in one year. So they covered the entire high school pre-calculus sequence in four years, or they did Algebra I and Algebra II. I think I might have said that wrong. They covered the full four years of the pre-calculus curriculum in about 14 months, or they did two years of mathematics in about 12 months, or they accelerated in several other ways. So these are individuals who have gained an enormous amount of time and covered an enormous amount of mathematics. When you follow them up later in their education, say ten years later, what we find is that these individuals who were accelerated, who learned mathematics at a very rapid rate, took more elective math courses in college and more often majored in mathematics in college.

Also, when you look at the accelerants, while they had gained several years in their education and therefore when they were compared to equally able non-accelerated students, you have to keep in mind that the comparisons were made when these accelerants were much younger than their equally gifted age mates.

Nonetheless, the accelerants performed as well as or better on a host of these variables.

When we looked at self-paced learning we found effect sizes of about .45. Self-paced learning plus enrichment was even more effective. But you can notice that there are very few studies. Enrichment by itself produced mixed results.

So what are some tentative conclusions? Increasing the pace and level of instruction for gifted youth is beneficial. Acceleration is effective. And let me just add that a lot of people are concerned about acceleration because of social and emotional impacts. While we did not evaluate that here, all the literature says that there is no impact on their social and emotional development.

Enrichment might be a positive enhancement, but by itself it yields mixed results. The results, some are negative, some are positive. Overall it's a very small effect, if there is one.

Much research has been conducted, but really very few individual studies meet methodologically rigorous criteria. So this is a recommendation for research, I'm sure, coming forward.

DR. LOVELESS: The section I'm going to report on is student-centered versus teacher-directed instruction practices. This is an update. If you recall I spoke at the last meeting in Illinois and presented the studies that we have looked at dealing with cooperative learning and peer assisted learning.

So what has happened since then, we revised the cooperative and peer assisted learning section of the report, taking into account input from the fellow task members and also additional research that we added in.

The main finding, if you recall, the headline finding, was that one particular cooperative learning intervention, called Team Assisted Individualization, (TAI), has a large effect size that appears fairly robust. This applies only to computation skills and it was based on six studies. All six studies had a positive effect, comparing TAI mostly to individualized learning but with a direct instruction component.

We also identified three experimental or quasi-experimental studies that I'm going to talk about today that compare student-centered instruction to teacher-directed instruction. We've used several different terms. It seems like every time I talk about this I use a different set of terms. But in the debate that rages today about these two ideas of learning, and it has raged for a very long time, sometimes people refer to it as whether teachers should be a sage on the stage, which is the teacher-directed version, or a guide on the side in terms of being more student-centered.

The short answer is, research can't answer that question. We only identified, using our criteria for rigor, three studies that really comment on this at this time. The first, Hopkins and DeLisi study, is with third and fifth graders. It was only a single 30-minute intervention in this study. That's important to note. Children were taught computation skills and then retested in the two conditions. There were significant effects for the direct instruction condition, but it was for girls only and it favored the didactic approach. You see the effect size in the "P" value there.

The second study was done by Muthukrishna and Borkowski in 1995. This was third graders, and this study and the one after it both deal with teaching problem solving strategies. This strategy is known as a part whole or number family strategy for solving problems. There was a significant effect for far transfer of form only. What that means is that the kids in the student-centered treatment were able to solve problems of a slightly different form after the intervention. You see the effect size there of .58, which is statistically significant.

A couple of important things to note about this, in this particular study, a pre-test was given and only children who could do the underlying computations for the problems were included in the study. So the children already knew how to do the computation, and by the way it was rather basic. It was only first grade skills; it's addition and subtraction of whole numbers with no regrouping, two digits. So this was a test of an intervention involving a skill that was rather low level, but there was a positive effect in solving these problems.

Then finally, Brenner, et al, this was a test of pre-algebra students. The intervention involved teaching them a method of representing function problems. These were just linear functions. You see a rather significant effect size. But what's very important to note here is that the pre-imposed test for which we get this effect size had four different points awarded to each item, and the correct answer only counted for one of the four points. So the significant effect arises for the children being able to represent function problems and what they were told to do was make a table or draw a picture or write an equation that represents this problem. We know representing function problems is one of the difficulties the kids have in making the transition from arithmetic to algebra. So this is a very narrow skill that was learned. It's an important skill, but very narrow.

Another important thing to note about this, it was done in 20 lessons. So this represents an effect of 20 lessons in terms of the intervention.

Tentative conclusions. First of all, research in its current state will not settle the great debate between student-centered instruction and teacher-directed instruction. We just don't have enough to say, you know, this debate now is over and that it's settled; it simply is not.

Effective practices that have been identified are situational. They depend on context. They also depend on the outcome that is sought. If you recall from the last slide that I just showed you, the two skills that were favored in the student-centered treatment were both involving problem solving and narrow aspects of problem solving; computation -- and some very narrow computation skills with only a single 30 minute intervention was favored, and only with girls, was favored in the direct instruction treatment.

Then finally, teacher-directed instruction is often assumed to be present in the control groups in these students, and that's not always clear that

that's the case. So you read about an intervention that involves a student-centered strategy and then the researchers assume that teacher-directed instruction is present in the control. So we really do need more studies of teacher-directed instruction as a treatment so that we can find out what parts of that work and whether it does.

DR. GERSTEN: Any comments, questions?

CHAIRMAN FAULKNER: Are you finished with your report? Okay, then we will go to questions and comments. It looks like Wade is ready.

DR. BOYKIN: Tom, I sent away my notebook a little while ago to head back to Washington, so this might already be in the previous report that you gave on the subject.

But I'm wondering if you looked at any of the work by, I think his name is Greenwood, out of Kansas on class by peer tutoring, any kind of impact on math achievement?

DR. LOVELESS: I don't recall if that study is either in the initial sweep that generated 129 studies, and then we applied our criteria and that reduced the number to 35. Frankly, I don't recall the Greenwood study. I did not read all 129.

DR. BOYKIN: And there are several studies that he's done over the last 15, 20 years. I just call it to your attention if you don't know it.

DR. LOVELESS: I'll go back and take a look at that.

CHAIRMAN FAULKNER: Skip Fennell.

DR. FENNELL: Skip Fennell, National Math Panel. I've got actually two questions.

Tom, in your statement about the great debate, you do indicate in your draft that neither extreme exists in pure form in real classrooms. I think that's important, that while there may be this debate out there, what we know as direct, what we know as something counter to that in terms of its existence is hard to find, as you note when you look at the control groups in terms of the explanation. So I'm not really sure how we say that. It's just an observation.

DR. LOVELESS: I think you're right. That also makes it difficult. If you noticed I didn't present any pooled estimate of the effect because these interventions each look different. They're asking for different outcomes, and the controls look different. You're right.

DR. FENNELL: I have a second question.

DR. GERSTEN: Yes.

DR. FENNELL: Doug, in your work with computer-based instruction, are computer-based algebra systems subsumed under that work or is that something that you'll look at differently?

DR. GERSTEN: The graphing calculators work off of the net analysis that exist put CAS systems and lump them together.

DR. FENNELL: Underneath graphing calculators.

DR. GERSTEN: None of them have separated those. But again, I want to emphasize that we have not started, but we are conducting our own meta-analysis, so we'll see if we can indeed include that as a variable.

CHAIRMAN FAULKNER: Other questions or comments? I have one for Tom.

Tom, it seems to me that the issue of controls is a complicated one in the debate that you focused on at the end there. The question of the ability of the teacher or the distribution of the abilities of the teacher to deliver on either side of this has to be somehow in this picture. It's easy to imagine that one side delivery would be favored given a control group that has either strong skills or weak skills for the other side of the delivery approach.

Did the studies address the question of the distribution of skills that make up the control group, and how do you address that question?

DR. LOVELESS: You're talking about teacher skills now?

CHAIRMAN FAULKNER: Yes, teacher skills.

DR. LOVELESS: Well, in a couple of the studies, the last one that I mentioned, the Brenner study, you only have three teachers in the study, and the same teacher taught both treatment and control. These are pre-algebra teachers. This is very typical in this kind of research. You have your teacher teaching the student-centered methods in one period of the day and then later on in the day the same teacher teaches the direct-instruction portion or strategies. So that's the way in which these within teacher effects are controlled.

But obviously there is a problem because if it's true, and we don't know if it is or not, that some teachers have a better skill set for direct-instruction and other teachers have a better skill set and are more effective with student-centered, obviously that would then be confounded with this particular arrangement.

What would give these findings a lot more support would be if we had lots of teachers taking part in these experiments, but we don't have that.

CHAIRMAN FAULKNER: So you would like to have an "n" that's large enough to encompass the typical distribution of teachers, whatever it is.

DR. LOVELESS: That’s right.

CHAIRMAN FAULKNER: I don't know whether you could design such a study, but it would be interesting to have a study that involved teachers on the direct instruction side that were well suited to direct-instruction compared with teachers delivering through student-centered methods who are well suited to delivering in student-centered methods. That would be a very interesting comparison because I think that there needs to be preparation and thought about delivery by either of these methods by the teachers that are doing the job.

DR. LOVELESS: Or to randomly assign teachers to the two conditions too.

CHAIRMAN FAULKNER: That’s probably more valid. Anyway, what we're really saying is there were no studies with large “n’s”.

Deborah.

DR. BALL: Deborah Ball. I am with the National Math Panel.

I think the point you make about, that Larry's also talking about, about the fact that these are often not treated as the intervention is very important and it seems it's related to something we've been talking about over several meetings now, and that is that these treatments are completely under-specified. So that if we were interested in what the role is of the teacher and helping students learn and how to get that more clearly. Much more explicitness around what we mean by these treatments would really help make some progress on what's obviously a crucial variable and that's what the teacher does to help students learn. DR. LOVELESS: Yes, I agree. The point still stands, and I want to re-emphasize it, and that is that if the student-centered practice is always the intervention, and we never hear very much in terms of specifics of how direct-instruction is operating, simply that it's the control or that it's traditional in its aspects, in its important aspects, then we're never going to learn very much about direct-instruction. We might learn something about student-centered practices.

DR. BALL: Just to follow up. The other thing I think is significant is your identifying what content is actually being taught in these different studies. So in fact one of the crucial issues may well be to investigate how particular instructional approaches by the teacher especially speak to the need to have students learning more complicated mathematical skills and knowledge. Perhaps calling for investigations to treatment content interaction as well as the treatment teacher interaction would be very important.

DR. LOVELESS: I think that's a very good point. Not only that, but also the tradeoffs of time. Because with these interventions, the two problem solving strategies, one of the interventions was 14 lessons, the other intervention was 20 lessons. And the kids are learning very narrow problem solving skills that don't necessarily improve their ability to solve the problems, but it's a skill that's related to problem solving. That's 34 lessons. That is a big chunk of a school year. The issue of time has to be explored too and what gets lost if the time is devoted to these other activities.

CHAIRMAN FAULKNER: Bob Siegler?

DR. SIEGLER: I'd like to ask Camilla about the range of outcomes examined in these studies of gifted kids. Some outcomes that I don't think you mentioned but that maybe there's research on, that are important, include the affective reactions to the kids of escaping the boredom of going a whole lot slower than they might, and also their long-term likelihood of going into math intensive occupations. Is there enough research on that to draw any conclusions?

VICE CHAIR BENBOW: There's a lot of research on that topic. Not all of those studies, I just want to say, perhaps meet the criteria that we specifically utilize, but there are longitudinal studies of these individuals. And basically the kids who are accelerated during the secondary school years, when they get to college and they look back, or later, we asked them that later, they're very satisfied with their acceleration. They do not think it affected them socially or emotionally, and we asked them if they would change anything about their acceleration. Their answer is, "I would accelerate more." And many of the students will say that 12th grade was a complete waste of time for them.

In terms of the other academic outcomes that have been looked at with acceleration, there's a wealth of data, grades, college majors, careers, graduate school attendance, honors and awards, competitions that they've participated in, and so on. We only focused here on specifically the math achievement variables. But what we have found is that overall if you sum across various studies, that kids who participate in special programs are about twice as likely to be in career tracks that involve math and science down the road.

DR. LOVELESS: Larry, if I could just go back to Wade's question about the Greenwood studies. Greenwood's 1991 study we did screen, and it didn't provide enough data to compute an effect size. So it was dropped.

DR. STOTSKY: Sandra Stotsky, National Math Panel.

My question cuts across both real world problem solving and the issues you raised about teacher-directed versus student-centered, and also involves some of the parts of the learning process report on the support for peer led small groups which are all related. And just a question about how one gets at the combination of all of those together in terms of what you isolated just recently on the time that it takes to do all of that in the curriculum as part of the cost for the curriculum. I don't know how one gets at it, but these long-term projects that may be real world problem solving that we need to think about from a bigger picture, which is how long does it take, what else is not being taught in the curriculum, and the issues that surround sort of getting across several different types of studies from different groups? How can we get at it?

DR. LOVELESS: Well I can respond to the cooperative learning part. Don't forget that the cooperative learning intervention that was effective was TAI, team assisted individualization, and it was with computation skills. So there really wasn't a loss of learning there because the kids in both treatment and controls were learning the same skills, they had the exact same skills.

It also is not an intervention where you simply put kids and sit them in a group. It's far more sophisticated than that. These are groups of four or five kids and every child has a set of individual work sheets to practice skills that they've been shown to be deficient on in previous assessments. So what you have is, you have children sitting in groups working on computation skills that they're a little bit weak at and they're helping each other. And this appears to be an effective intervention. In the control you have kids that are practicing those skills at their desk by themselves and maybe with some teacher help.

DR. FERRINI-MUNDY: I’m Joan Ferrini-Mundy.

The real world problem set of studies that we're looking at right now actually is complicated because some of the interventions have more in them than real world problems. And so we're trying to untangle whether these are really confounded in a way that lets us not use them or whether there's a way to talk about them sort of separately from the tighter studies that have a very narrow focus only on real world problems.

I mentioned ones that involved perhaps also cooperative groups and student writing and a variety of other instructional strategies. I think when we see what the outcome measures actually look like, we’ll be able to say a little bit about the issue that you raised, because we'll be comparing students in some other kind of treatment on certain kinds of outcome that span a range of content and types of performances.

But that all said, I still think that the question you're raising is going to be a place where we need to make some recommendations about further research, because it's a question that's not being directly explored, at least in the real world studies that we're examining.

CHAIRMAN FAULKNER: Dan?

DR. BERCH: Dan Berch.

Tom, your last statement in response to the other question triggered for me some issues that I've had with this section, which I think is excellent, but my concerns have to do with some of the labels and terminology used in the field that might inadvertently get conflated with respect to the overall labels of teacher-directed and student-centered, which I'm sure you're well aware of.

So for example, as I understand part of

the TAI, one could look at that and say at least on the surface, wait a minute, that's cooperative learning so that's part of student centered and somehow would not be consistent with the other end of the scale of teacher directed which sometimes gets conflated with direct-instruction, either of upper case or lower case. Yet there's nothing, as you know, inherent in direct-instruction approaches that is inconsistent with the use of cooperative learning if it's done in the scripted manner, somewhat consistent with the TAI approach.

I'm wondering in part to what extent you will be going into some of those issues or whether they'll come up in the glossary. Along with that, I am concerned about the extent to which we may be able to delve into further distinctions like virtual cooperative learning with a computer or another virtual student or something as opposed to some assumption that you've got to be sitting at a table with four or five other individuals. The factors, as you well know and you've indicated to some extent, that determine the success or failure of some of these approaches seem to be so critical that even if they haven't been studied adequately, I hope you will be at least speaking to the need for further elaboration of those. That's a question/comment, whatever.

DR. LOVELESS: I think that's an excellent point. The introduction and the revised version of the report, if you notice how it's changed since Illinois, is beginning to build in some of these cautionary, yellow flags flying out front because we know that this could easily be misinterpreted.

But on the other hand, there are some real findings here and we don't want to just do that. But we will consider your point as it is a very good one.

CHAIRMAN FAULKNER: Other questions or comments?

(No response.)

CHAIRMAN FAULKNER: Okay, let me thank this Task Group.

We will now go to the Task Group on teachers. Deborah Ball is the Chair.

VICE CHAIR BENBOW: Are you ready to proceed?

DR. BALL: Yes. I'm Deborah Ball. I'm the Chair of the Task Group that focuses on teachers, and with me are two members of our group, Hung-Hsi Wu and Ray Simon. The remaining names of the members of our Task Group are displayed on the slide. They include Jim Simons and Russ Whitehurst. We are the group that lost Nancy Ichinaga due to her resignation. So we're down one person.

We also want to thank Ken Thomson who has been our staff associate for the last several meetings.

What we wanted to do at this report is frame a bit how our work on teachers compliments the work the rest of you are doing. So we're going to try out a conceptual frame for organizing the work we've done and then update you on our work on two of our four questions. But partly what we'd like to see is what you think about this way of framing what we've done.

So to think about our work as a panel on teachers, it's probably worth saying that in light of the fact that we noticed that many students in this country are not getting the opportunities to learn mathematics that we wished that they were and that achievement levels, particularly for certain groups, are really not at all what anyone would like.

One premise of the work on teachers by the Panel is that teachers teaching in the grades prior to high school often seem to be lacking the mathematical knowledge and skill needed to teach effectively. If you think about that statement, and I'll say a little bit more about that.

So first we remind ourselves that as a panel we need to investigate the evidence for this premise. That's something many people like to say, but it will be important for our report to investigate what the nature is of the evidence about this and whether in fact it's somewhat more variegated than the way we tend to talk about it. So we will be, before you hear from us again, looking to find the most current evidence about the nature and state of teachers' qualifications in the ways that you've heard us talk about this before.

But if you assume that this premise in some form or another is in fact true, then the way to understand the work of this group and what we contribute to the rest of the panel's work is that we're investigating what knowledge exists about the best ways to try to address that lack.

I'll remind you that at the last report we gave in Chicago we made comments to show you some of the issues related to teacher qualification, and we talked with you a bit about the probability, from the student's side, that a minority student or a student living in poverty would have a teacher who lacked a major or minor in mathematics or was otherwise qualified to be teaching mathematics. We also reported on what that looks like by middle school and high school.

This echoes something that your group

said, Skip, about the concern that many of us on the Panel have about the qualifications and preparation of teachers who teach in the middle grades. We now have data that go the other way around, not by the students but from the teacher perspective. Here we find that in the most current data available, 37 percent of middle school teachers who teach mathematics have a major or minor in mathematics. If you prefer to say it more negatively, 63 percent of those teachers lack that kind of preparation for teaching. If you wanted to compare this with teachers who teach only mathematics at the secondary school level, that is past middle school, over three-quarters of those teachers. I mean that's still not good, but you can see rather a large difference then between those teachers teaching post-elementary school and the likelihood that they will have appropriate mathematical training to teach.

It's worth pointing out that the data we presented to you in Chicago were from 1999, and so in fact these data look worse than they looked in 1999. These are data from 2003 and here we see that in 1999 23 percent of those teachers were lacking preparation and 10 percent at high school. So things are not getting better in this realm.

A further point that we've been making

about qualification isn't just about the mathematical preparation but disaggregates it by who the learners are. We remind you that -- and here we're talking about high school because that's what we currently have data for -- high school students living in poverty or minority students are twice as likely, once you break these basic numbers down, as their white and middle class counterparts to have teachers who are not qualified in the way that we're describing in mathematics. That's a serious problem.

So now here's the issue we wanted to try out on the rest of you about sort of the logic of the way we've approached the questions we're choosing and why we're investigating the things that we are. Maybe you'll have comments for us about this.

All the signals in the research we've reviewed for our first question had to do with the relationship between teachers' mathematical knowledge and student achievement gains. Although the empirical evidence isn't as strong as many of us would believe it should be, it's still the case that across the kind of research we reported to you in Chicago and that we've written about already, they signal all points in the direction of the central role played by teachers' mathematical knowledge in their ability to teach effectively and it's of course important to say that logic supports that. You would expect that a teacher who knew mathematics better would be in a better position to help students learn. But our group has been charged with investigating how that's been studied empirically.

So missing rather critically here is that while we may say that teachers' mathematical knowledge matters, it's not that we've been able to find from those studies anything that says well exactly what about mathematics do teachers need to know that makes that difference or how much do they need to know or in what ways do they need to know that. That is critical for the panel's work. We are going to want to find a way to be able to move into that space. Because simply asserting one more time that it matters on one hand and that teachers lack it on the other doesn't get us terribly far. So we're going find ways to speak to that question.

Further work that we'll still be doing on this question of teacher qualification will include what teacher tests actually measure. We'll be looking at some of the commonly used teacher exams to investigate both what kinds of mathematics are examined and how teachers do on those and what some of the item difficulties look like. We'll also be looking further into, and have been working on this already, what certification requirements stipulate for teachers' mathematical training and we'll be looking at what's required in other countries.

Though the logic starts by saying we assert that many teachers lack this knowledge, it's incumbent upon us to continue to ask the question about what is it about that mathematical knowledge that matters and what's known about that.

So then you can understand the rest of our Task Group's work as investigating key hypotheses about how one might address the problem of teachers' lack of mathematical knowledge. These are five that you see on the list, and I'll map those for you onto the questions that you've heard us talk about many times over.

We're investigating the research evidence that exists in support or against any one of these; one is that one way to address this problem would be to provide effective pre-service teacher education. Here you should understand that every time we say effective, what we're talking about is teacher education that would actually equip teachers with the mathematical knowledge and skill that could be demonstratively linked to capabilities with students and students' learning. I'm not going to keep redefining what effective means for each bullet here.

The second hypotheses would be if not at the pre-service level, then what's known about how effective professional development is or professional structures such as math coaches, for instance, or other structures.

A third category of hypotheses has to do with incentives for performance. I'll say more about this in a moment. But here what we're talking about are incentives to actually produce student achievement gains; as distinct from the fourth hypotheses, which is incentives or other mechanisms for attracting, retaining and distributing skilled teachers more effectively. Here we're talking about pay related to teachers' skills and location pay. Again, I'll say more about this in a moment. For the moment just understand that the fourth one is a hypothesis about how to address the problem with teacher capability.

The fifth hypothesis that's been highly touted and one that we’re working has to do with the use of what are sometimes referred to as math specialists at the elementary level.

So this is a way of understanding the logic of our work. It's to start with a problem, investigate the extent to which it's true, provide the best evidence we can about the relationship of teacher knowledge to students' achievement gains, and then begin to look at what evidence is there that policy makers and others might draw upon to try to address the problem.

So here again are the questions that you've seen before. Our progress thus far, as you've heard a report already on question one and work on that, is ongoing in the ways that I just mentioned a moment ago to you.

Question two is related to pre-service and in-service or professional development education. And this is the one on which you'll hear us report at our next meeting. We're in the process of reviewing available studies on this.

The third and fourth questions are the ones on which we'll provide an update at this meeting, and on each of those we have further work to do.

So going directly then to question three. Question three asks questions about the kinds of retention and recruitment strategies that are used to attract and retain effective teachers of mathematics and distribute them to those students who most need really highly qualified teachers. So it's worth observing that many things have been shown to be incentives for teachers. I think before we get into ones that are primarily around financial incentives, it would be a misleading statement to indicate that only financial incentives are those that motivate teachers, and in fact it may be worthwhile for us to investigate whether there are other ways we might approach this. It's quite clear that people who enter teaching find many other things rewarding besides what many people in society think they would find rewarding. Here we'll be reporting on those things that people often mean by incentives, which are financial.

There are three kinds of financial incentives that we've been investigating research on. They include pay for performance, skill pay and location pay, and I'll explain those each a bit more in a moment. Our basic question as we review these studies is to look to see what the evidence is that any of these particular approaches can be effective. Again I'll remind you that when we say effective, what we mean is accomplish the goal of equip/supplying teachers who are actually capable of and do produce learning in students.

What have we learned so far about this? One thing just to put in context is, given the shortage of mathematics teachers, it's worth observing that what we've been able to determine in detail is that there is a distinct salary differential for people who have sort of technical training that could equip them to be math and science teachers. Here science is not disaggregatable out of the math and science data. But let's just say for the moment, technically trained people, between that and other career options that they might pursue, but it's worth pointing out to you that the data show that at entry level the salaries are very similar. So the entry level for teachers' salaries or for other technical careers to which these people might enter with equivalent levels of training is virtually the same. What you see is that over the first decade of employment a huge gap begins. It's by the fourth year and then further by the tenth year where there are quite dramatic differences in earning potential.

It's also worth noticing that we have problems, not only in attracting people into teaching, but that the exit rate of math and science teachers is greater than other kinds of teachers; that is, teachers with other kinds of specialization. This is worth I think pointing out as part of the work of the panel. We see that in the studies done of teachers that salary is why they've left teaching. It is one of the principal reasons but not the only one. I think this relates to my earlier comment about incentives. It is one of the main reasons given by math and science teachers as they leave teaching.

So what are the kinds of pay incentives that our group has been investigating? There are three kinds that I've now mentioned to you a couple of times. Now I'll detail them slightly.

Skill based pay is the term given to pay based on qualification and is often thought to be the kind of incentive that could attract people with certain kinds of preparation to enter teaching as opposed to something else. You're paid more because you have certain kinds of qualifications. That's meant to compensate for what I just said about the earning capacity.

Location pay is a term we're trying out on you as a panel, as our fellow panel members, to escape what we find to be insulting or otherwise deleterious terms often used for this kind of pay, but this is the pay plans that have to do with attracting teachers to work with populations in areas most in need of skillful teachers. In fact the data show that, as I told you earlier, minority students and students living in urban centers and poverty are more likely to have under or unqualified teachers. So these location pay incentive plans have to do with attracting teachers and paying them to teach in settings where they're most needed.

What we have found is that both of these kinds of pay plans, skill based and location pay, are relatively weak if the goal is to increase the supply of effective teachers; that is, teachers who can really help kids learn. So we've turned attention in this first round of our work to investigating what is often called pay for performance plans; that is, pay that directly is in concert with teachers' ability to produce achievement gains in students.

I'll talk about what we've learned so far. First is that there are different schemes for what is called pay-for-performance. Some of these are individual; that is, individual teachers are compensated for the achievement gains of their students, and others are at the school levels. The salaries of teachers within a school are in concert with the achievement of the students in that school. You can see why people might advocate for one or the other and these are different kinds of plans.

The second is level of compensation. Some plans include very low, very small amounts of differential of salary for performance, and some are rather large. Continuity refers to plans that occur over time; that is, teachers can count on this being part of the salary structure over the next years as opposed to pilot programs which are only very short term. These differ also in the studies we've looked at.

Of the 14 studies we were able to identify, and acknowledging that they include different schemes, 13 of those found distinct positive effects on student achievement. We found this interesting given that there really wasn't any single treatment being studied here. They're rather different plans. What they had in common was that they were pay plans in one way or another that targeted or increased teachers' salaries as a function of their students learning.

What are we doing next on the question of incentives? We'll be looking at more studies of incentives; that is, trying to find out more about the kinds that we've already looked at. We haven't looked in as much detail yet at all the forms that exist. We're also going to learn more in particular about skill-based pay and location-based pay plans. We've not had as much luck in identifying studies for those yet. And we thought we might also investigate how in other professions these issues are treated. There may be parallel professions, which have similar kinds of needs of attracting people with training. Nursing for example might be an interesting comparable occupation. We’re also looking at what has been learned about the possibility of pay based or other kinds of incentives for attracting people into high need areas for high need clientele or for attracting people of other career options into these careers. So we thought that could strengthen our work, to not restrict our investigations to educational related studies.

I'm going to turn now to our work on math specialists. First of all as you know from reading our draft, math specialists have been widely touted in many policy reports but no one really means the same thing by math specialist; hence our use of quotation marks here.

It's also worth saying that although this has been widely promoted as a possible strategy, and people don't agree on what they mean by that, there is also a recurrent and persistent resistance in some quarters toward the notion of specialized teachers at the elementary level, citing such things as elementary students' need to have a single teacher all day. It's not research on this but when you think of our sort of societal views of this idea, there certainly continue to be voices on both sides of the question.

While we're looking at the question of specialization at elementary school as we investigate math specialists, it's obviously related to the comments I made earlier about the distinct need to address the question of qualifications to teach middle school. What this represents is a particular strategy to address the question of how might elementary teachers be more equipped mathematically to teach children.

So what did we learn so far about math specialists? First of all we find that among the programs available, and there are many in this country already, there are two distinct models in use, both called math specialists. One comes by many different names but involves the sort of lead teacher model. A math coach is a teacher in a building or in a district who is equipped to work with students, to work with teachers, to provide professional development, and effectively is working with other teachers to provide leadership and support and skill for the teaching of mathematics at the elementary level.

The second model uses the word specialist but is one in which teachers are directly teaching children and have qualifications or demonstrated effectiveness at being particularly good at affecting students' achievement in mathematics. You can see that these are two different approaches.

We found as we attempted to survey what we could learn about math specialists that there are lots and lots of descriptions of programs. In fact this has been an increasing phenomenon from what we can tell, and there are many arguments advocating for this as a strategy. However, we found really no evidence of effect. That isn't to say that we're saying there couldn't be or we're casting doubt on it. We're simply reporting to you that we haven't found evidence that investigates the relationship of any particular program involving math specialists and student achievement gains.

So what are we going to do next about this question? We're going to be focusing on the versions of the specialist model; that is, we're not under this question going to be looking at the lead teacher model. We construe the lead teacher model to be one appropriate to investigate for our second question; that is, professional development programs and structures designed to help teachers learn. For our work on math specialists we'll be focusing particularly on the question of specially prepared teachers or specially demonstrably equipped teachers who would teach students directly at the elementary level.

We're going to be looking and conducting searches that are better targeted than the ones we've conducted so far to learn about models of this type in high performing countries. We've heard over and over that there are countries in which this is typical in the elementary level and yet our first searches identified a host of programs and data that didn't actually help us with this question. So we've asked our colleagues who are working with us to help us to identify more information about international situations.

Finally, we'll be looking at different models and what they actually cost. We think that it would be useful from a policy perspective to identify what does the implementation of a specialist model actually look like? Are you adding teachers? Is it that you're redistributing responsibilities among elementary teachers? This could be important as districts or other entities attempt to pursue this possibility.

Just going back it's worth my underscoring though that we have already done the literature search that investigates the research evidence about the efficacy of this model. The reason we continue to pursue it is to find out what it might mean to equip elementary school children with teachers who are more specially prepared to teach in the same way that we have concerns about that at grades post fifth grade.

Greg or Wu, would you like to add anything or correct anything that I said?

(No response.)

DR. BALL: Okay, then I think we're ready for questions.

VICE CHAIR BENBOW: All right. Thank you very much. Are there questions from panel members?

Bob Siegler.

DR. SIEGLER: Bob Siegler, National Math Panel.

Retention of teachers is one that I had a question about. So you could imagine two extreme models of why teachers fail to continue. One of them, teachers who are very good have lots of other opportunities and they go for higher salary or greater recognition or better work conditions or for whatever reason.

Another model though is that teachers who are not very good teachers are the ones who leave because they know they're not very good teachers and they see they're failing.

The first situation, retention, is a real problem for society. The second situation, it may be a good thing that they don't continue. Do the data enable us to distinguish between these two hypotheses?

DR. BALL: That’s a great question and one that I've actually wondered about many times, and in fact it’s not clear that we're able to learn that from the data. So you're right that the attrition data very likely include people who tried it, found that they weren't good at it and it's an appropriate thing for them to move to other kinds of occupations.

It's worth saying that of many occupations that people enter in their 20's, their attrition rate's very similar to teaching. But your point is a very good one and we should continue to probe whether there is anything more to learn about how to disaggregate the levers. I think that's a very good point.

DR. WU: I have some anecdotal evidence, that there's a third kind, which is the teachers who are quite capable, and I personally know quite a few, who just got stressed out because of the extreme demands on their time, by I think more of a lack of support by the school or district administration. We haven't done any research on that one, but I think that we might. But anecdotes, it's a very worrisome phenomena.

VICE CHAIR BENBOW: Doug?

DR. CLEMENTS: Doug Clements.

I wonder in the pay-for-performance kind of thing if there's any information in the literature, given the well known but perhaps individual kind of responses to some school systems where they game the system or the like. Is there anything that would give us confidence that these kinds of things don't lead to either gaming the system, cheating or even just narrowing the curriculum?

DR. BALL: That is a question that we wondered about and we'll attempt to see whether there's more that we can learn. At this point we started our search by looking to see whether there are actually any studies that show effects. So we're not giving you detail about that. But that question comes up. One reason for the different models, for example the individual versus school model, might possibly have different kind of interactions in what conditions they create professionally.

VICE CHAIR BENBOW: Sandra?

DR. STOTSKY: Thank you. Sandra Stotsky, National Math Panel.

Just to follow up a bit on the question of why teachers leave, and I don't know whether you have a lot of systematic data from this, but there are in many large school systems school leaving surveys that they do for both students and teachers. I have heard some data reported by Paul Hill, who I believe was at the University of Washington, who's done some studies on this. There are also others who have informally done these school-leaving surveys. One of the interesting things is that there's a third option.

Many teachers leave because they get married, get pregnant and they have other reasons not to continue in the school that they're in and then may later on resume teaching elsewhere. You have a whole variety of reasons to figure out if you can get any systematic reason for the school-leaving element of the teacher turnover rate. It would be interesting to see if there was now more information available on that.

VICE CHAIR BENBOW: Joan?

DR. FERRINI-MUNDY: I’d like to go back to one of your earlier questions about teacher knowledge. In light of what the Conceptual Knowledge and Skills group has been talking to us about and how that piece of the report is shaping up, do you think it will be possible for the research to be robust enough and extensive enough to tell us much about teachers' subject matter knowledge and its impact across the different sub-categories. It may be too soon to tell yet, but it seems like it would be helpful if it could be fine grained enough to tell us a bit about those specifics around the critical foundations area for pre-algebra or in preparation for algebra.

DR. BALL: I think we'll have to look more closely to see, but we only are aware of one random probability sample of teachers that would permit us to make very general inferences. That one is at middle school and it might speak at least to some of the issues within that specific area of the conceptual knowledge and skills group.

DR. WU: I just want to add that there are two major problems in this area. One, there is no way for us to define precisely what it is that teachers ought to know, not only about the scope but also about the depth. They need to know a lot over some areas, but what exactly that is and then once you have that you have to devise the instruments to assess it. I think both, as far as I know, are lacking at the moment. In fact, we are groping for at least a hypothetical definition of that knowledge. And I think it will take very hard work to get the instruments to do it.

VICE CHAIR BENBOW: Thank you. Tom?

DR. LOVELESS: Many of your findings are really interesting. But the one that stood out for me was the summary of studies on incentives and the 13 or 14 studies that had positive effects. Do you plan on reporting some statistical properties in terms of the size of that effect and the competence level?

DR. BALL: Yes, we will do that. We just, for purpose of this summary, decided to provide a sense of the direction of things.

VICE CHAIR BENBOW: Vern.

MR. WILLIAMS: A couple of things. Vern Williams, National Math Panel.

Alternative forms of certification. I need to know if you've looked into that. If I decided to become a teacher today I would find a way around the current certification, and I think that's keeping many good teachers out of the profession.

And the other thing is, you mention a very high percentage of middle school math teachers, without degrees in math or math education, and I suspect one of the reasons is the middle school philosophy. I know many teachers, once we went to the middle school philosophy where content was de-emphasized and social aspects were accelerated or raised to a higher level, were more interested in teaching real math and decided to go to the high schools. And I think middle schools are having a hard time recruiting math teachers because of that. That might be something that you could look into.

DR. WU: Hung-Hsi Wu.

I just want to add a parenthetical remark. One of the main points of our report I think is to emphasize the importance of teachers' common knowledge. I don't know exactly how to say it, but that's the intention, going that direction. So I don't know if that addresses partly your concern about teachers who are knowledgeable and don't come to middle school. I would just say that K through 8, no matter the grade you teach, you have to know the mathematics involved. That's a recurring theme in our report.

VICE CHAIR BENBOW: Last question. Wilfried.

DR. SCHMID: Wilfried Schmid, National Math Panel.

A couple of clarifications. First of all, you said that there is really no research supporting usefulness of elementary math specialists, and of course what I mean now is not math coaches but the actual teachers who teach mathematics specifically in the elementary school. You alluded to this very, very briefly at the very end. You do say that there is evidence, maybe not as much as you expect, but there is clear-cut evidence that teacher knowledge does raise student achievement. So one argument for elementary math specialists is that then you have a mechanism for getting more teachers with mathematics subject knowledge into the elementary grades, independently of whether you have research specifically on the effectiveness, there is then the secondary effect, which is very clear-cut.

The second clarification is that when you talked about the percentage of middle school teachers who have degrees in mathematics, would you clarify if by mathematics you mean just mathematics or does this include degrees in mathematics education?

DR. BALL: We have some disaggregation within that where they got their degree, but in that case we’re talking about people who either have a major or minor in mathematics or are certified in math as their primary subject. We can break that out for you. In this report we just gave the global. I just put this slide back up to say that what you just said about math specialists is our rationale for continuing to pursue this. We see this as one of several hypotheses for addressing the question of equipping the elementary school classrooms with teachers who actually are prepared to teach mathematics.

DR. SCHMID: Well, it seems to me it's more than a hypothesis. I mean when you say that there is evidence that mathematical subject knowledge raises achievement, it seems to me there is already a clear-cut argument.

DR. BALL: We’re just not done with our work. I mean we're looking for what the model really would look like. That's what I mean, and I'm trying to explain the logic of how our group has worked. I think we're in line with what you're saying.

MR. SIMON: Ray Simon.

I just want to make a comment relative to political events in our country now, relative to the teacher issue. As Congress is debating both the Higher Education Act and No Child Left Behind, the issue of teacher effectiveness, of incentive pay for teachers is getting more and more debate, both in the Congress and around the country. There are more and more advocacy groups that are advocating for more attention being paid to good teaching. I think the work of this committee is going to be very timely, both in informing the debate in Congress as well as informing actual practice by the schools. We're seeing more and more interest for differential pay for teachers.

The issue of distributing good teachers among all children is one of our biggest challenges. Anything we can do to help inform that debate and inform that practice is going to be very, very positive for kids. I think we all know that unless we get this part right, the rest of our work is not going to have very much fruit.

DR. WU: Hung-Hsi Wu.

I want to say something that may be in line with what Ray just said. I want to raise an issue, raise a question and also maybe to solicit comments from the other members of the panel. I wonder if you notice that in the report that Deborah just gave, you notice that there's a glaring gap in our assessment of state teachers. I believe this panel was formed, one major reason was because we want to increase the production of very capable scientists and mathematicians and engineers. For that we need the students to be taught by very capable teachers. What we have not addressed more explicitly is how to get more capable teachers to teach the better students. We're not talking about a gifted student; just say the upper quartile, maybe the upper 10 percent of the students. They deserve better teachers. Our main attention has been more or less devoted to getting adequate teachers to teach many of the high need areas adequately. But to produce good scientists and engineers, it may not be enough. And we have not been able to investigate this aspect of the teacher problem.

Part of the reason is that you want better teachers to teach the better students. You have to qualify what you mean by better teachers. We obviously have trouble even qualifying exactly what we mean by competent teachers. I wonder if there are comments from the other members of the panel about this aspect of our work.

VICE CHAIR BENBOW: I think we're going to have to cut it off right now. We can have that continuing discussion in St. Louis. And I think we need to move on to the Assessment Task Group.

So if the Assessment Task Group could move forward and I'll turn it over to our Chair.

CHAIRMAN FAULKNER: Thank you. The Assessment Task Group is chaired by Vice Chair of the panel, Camilla Benbow, and they will take their place in front.

VICE CHAIR BENBOW: The Assessment Task Group was formed and began its work in Illinois. So it's almost a year behind the rest of the Task Groups. So keep that in mind. We have had not as much time to work as a group and we will not be presenting findings today.

The Task Group members are the individuals on top, myself, Susan Embretson, Skip Fennell, Bert Fristedt, Tom Loveless and Sandra Stotsky. We will be joined by Wilfried Schmid in the future, but he hasn't participated fully until this time.

What we have been working on is really to define our charge, what is it that we're going to do? We have also heard about the NAEP validity studies. So that has informed us in terms of formulating our research questions.

In addition to formulating our research questions and our approach, we have also spent time laying out the work that's ahead of us. But let me just go back now to the research questions.

These are the two main research questions that the assessment group is planning to pursue. Number one: What are the mathematical knowledge and skills that are assessed on a NAEP, TIMSS and state test? The second question: How do these competencies align with the essential knowledge and skills required for eventual success in algebra as determined by the National Math Panel, specifically the Conceptual Knowledge and Skills Task Group?

These are the procedures that we're going to be following, or the types of issues that we will probe a little bit more deeply. We will assess the content validity and the item types across the five NAEP strands at the fourth and eighth grades only. We will then supplement this main analysis with more of a case-based analysis that looks at the content strands of each of the six state tests that were analyzed by the NAEP validity study. But the NAEP validity study only looked at the fourth and eighth grade and we are going to be looking at grades 3 through 8. Then we're going to try to attempt to assess the content validity to item types and the complexity across the various strands for grades 3 through 8.

Once we have done that work, as we're working with those types of issues, we'll compare the content validity, the item types, the item difficulties of the NAEP and state test with each other, with TIMSS and again the essential content to be learned as described by the National Math Panel.

Again, I think we can say much more definitive things about the NAEP versus these issues than we can with the states so the main focus will be on the NAEP. But then again, a case-based analysis of the state test to see if we pick up any trends or interesting questions that ought to be pursued further with regard to the state tests.

Another set of questions is how well do the items; categorized by sub-topic on the NAEP fourth and eighth grade test and the six state tests, grades 3 through 8, conform to the algebra as defined by the National Math Panel.

Question number five is really something we're going to be looking at the research literature to determine whether contrasting item types capture the same skills and concepts equally well. Depending upon what the scientific literature says, what are the implications for the NAEP and the state tests?

The other thing that we're trying to look at and will be exploring is what are the policies that govern administration procedures, for example, the use of calculators, manipulatives, providing formulas. What are the various policies? Then we're going to look again at the scientific literature to see to what extent do these variations and procedures enhance or attenuate validity and the value of the assessments? We're going to document what is happening out there and then look at the scientific literature to see what do we know about how these things affect the value and the usefulness of the assessments.

One of the things that is of specific interest to individuals is do items that contain excessive language, bias the assessment of mathematical competencies. We're going to look at the scientific literature to see what that says. If we find that it does, then does it differentially impact certain sub-groups and what are the implications for NAEP and state tests?

Finally, we're going to look at how the NAEP and state proficiency levels were established? Are they based on procedures in which experts inspect the actual item content or on global definitions? Are empirical procedures such as the modified Angoff procedure used to combine expert opinion? What's the background of the experts? What descriptions of instructions are given, if any, about the nature of the proficiency at different levels? And what is the content of the items at the cut point?

These are the eight questions that we're going pursue, but it's really looking at the content validity of the NAEP and doing an exploratory study with the state tests and then have some specific questions. So we used your feedback the last time in St. Louis. I think we've revised our charge some. I hope it's more to your liking.

CHAIRMAN FAULKNER: Thank you, Camilla. Any other comments from any of your panel members?

(No response.)

CHAIRMAN FAULKNER: Okay. Now we'll go to questions. Wilfried?

DR. SCHMID: Well, first of all, a clarification. You say that six of the state tests were looked at in the NAEP validity study. That's true only in the aggregate, not individually, and that's an important distinction.

Secondly, a question, should you also look, I'm not suggesting in detail, but at the Programme for International Student Assessment (PISA)? PISA is a test, an international comparison that the U.S. participates in, but for a variety of reasons it is much less well known in the U.S. than

TIMSS. It is taken very seriously in Europe. It might be instructive to at least comment on PISA, because PISA is drastically different from TIMSS. PISA is, I would say at one end of the ideological spectrum that some of the state tests tend to, so it might be worthwhile to at least look at some of the released PISA items and compare the philosophy of PISA to let's say some of the state tests, NAEP and TIMSS.

VICE CHAIR BENBOW: We did discuss that in the Task Group, but Tom or Skip, would you like to address why we decided that we wouldn't spend much time on that issue. We might look at why we didn't? We can change if you people feel very strong.

MR. FENNELL: I think when we discussed it as a Task Group, the following considerations came into play. One is PISA is solely a problem solving applications oriented test; and two, it's geared primarily to 15 year olds. And so we're looking at those levels of difference as well as the time we have to do this. Tom, if you want to add anything more.

DR. LOVELESS: No.

DR. SCHMID: I mean of course I was not suggesting that you look at PISA in detail. For one thing, the items are not released and you probably wouldn't get access. But I think in order to avoid potential criticism you should have some comments on

PISA.

DR. LOVELESS: We are going to refer to a study that NCES did comparing the content of TIMSS and NAEP, and in that same study PISA was part of the comparison as well. So we'll introduce PISA there. We just want it to be clear that we're not going to give PISA the kind of attention that we're giving the other tests, but we'll refer to that.

DR. SCHMID: I mean I certainly did not mean to suggest that you should give PISA that kind of attention.

VICE CHAIR BENBOW: You'll get your chance when you join us.

CHAIRMAN FAULKNER: Other questions?

(No response.)

CHAIRMAN FAULKNER: All right. That concludes the report of the Task Groups. And in fact, it concludes the meeting.

I'd like to close by thanking the public, those of you in the audience, for attending, and I would like to announce that the next National Math Panel meeting will be hosted by Washington University in St. Louis on September the 11th -- sorry, September 7th, not the 11th. And I would like to thank Miami Dade College for the hospitality and excellent facilities that it has provided. Thank you all.

(Whereupon the meeting concluded at 12:15 p.m.)