UNITED STATES DEPARTMENT OF EDUCATION
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NATIONAL MATHEMATICS ADVISORY PANEL
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Thursday, January 11, 2007
8:49 a.m.
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Hotel Intercontinental New Orleans
444 St. Charles Avenue
New Orleans, Louisiana 70130

PANEL MEMBERS:
Dr. Larry R. Faulkner, Chair
Dr. Camilla Persson Benbow, Vice Chair
Dr. Deborah Loewenberg Ball
Dr. A. Wade Boykin
Dr. Francis "Skip" Fennell
Dr. David Geary
Dr. Russell Gersten
Ms. Nancy Ichinaga (NOT PRESENT)
Dr. Tom Loveless
Dr. Liping Ma (NOT PRESENT)
Dr. Valerie Reyna
Dr. Wilfried Schmid
Dr. Robert S. Siegler
Dr. James Simons (NOT PRESENT)
Dr. Sandra Stotsky (NOT PRESENT)
Mr. Vern Williams
Dr. Hung-Hsi Wu

EX OFFICIO MEMBERS:
Dr. Daniel Berch (PRESENT VIA CONFERENCE PHONE)
Dr. Diane Jones
Dr. Kathie Olsen (NOT PRESENT)
Mr. Raymond Simon
Dr. Grover J. (Russ) Whitehurst

STAFF:
Ms. Tyrrell Flawn
Dr. Michael Kestner
Ms. Marian Banfield
Ms. Ida Eblinger Kelley
Ms. Jennifer Graban
Mr. Kenneth Thomson

C-O-N-T-E-N-T-S

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

8:49 a.m.

MR. FAULKNER: (Presiding) Now I think we are ready to go. I'm Larry Faulkner. I'm chairman of the National Math Panel. I'd like to welcome everyone in the public audience here and the members of the Panel to this New Orleans meeting, the fifth meeting, I think, of the National Math Panel.

We do want to thank Xavier University of Louisiana for hosting this meeting with us, and we will hear from the university's president here in a moment.

I'd like to note to the audience that we have signing services here. We are happy to continue those services if there is anyone in the audience who is actually using them, but we will not continue if they are not being used. So I'd like to ask if there is anyone here who requires signage services? If not, then we will discontinue them, and we can reinstitute them if the need arises. Thank you.

The National Math Panel has met

in various locations around the United States to carry out its work and to receive testimony from people in different geographic locales, and we are happy to be here in New Orleans. As we have been in different cities, we have carried out our meetings in partnership with institutions that represent high academic achievement and aspiration. We are delighted to be here in New Orleans in partnership with and hosted by Xavier University.

I'd like to introduce Dr. Norman Francis, President of Xavier University, who will bring greetings. Dr. Francis is a 1952 graduate of Xavier University, received a J.D. from Loyola University in 1956, and was the first African-American to receive a law degree from the university.

In 1957 Dr. Francis was recruited back to Xavier to serve as Dean of Men. He served continuously in administrative leadership until he was appointed president in 1968. His 34 years as president is among the longest tenure of any college president in the United States.

And under his leadership, the university has thrived. It has more than tripled its enrollment. It has broadened its curriculum, expanded its campus, and received national attention for its award-winning academic initiatives and programs. Dr. Francis will tell us a little bit about that.

He also has a significant record of national service. He served on the Historic National Commission on the Excellence in Education, which published The Nation At Risk. He served on the President's Council for the United Negro College Fund. He served as former president of the American Association of Higher Education.

He is a former member of the board of the Carnegie Foundation For the Advancement of Teaching and the Foundation For the Improvement of Education. He is the immediate past chairman of the board of the Educational Testing Service. He is active in the New Orleans community serving as chair of the board of Liberty Bank and Trust, co-chair of the committee for A Better New Orleans, a member of the advisory board of the Times-Picayune publishing company. His awards include 22 honorary degrees and major awards from the UNCF, the National Urban League, and Southern Association of Colleges and Schools.

Last December 15th, just about a month ago, President Bush bestowed upon Dr. Francis the National Medal of Freedom, the nation's highest recognition of civilian leadership, and I appreciate very much his being available and with us today.

Dr. Francis, we would be delighted to hear from you.

DR. FRANCIS: Thank you very much and good morning. I'm going to try to keep us on schedule, although we are already behind schedule. We'll make sure that we don’t go over the 15 minutes that both Dr. Faulkner and I had here this morning. Let me start, of course, by welcoming the panel again and the opportunity at Xavier, was it two nights ago, one night ago? I can't remember right now what's been happening since Katrina. I know we have got some New Orleans folks in the audience, and they know what happened to us, and I think I share with everybody else we lost the year. We don't remember what was what, but we know we are still here. We will be back, and New Orleans will come back stronger than it was.

My wife reminded me, Dr. Faulkner, that in that introduction whoever the PR people are, they are not good math people. I started in '68. So that 34 doesn't work. I have been here 39 years
year as president of the university, not 34. You know, wives do that. They bring you up short. So she reminded me that I should clarify that.

Let me start by saying how important this Panel is and how grateful I am having spent all of my time in higher education and watched the production of young people, many of whom have done great things, but there is so much more to go. And for us at Xavier, we have taken it very, very seriously. I'm going to take a few minutes at least to tell you about what I think is an amazing story, and it doesn't get told much. You know, it's like football and baseball. If you are not in a major market, you could have the best team in the world, but nobody hears about you; but if you are in New York or Washington, everybody knows who you are and what you do.

And I tell you this story because in 1974, give or take, there were newspaper articles and research being done about the lack of young people, particularly African-Americans, going on to medical school, dental schools, and the like. And a large part of that was that many of those youngsters, though very bright, were not and had not been given the opportunity in curricula work, even teachers, or encouragement to study the hard sciences and particularly mathematics, which, as we know, is the foundation for much of what we find and much of what we do in the sciences.

I had a band of faculty members who read that story and said, "Well, my goodness. We have been seeing bright youngsters. We can do something about that."

And I tell this quickly because as the Panel makes its recommendations about what kinds of strategies we need to use to improve for young people the study of mathematics and the like, I hope you take this as an affirmation of some of those strategies that are important. The first one is that you have to hold young people to high expectations, and you have got to believe that they can learn. Having done that, you have got to take them for where they are and support what they have to do.

And so what those faculty members did was they went directly into the high schools with the students at Xavier, and they said to the teachers who were teaching math and science, particularly science, but math is a part of this, "Can we teach a few classes for about three weeks? We'll come in maybe once a week," and they did. And those youngsters got so excited that the faculty members said, "You know, we are going to do a high school summer program. Would you like to come to that summer high school program?" And they lit on fire. The first program was SOAR, and we still do it. It's now close to around 32 years, and it's been called "Stress on Analytical Reasoning."

Now, high schools weren't teaching Stress On Analytical Reasoning, and it was a teaching method on how to think. I have to say to you it was like letting the genie out of a bottle. For five years, we had oversubscribed admissions to that program from high school seniors, and that's what we limited it to. It was so successful.

I was sitting on the -- I guess the ETS board at the time, and youngsters who were coming with, can you imagine, PSAT scores of about 700, 750? It doesn't get you into the front door anywhere.

Started raising their scores by 200 points in a four-week session. Now, there are no ETS people in here.

ETS said the SAT was a scholastic aptitude test. It may have been aptitude, but it was also achievement. And so what we were teaching these youngsters is how to think, and it was so successful we decided, well, we ought to do more. We brought junior high school students in to take math star, and we prepared them to take algebra in high school, and it went like SOAR.

And the teachers told me when I saw them, "I could always tell in my algebra class if a freshman in high school -- whether that student had been to Xavier or not."

And what we did is we added algebra, I mean, math, chemistry, biology, and chemistry to SOAR, and we actually increased the nine-month agrarian session for going to school by one month because they came to Xavier and spent four weeks.

As the story goes, a few people lived, thank God, to see something that's started somewhere and then come to fruition. Here is the bottom line: In those summer programs, Xavier with roughly 1,800 at the time, 2,000 students, increased it by 1,600, up to about 3,000, and the number of science majors at Xavier was 62 percent of our entire arts and sciences.

Today only 40 percent of American youngsters, not just African-American youngsters, only 40 percent, if you have read the latest research, are studying science in colleges. We have the global rate. The global rate is 65 percent. We have 62 percent of undergraduate enrollment, and that's a direct result, we know, of ratcheting up young people in high school to understand the rigors of what you are going to have to do in college, but more than that, encouraging them to know that they can do math, and they can do science.

And what we have done, without question, maybe some faculty members in here might think you destroyed academic freedom, but nothing happens by chance, and what we did is we managed the process. We made sure the curricula was what it should have been for college work or high school work for the kids who came at summertime. We made sure that faculty held youngsters to higher expectations. We called them "A Standards With Sympathy." We had the standards, we were sympathetic, but we didn't move from what we expected.

And we had youngsters who had to know that they had to check with their advisors every two weeks. They had to develop their portfolios in their freshman year. And you might say, well, boy, that was too much parental authority. Well, the problem is that too often in high school we have less authority than we should about what we know isimportant for young people to achieve.

And the last thing: What has that produced for us in that 25-year, 30-year period? And some of you read it, but I'm always proud to say it. For the last 14 years, Xavier has been the number one, if you want to call it, producer of African-Americans who get admitted to medical school, and that admission rate is about 75 percent. The retention rate is 95 percent.

We are number one in terms of African-Americans who major in the biological and the physical sciences in the United States. And, of course, we have a College of Pharmacy, and we are number two. We are probably one and two in the world in the production of African-Americans who get M.D.'s.

The moral of the story is simple. If you focus, you have rigor, you believe young people can learn, and you take the strategies that go directly to the problem, you will be successful. And what the response is: Young people respond to what you support them with and what you expect of them. Though they might say under their breath how much they don't like you, in four years in college, I'm here to tell you when I travel around the country, I hear alumni who say, "Thank God you didn't let me do what I wanted to do when I was 18 years of age."

And so to the Panel, I wish you

good luck, best wishes. And I wish that when you look at the report that you are going to produce with your expertise, you will remember those fundamentals about good teaching, high expectations, the best strategies, and not moving off of what are standards and requirements, but making sure we supply people what they need and the environment that works.

You know, the old saying is: If you want to plan for a year, you plant a seed; and if you want to plan for two or three years, you know, you plant a tree. But if you really want to plan for a lifetime, and that's what our business is, educate young people for the higher standards.

Thank you very much, and we are very happy to have you here in New Orleans.

MR. FAULKNER: Thank you, Dr. Francis. I appreciate you correcting my math, and we very much appreciate your hosting us here and your very valuable message for this morning. Thank you so much.

We will now prepare to go into the session during which we will take public testimony. Again, let me thank the public...I think it was me and the microphone. Yes. Let me thank the public for attending this session, and let me make a couple of announcements here.

First I'd like to present the Vice Chair of the Panel, Camilla Benbow. I would also like to introduce Dr. Joan Ferrini-Mundy, as a new ex officio member of the National Math Panel beginning January 22nd. She has been named Division Director of Elementary, Secondary, and Informal Education for the Directorate For Education and Human Resources of the National Science Foundation.

Dr. Mundy, please stand.

And I'd like to also express public thanks to Kathie Olsen, Deputy Director of the National Science Foundation, for her contributions to the National Math Panel in her role as an ex officio member. She will be leaving the Panel effective at the close of this meeting, and Dr. Ferrini-

Mundy will be her replacement.

I'd also like to acknowledge helpful comments from the public that have formed the Panel's work. They have come in writing, come by e-mail, they have come in briefing sessions that we have had held, and they have come through testimony at meetings like this.

We are about to proceed into a round of public testimony. The speakers who are registered for public comment are found at the beginning of tab five, for the Panelists here, in the notebooks. I think there are five total speakers now. Is that correct? That's correct. And they have preregistered, and they have been handled on a first-come-first-served basis.

So we are about to proceed, and the first person who will be speaking is Lorelle Young, President of the U.S. Metric Association. Let me ask Ms. Young to come forward, take the place right there in the middle of that table, turn on the microphone, state her name and affiliation for the record, and proceed.

Each person has five minutes to testify. We will keep an eye on the time.

MS. YOUNG: Can you hear me? No?

MS. REYNA: Yes.

MS. YOUNG: I think yes. Okay. I agree with Dr. Francis, to use strategies to go directly to the problem. And I'd like to thank you today for allowing me to be here to discuss the subject of improving math education through improving measurement education.

Having seen no discussion of measurement on your transcripts on the web, I don't know if you have discussed measurement yet. So please allow me to outline the status of measurement education in the U.S.

In 2003, the National Council of Teachers of Mathematics published its yearbook on the subject of measurement entitled "Learning and Teaching Measurement." In it, it states: "Results from the NAEP international assessments indicate that students' understanding of measurement lags behind all other mathematics topics."

It's serious. Today I will share some of the causes and suggest a different strategy for teaching measurement. It is also germane to my proposal today to share this quote with you from the 1966 NCTM yearbook, "The Metric System of Weights and Measurements."

Forty years ago John R. Clark, who was the honorary chairman of the National Council of Teachers in Mathematics, which he helped establish, made this very important point in the Foreword to that book.

"From the point of view of teaching and learning, it would not be easy to design a more difficult system than the English system. In contrast, it would seem almost impossible to design a system more easily learned than the metric system."

Further, on the status of measurement education, published articles abound about the difficulty students have in learning measurement, even the most elementary aspects of reading and using a ruler.

With respect to students' metric system knowledge, chemistry teachers constantly complain to me that they have to rob time from teaching chemistry because students don't know the metric system, and they can't teach chemistry without it.

College professors report that too many students enrolling in university classes, as you know, do not have sufficient skill in math nor the metric system to pass their courses. And companies complain that it's difficult to find metric-knowledgeable workers.

Two sizable studies have been done by researcher Richard Phelps and E. James Tew, when he was Quality Assurance Manager at Texas Instruments. These works provide evidence of the unchallenged superiority of teaching using the metric system respectively.

In addition, a Metric Bibliography CD, compiled by my association, is available. It is a database of references to articles about metric from the mid 1940's to the present; and, of course, you can find a wealth of information on our web site.

Teachers report to me that they would welcome in-service training in the metric system. As President of the U.S. Metric Association, I have the advantage of having discourse with many individuals who contact us about their metric system concerns.

Throughout the year, teachers request information on teaching the metric system, and many freely admit that they have weak metric system backgrounds, and they are uncomfortable and insecure in teaching the metric system.

Each year during October, when Metric Week is celebrated, teachers, and even entire schools sometimes, take that opportunity to try out teaching the metric system. Our newsletters abound with articles about these exciting experiences. Teachers say they love teaching it, and it was easy, and students said they learned it without any problem. In fact, some of them say, "Why don't we use the metric system all the time? It's so easy."

Teachers also report that they are confounded by trying to teach two measurement systems concurrently, resulting in students mixing up the units between the two systems and learning neither system well, if at all. Student test scores support their conclusions.

Because it is a fact, the superiority of the metric system has long been touted; but because the inch-pound system is still used in some applications in the U.S., proponents insist that it be taught. But, ladies and gentlemen, this is the 21st century, and the truth is the inch-pound system use is waning, and the metric system use is accelerating here in the U.S.

Here is some sage advice from one of your colleagues, who I'm very sorry to hear is going to be leaving us an ex officio member of your panel, but she has a right philosophy on education reform, I believe.

In a speech last year, Dr. Olsen quoted hockey great Wayne Gretzky, "I skate to where the puck is going to be, not to where it has been." Paraphrasing Gretzky, she said, "That means teach to where the kids are going, not to where they have been."

Here is my proposal quickly: Cleanse the curriculum of the inch-pound system. Yes, I am proposing that you remove it completely from the curriculum through grade six. True the inch-pound system is still around in the U.S., but this is poor rationale to teach it to young children. It has no relevance to elementary school students' needs. They are not doing comparison shopping, and there is no evidence to show that teaching the inch-pound system helps students learn math concepts. Instead, the reverse is true.

After the fourth grade, students' scores in math and science plummet on the eight and twelfth grade tests, as you well know, which is clear evidence that they didn't master basic skills in elementary schools.

The "I hate math" syndrome, so

common in the U.S., is partly the outgrowth of trying to teach two measurement systems. The high-achieving students of Japan and Singapore, and, for that matter, students in all other countries, learn only the metric system.

Measurement is an easy subject for them because the metric system is easy to learn and use, and it gives them a foundation for success in advanced math and science courses. They quickly develop skill in using decimal measures, while American youngsters are perplexed with fractions like 11/16ths and 3/8ths, at a time when they cannot yet comprehend fractions well.

Our dual management of philosophy leads students to confusion and fuels their failure, and, perhaps, worse still, to their avoidance of taking higher math and science courses.

I'm going to leave a metric leaflet for each of you today to remind you that measurement lags behind all other topics in the mathematics area as far as student achievement is concerned. And I thank you very much for allowing me to speak today.

MR. FAULKNER: Thank you. Are there questions or comments from the Panel? Thank you, Ms. Young.

MS. YOUNG: Uh-huh (affirmative response).

MR. FAULKNER: Testimony next comes from Jim Ysseldyke. Ysseldyke. And he is from the University of Minnesota. May I ask that he come forward, please.

MR. YSSELDYKE: My name is Jim Ysseldyke. I'm a Birkmaier Professor of Educational Psychology at the University of Minnesota. I want to thank this distinguished Panel for the opportunity to address you this morning on a set of topics that I believe are critical to improving math achievement in our students in our nation. I'm not a mathematician. I'm not a math educator. I train school psychologists, and I am a person who conducts research on effective instruction with an overall goal of enhancing individual student competence and building the capacity of our systems to meet the needs of students, and I think that capacity-building is something we can focus on this morning.

I have served as Director of the National Center on Educational Outcomes. I have served as the Director of the Institute for Research on Learning Disabilities at the University of Minnesota. I have authored what I believe is the most widely used textbook on assessment and special education, and I served as editor of the journal "Exceptional Children," which is the main journal of the Council For Exceptional Children.

Recently my work has focused on policy issues, on components of effective instruction, and most importantly, I think, on improving formative assessment practices and data-driven decision-making. I believe firmly that there is a welcome firm knowledge base on effective instruction. I don't think we have to worry about what does and doesn't work with students, but we have an enormous difficulty implementing that knowledge base with any degree of fidelity in treatment or intervention integrity.

We have developed a methodology to look at the extent to which effective instruction is occurring in classes, and I can provide references to that.

I'm here today, though, to talk about what I consider to be the most important and most often overlooked components of effective instruction, the match of instruction to the level of skill and development of the learner, relevant guided practice, formative assessment, academic engaged time, and differentiated instruction.

I urge the instructional practices task group and the national panel as a whole to consider the role of relevant, guided, monitored practice in improving student outcomes in math. By relevant practice, I'm referring to practice in which students are given adequate opportunity to work at high success rates with materials that are targeted specifically to their individual skill level.

And by continuous progress monitoring, or ongoing continuous progress monitoring, I'm referring to the use of systems that give teachers the information they need to systematically employ evidence-based principles and then to adapt their instruction based on the extent to which students are profiting from what they are doing.

Now, I must admit that the notion that kids need relevant, guided practice is pretty obvious. Yet the National Reading Panel in their charge to inform policymakers overlooked the importance of guided reading practice with feedback, focusing instead on the inconclusive evidence for the effectiveness of independent, unguided reading practice, going off and reading on your own with minimal feedback.

Researchers have shown significant difference between these two types of practices. Yet this was not specified in the Panel's final report. Those recommendations now serve as the foundation for the federal education's policy in reading. They have been implemented in schools all across the nation, and one of the things we see is that states and schools and districts have been left with an inaccurate impression about the importance of all reading practice and are unable to provide sufficient in-class time for guided reading practice with feedback.

Now you're faced with a similarly and equally large challenge. Like the reading panel, your recommendations will serve as a foundation for future practice. I believe it's critical in considering the role of math practice and more specifically the right kind of practice, relevant practice, with formative assessment in performance and progress, and direct immediate feedback to teachers and students themselves. I strongly urge you to look at the research that supports this practice.

The Black and Williams studies, some of the Fuchs studies, some of the research of my colleagues, and Deno. The research showed quite clearly the effectiveness of relevant guided practice. I am leaving with the panel one copy of 8 of our data-based refereed publications that deal with these topics.

I want to highlight some findings of two recent studies and then leave you with that. In one we study the impact on -- we need to wrap up.

MR. FAULKNER: You need to wrap up. Your time is already expired.

MR. YSSELDYKE: I'm sorry.

MR. FAULKNER: Proceed.

MR. YSSELDYKE: All right. One of the studies I summarized in the report to you, is a study just completed with Dan Bolt at the University of Wisconsin, a two-year study, 1,800 kids and 41 experimental classrooms contrasted with games with 39 kids in control classrooms, the results of regression analyses using residualized gain scores showed significant effects for one dependent but not the other dependent measure.

Yet we also got major school

effects. So what we have to do is control for school effects. When we did so, we found huge differences in implementation integrity with teachers, with students mastering from zero to 197 objectives over the course of a year, and, frankly, there were lots of kids at zero.

When we implement -- when the program was implemented with high integrity, we got from four to seven times the gains as for those in the implementation group. So we got significant effect sizes. Okay. So I'm leaving you, really, with two major recommendations, which are at the top of the handout I gave you. One is to focus on and to call your attention to the need to recommend, first of all, the relevant practice and, secondly, continuous progress monitoring.

I recognize that what I talked about is only part of the complex puzzle. Even relevant practice with the use of frequent progress monitoring doesn't help teachers who don't understand how to teach math. I sincerely hope you'll make those recommendations. I thank you for the opportunity to speak.

MR. FAULKNER: Thank you, Dr. Ysseldyke. Questions or comments from the Panel?

MR. BOYKIN: Could you comment just briefly on the various populations that your research has been done on.

MR. YSSELDYKE: The research has been done primarily on students at risk, students at the margins. By "the margins," I mean both gifted kids and kids who are at risk of academic failure.

The research I'm reporting on today is done in regular classrooms with a range of students. One of the reasons we did this is the incredible diversity in those classrooms. When we go into the Minneapolis schools and look at sixth-graders, the range in math performance is about ten or eleven years. Many of those kids are new immigrants.

We don't know what they know. Some of them have mothers who are software engineers at Honeywell, and at night they do quadratic equations for fun before they go to bed.

When you've got that kind of diversity and performance, my opinion is you need to get a system in place that will match instruction very carefully to the skill of each of those learners. No teacher, no sixth grade teacher, is prepared to go in and deal with that kind of diversity. So we hit the middle of the road, and on we go. So you need to take that into account. So it's been the whole range of kids.

Several of the reports focus on gifted kids. Several of them at a report in the Journal of Education for Students Placed at Risk are on kids with significant learning needs.

MR. FAULKNER: Tom.

MR. LOVELESS: Of the studies you mentioned and of the studies mentioned in the list that you have provided us, could you just pinpoint one that you think is particularly good, especially in terms of design. Do any of these have, for instance, randomized assignment?

MR. YSSELDYKE: The last study, the one on the top that I did with Dan Bolt, an education professor at the University of Wisconsin. It's a randomized, controlled study. Now, we could only randomly assign classrooms to treatments.

In fact, one of the things we find is if the program is successful, the control class teachers assign some of their more needy kids to the other teachers' classroom because they need that kind of instruction. So I think that’s the most powerful one. And I have given you a copy of the next-to-final revision. I would be more than pleased to provide the Panel with a copy of the final revision, which will be done later this week. So it is accepted for publication in School Psychology Review, which is a really high quality journal. That's the best one to look at.

MR. LOVELESS: And just one quick follow-up question. With this particular program that you have evaluated in this book, do you know what the effective technology, in terms of the use -- in other words, could that program be used in a hard-copy basis or a non-technological basis?

MR. YSSELDYKE: It's a technology-enhanced progressed monitoring system. It fits any curriculum. It is not a curriculum. It is not computer-assisted instruction. You are monitoring progress of students throughout the curriculum. Kids get the computer generated worksheets. They go work at their desk. They complete the worksheet. They scan it in a scanner. They get immediate feedback on their performance. The teacher gets a daily printout showing the performance of every kid in the class.

Kids who are in need of further instruction are flagged. Once kids accomplish sufficient expertise on the practice items, they are then given an opportunity to take a test. The teacher controls the test. The test is generated. Paper and pencil.

We found that computer-assisted stuff doesn't work very well. So it's all paper and pencil. Scan it in. If they pass the test with sufficient outcomes, they move on to the next level. You can have multiple kids at one level. So you can group them using cooperative grouping strategies and other kinds of instructional strategies shown to be effective. I hope that helps. You have some other questions, Dr. Loveless, on that?

MR. LOVELESS: Thank you very much.

MR. YSSELDYKE: Okay. Thank you.

MR. FAULKNER: Thank you, Dr. Ysseldyke. We appreciate your testimony. Our next person testifying is Dr. Jerome Dancis from the University of Maryland.

MR. DANCIS: Good morning. My name is Jerome Dancis. I'm an Associate

Professor Emeritus in the Mathematics Department at the University of Maryland in College Park.

The National Math Panel has an important task, and as 1960 civil rights icon Dr. Robert Moses has been saying, algebra is the next civil right, and that's because knowledge of algebra is crucial for economic and political access.

I will share some thoughts with you, thoughts that are known very well by many of you. When you define algebra, please include algebraic word problems, especially non-trivial algebraic word problems. This is where algebra interfaces with the world.

It’s important for students to be comfortable with algebraic word problems. It's also crucial for students to take a serious high school chemistry or physics course. Otherwise, they are relegated to rough chemistry classes.

Now, the requirement for algebraic word problems is not just fluency in algebraic computations. It also requires fluency in arithmetic word problems, especially multi-step non-trivial arithmetic word problems. And to provide an example, you go to the store and you buy a container of milk for $2, a loaf of bread for $2, and you hand the clerk a $5 bill. What's the change? This is a two-step word problem. It's one that requires SOAR. There is some stress on analytical reasoning. It's the type of problem that is largely avoided in elementary schools today.

Now, the No Child Left Behind has decreed that middle school math teachers will be highly qualified in math. The result of that is that there is a group called Praxis II, which has written a math content exam for middle school math teachers, and this exam is used by many states to identify how they qualify for middle school math teaching.

So I went to their web site, and I looked up their sample questions; and they had two ratio questions, but they are all the straightforward type. They did not have the two-step extended ratio questions. So, again, it's another type of reasonably basic-type question, which is falling through the cracks. It's not even being expected of middle school math teachers.

The second item that's important for algebraic word problems is measurement, and so I believe that measurement is something else that seems to be falling through the cracks, as was just mentioned.

So three days ago the American Math Society met right here in New Orleans, and Betsy Darken, who was a math professor at the University of Tennessee, told us about a pretest that she gave to her students She is teaching math for elementary school teachers, and the question that she posed was: How many cubic feet are there in a cubic yard? And on the pretest, none of the students got this question. On the post test, half the students got the question.

So we still have some students that have made it made it through her class and will be going out to teach without knowing how to do that problem.

She then gave it to calculus students, and a quarter of the calculus students were able to get that problem. Measurement is falling through the cracks, and measurement, you know, is really important.

MR. FAULKNER: Your time has expired. So please wrap up.

MR. DANCIS: Okay. The other important thing, if I can talk about one more crucial thing, is that we need science lessons in elementary and middle school, which use arithmetic and use measurement and give students lots of practice on -- on measurement and arithmetic.

And my other point is that students need reading instruction for arithmetic word problems, not just practice.

So I'm going to -- I'm going to trump the next person and say they need actual reading instruction. That's why I provided you my report on reading instructions for arithmetic word problems.

And, I guess, the first example I mention, I think, is an example of SOAR. It's crucial that the arithmetic word problems in elementary school and middle school stress analytical reasoning, and that's something that really seems to be low on the agenda these days. I thank you.

MR. FAULKNER: Thank you, Dr. Dancis. Questions or comments from the Panel? Okay. Thank you very much.

The next testifier is Barbara Franklin from PLATO Learning, Inc.

MS. FRANKLIN: Good morning and greetings to the distinguished Panel. Thank you for this opportunity to make comment. My name is Barbara Franklin, and I represent my company, PLATO Learning, where I am the director of Field Market Development. My job includes analyzing policy-making groups such as yours to ensure that our company's educational strategies and solutions are in line with current research and guidelines.

PLATO has been in business for 44 years, beginning as a national Science Foundation grant to the University of Illinois. We were the first company to provide computer-assisted instruction in education. Continuously reinventing ourselves and our products over the years, we now provide supplementary instruction and formative assessments for many diverse student populations all across America.

When we began product development, we tried to understand the research that is currently available in that academic field, in this case math. We learned that there is not a lot of research.

I would like to tell you today about straight curve math, our newest and most innovative elementary math product that we researched, developed, and beta-tested in the past year. We have released it for classroom use just in the past few months. I have provided the research body and design principles that we used in this development in the handout with Jennifer.

Straight curve math is to be used by math teachers and students in kindergarten through sixth grade. It is designed to be implemented daily during a 20-minute segment of the math period. To promote easy implementation, the product has both technology and print components for teachers and students and supports core instruction in the classroom.

It has two primary objectives. First, of course, is to increase student achievement in math through research-based best practices, which we look at as good classroom instruction, investigations, workshops, quizzes, and games.

And, secondly, to increase teacher effectiveness through professional development in math content, instructional strategies, and technology product usage, which is also technology literacy. It is to be used as a preventative, rather than an intervention.

Straight curve math is designed

with landscape of learning methods, big ideas as, and I'm borrowing this term, focal points of its curricula. These big ideas allow teachers to grasp instructions and seek connections that can be defined as central organizing ideas of that, principles that define mathematic order.

Some of the big ideas we included are numbers, operations, measurement, geometry, algebra, which we are beginning in kindergarten, and data analysis of probability. These learning maps and big ideas translate into hierarchal charts that align with NCTM curriculum focal points and some state standards.

Clearly we did not try to cover everything, but instead identified those concepts that inexperienced teachers struggle with in teaching concepts that students must have to lay a foundation for future learning.

As you move towards your final report on policy recommendations for math education improvement, please consider these three points: Consider that the best amount, quantity, and quality of differing state standards create difficulties for both teachers and students in American math classrooms.

Secondly, allow and encourage systematic innovation on the part of smaller supplementary vendors to bring forth promising practices and emerging technologies to improve student achievement. Do not be so prescriptive in your recommendations that innovation is blocked.

And, lastly, establish criteria for the review of commercial products that will allow all companies to undergo a fair and ethical process for participation in future elementary Math Now programs, the science and math initiatives, and other federal programs that will result from your report.

Thank you for your commitment to this extremely valuable undertaking and for allowing me this time today. Do you have any questions?

MR. FAULKNER: Thank you, Miss Franklin. Questions or comments from the

Panel? Okay. Thank you.

MR. BOYKIN: That's okay.

MR. FAULKNER: We have a fifth testifier, James J. Madden, from Louisiana State University. Dr. Madden.

MR. MADDEN: Good morning. I'd like to thank the Panel for allowing me to speak to them briefly this morning. My name is James Madden. I'm a professor of mathematics at Louisiana State University.

Since 1996 I have become increasingly involved in designing and delivering education for future math teachers, including undergraduate math courses curricula and programs and professional development programs that I provide in the summer.

I have been the Principal Investigator (PI) on a couple of NSF course curriculum and laboratory improvement grants, and I'm the PI on the Louisiana's STEM 2P grant that is funding our new program for preparing secondary math and science teachers.

Also since about 2000, I have been a member of the Cane Center at LSU, which is a unit whose mission is to use the researchers of the university to effect positive change in mathematics and science education.

What I want to comment on is the difficulty of knowing or determining the effectiveness of what we are doing. We are sincerely attempting to provide for the teachers that we interact with the best possible preparation for effective practice. But we find that we are unable to determine whether or not we are having effects or what those effects are.

We have numerous choices concerning what we can provide, and there are numerous recommendations from different sectors regarding what is supposedly the best preparation. We hear sometimes that content knowledge is very important, and then we hear that specialized content knowledge for teachers is even more important. Then on the other hand from other sectors, we hear that enabling teachers to become part of learning communities is important, or helping them interact with one another or providing them with mentoring is important.

Of course, all these things are important, and we understand that, but we have choices to make. We have a certain amount of resources to provide, the training we provide, and we don't know what the best choices are.

I believe that part of the problem is that we don't have good ways of describing what practices there already are in classrooms. So that when East Baton Rouge Parish schools, for example, asked us to design a summer program for the teachers, we don't have but a sketchy idea of what the teachers in the district are actually doing. We don't know what percentage of time is allotted to mathematics instruction, activities, lectures, or for seed work.

There is good work in this area, the TIMSS studies, of course, and the

Learners Perspective Studies say a lot about how we can describe the things that are going on. But for a person in my position who is attempting to provide the professional development and then respond to our funders about the effectiveness of this, I don't have the tools that enable me to do this.

So I think I'll elaborate on the lack of, well let me say a couple of other things. I searched through several handbooks of mathematics education, 3,000 pages of scholarly articles on math education, and found only three pages that use or that mentioned observation. So I think we have an observation protocol that was developed in Minnesota, and it is used widely in Louisiana. It's called the LACOPT.

We are aware of observation protocols developed by Horizon Research, and there is a very good one that's being used in Arizona. However, different observation protocols don't seem to be comparable, and we don't know how to use them effectively to answer the question that I just posed, that is: Is what we are doing effective?

So to summarize, I urge the Panel to help, to find, to seek for ways to provide me with a solution to this problem. Again, the problem is: How is what I am doing affecting teacher practice? Thank you.

MR. FAULKNER: Thank you, Dr. Madden. Any questions or comments from the Panel? All right. I think that brings us to an end of our public session, and the public testimony here. We will then move into the Open testimony, during which the Panel will move into consideration of its preliminary report. We are going to take the break that was scheduled for 10:00 right now, and we will come back at about five minutes after 10:00 and begin this preliminary report.

Let me indicate, for the benefit of the audience, the way that this next session will proceed. The preliminary report does not contain sections -- in its draft, anyway -- sections that represent reports of individual task groups. We will proceed through the review of the preliminary report and try to reach the stage of adoption. Assuming that there is time left in the session, we are going to proceed into a set of progress reports for each of the individual task groups from that point forward. So we will do the preliminary report, then we will do the progress reports from the task groups, and we will start that at 10:05. Okay?

(A brief recess was taken).

MR. FAULKNER: All right. I think we are ready to begin. Let me draw the Panel's attention to the draft preliminary report that has just been given to you. This is the corrected version of the one that you had in your hands. You can distinguish it in case you already mixed it up. This one has Bates numbers.

For the audience, let me say that we are going to be working through a draft that you won't have in text form, but I will walk you through what's in this preliminary report; and as the preliminary report is completed in editing by the Panel and it's finalized, we will make it publicly available as quickly as possible.

Let me also indicate that the preliminary report has been emerging over the last couple of weeks by work in the Panel at large, by individuals, that's gradually been brought together in a draft form, and we are going to talk through this, which has been put together in this place. We are required to act on it in open session, as we are going to have this discussion, and take action here in the open session.

I will walk everyone through it, the Panel and the audience, and I ask you to -- the Panel, of course -- make comment or propose revisions at any moment here, and let me just go ahead and walk people through it.

First section of the draft report is called The President's Charge. The report provides background. It indicates that the Panel was formed through Executive

Order 13398. It makes reference to the Executive Order. The Executive Order is actually reproduced in Appendix A. It notes that the Executive Order calls for the Panel to issue a preliminary report not later than January 31st, and it says that this document fulfills that obligation.

Then the section proceeds into a brief summary of the basis for national concern over the mathematic proficiency of young people emerging from our schools or due to emerge, and it cites information from PISA, from the TIMSS study, from NAEP, and it cites The Rising Above the Gathering Storm report from the National Academies.

It makes some reference to the debates that have existed in the teaching community about how teaching should be done. It makes comments about the belief among the public that it is important for students to improve skills in math, science, and engineering.

I might mention for the Panel that the second paragraph -- actually, the first full paragraph on page 3, the one that begins: “The United States finds itself at a crossroads.” There has been one member of the Panel who has questioned the 3.7-billion dollar-a-year number. I would propose that we simply drop that sentence from the report, unless there is an objection. Okay. Then we will consider that edited out.

Then it goes on to say: This section deals with the President's precise charge. It emphasizes that the President has asked the Panel to provide advice on how to foster greater knowledge of and improved performance in mathematics among American students with respect to the conduct, evaluation, and effective use of results of research related to proven and effective and evidence-based mathematics instruction. Then it notes that the Executive Order calls for recommendations based on the best available scientific evidence. It makes the comment that the Panel has particularly noted that.

The report then proceeds through items A through J in the President's

Executive Order. It actually gives a list of elements of the charge, and it notes in item A that the President's list clearly indicates that the Panel's focus should be on the preparation of students for entry into and success in algebra, which itself is a foundation for higher mathematics. And that paragraph completes the section called The President's Charge.

Is there discussion about that paragraph that the Panel would like to enter into? None. Very good section.

All right. Then moving on -- moving on, I think the composition of the Panel and the process of work comes up as Section 2. It notes that the National Mathematics Advisory Panel, often called the National Math Panel, comprises 22 members designated by the Secretary of Education. It assumes 17 are experts not employed by the federal government, and 5 are ex officio designees from federal agencies.

The members were sworn in to serve as the Panel began its work on May 22nd,

2006. Then there is a list of the Panel. I note, by the way, folks, that this roster is not quite correct. The roster will be corrected. I think I will just leave it at that.

Tom Luce, who served for a brief period, is missing. There will be a notation on Kathie Olsen's name, that she will be bringing her service to a close at the end of this meeting; and there, I think, are some title corrections that need to be made of individual members of this group, but that's all basically clerical activity, and we'll just see that it gets corrected. But it's a list of members and ex officio members and staff members.

The document then proceeds to note that the Panel has met five times over the last eight months and that there will be five additional meetings. There is actually an appendix -- what is it, C? B. Appendix B is a roster of where the Panel meetings have occurred and the composition of those meetings, at least with respect to the nature of testimony, but I believe this document is missing, a reference to Appendix B. We need to insert that Appendix B.

At each meeting other than the first, the Panel has used the time, or rather a portion of the time, working in task groups and the balance in public sessions. There is an explanation that the testimony has been open and public on a first-come-first-served basis, and some other testimony has been organized topically according to the needs of the Panel that cover things like textbooks, TIMSS or the use of technology.

We point out in this that the proceedings have been recorded and documented, transcripts and other information have been posted on the web site. The web site is provided here. The report goes on to indicate that organizations likely to have an interest in the Panel's work were contacted by mail to inform them of the work plan, and they have been invited to provide testimony in writing and orally. We also provided a stakeholder meeting in Washington in early December where questions and answers were handled.

At the Panel meeting in May, the Panel noted that it chose to divide into task groups. Four task groups are here: Learning Processes, Conceptual Knowledge and Skills, Instructional Practices, and Teachers. The document then proceeds to give the rosters of the task groups, and there is a notation that subcommittees were organized to address standards of evidence and survey of teachers in the field.

There is a discussion about how the task groups are being supported by contracts with Abt associates and the Institute for Defense Analyses, Science, and Technology Policy Institute. There is a discussion on the basis for the work of the contractors and the way they are providing course searches of literature and other information.

There is a recommendation, or rather a comment that the decisions at the boundaries about rigor, adequacy, and inclusion will be made by the Panel members working in task groups and that the task groups report periodically to the entire Panel and all final work products such as the language from task groups a be reviewed and accepted by the Panel. That needs to be changed because there is no language from the task groups in this report. Just take out the "such as the language in this report are to be reviewed and accepted by the Panel."

Then there is a declaration that the Panel intends that every assertion or statement of fact in its final report either be labeled as definition or opinion or be backed up by citation. Wherever practical, the final report will also convey the quality of evidence that exists for findings or conclusions, principles that we deem to be consistent with the President's emphasis on best available scientific evidence.

That concludes Section 2. Section 2, being the composition of the Panel that processes the work. Are there any recommendations for provision in Section 2?

MR. BOYKIN: Yes.

MR. FAULKNER: Yes.

MR. BOYKIN: In the President's Executive Order, item C on page 3 states: The processes by which students of various abilities and backgrounds learn mathematics.

That particular item was really directed for the learning processes task group. On page 6, the case of various abilities and backgrounds is not here in the report. This is sort of what the learning processes task group will be addressing.

MR. FAULKNER: You mean in what is known about how children learn?

MR. BOYKIN: Yes. I would urge that we reinsert that clause there.

MR. FAULKNER: Which is the --

MR. BOYKIN: The backgrounds.

MR. FAULKNER: Okay. So it could read: What is known about how children learn mathematical concepts and skills including --

MR. BOYKIN: Just insert the clause as originally stated in the Executive Orders as suggested.

MR. FAULKNER: Okay. So it would be --

MR. BOYKIN: Children of various abilities and backgrounds learn mathematical concepts and skills.

MR. FAULKNER: Okay. So you just want to say what is known about how children of various abilities and backgrounds learn mathematical concepts? I'm just trying to get the language exactly.

MR. BOYKIN: Yes.

MR. FAULKNER: Okay.

MR. LOVELESS: I have a problem with that wording.

MR. FAULKNER: Go ahead.

MR. LOVELESS: It implies that there aren't general findings or principles about how all children learn mathematics. To me better wording would be to leave the current statement what is known about how children learn mathematical concepts and skills and then comma. Then include a second clause, the processes by which students of various abilities and backgrounds learn.

MR. BOYKIN: I concur with that change.

MR. FAULKNER: Okay. Let's see. Diane.

MS. JONES: I'm really sorry, but I'm going back to Section 1.

MR. FAULKNER: Okay.

MS. JONES: Going back to page 2, I would say that the statement about characterizing of the Rising Above the Gathering Storm report is incorrect. It is correct that the Gathering Storm report questions future American competitiveness, but it does not document diminishing current competitiveness. So if we could change where it says "extensively documents diminishing." That's a mischaracterization in the report, and could we replace that with “questions future American competitiveness?”

MR. FAULKNER: Others? Okay. Let's go to item 3, then. Section 3 is called "Current Status." As this report is accepted by the Panel at its New Orleans meeting in January, the progress is described as follows: All four task groups are deeply engaged in the substance of their tasks and are in the process of examining relevant literature and materials. Subcommittees are also addressing various uses of pertinent evidence.

The Panel proposes to convey accordingly. It is premature for the Panel to convey major findings and conclusions with confidence. The findings from task groups will inform each other and will ultimately be aligned in forming conclusions.

The subcommittee on standards of evidence has made good progress toward a guide. However, the Panel believes methodological principles and details will be refined as members review the research. The subcommittee on the survey of teachers has developed goals for the planned surveys.

And as the President's agenda unfolds, we expect to examine parts of the President's charge that cannot be covered by the task groups. The pieces of the charge that are most in the forefront of my mind are assessment, and the President has called for comments on needed research.

That is what's in the task group report, in Section 3. Is there anything to be added there?

Mr. Chairman, yes.

MR. WHITEHURST: I apologize. I'm going to take you back to Section 1, as well. On page 2, third bullet --

MR. FAULKNER: Right.

MR. WHITEHURST: Section 2, the third bullet reads: It has been claimed that an applicant for a production associate's job at a modern automobile plant must have math skills equivalent to the most basic achievement level. Almost half of America's 17-year-olds do not meet this threshold. A publication by my office is cited.

I believe the citation is with respect to a portion of kids who meet basic standards, but it could be read as the citation supported the claim of the need for a certain level of skills, which is surely not in our publication. So I just think that citation needs to be shortened.

MS. FLAWN: So will you just get with me?

MR. FAULKNER: Do you want to --

MR. WHITEHURST: I don't know the basis of the claim.

MR. LOVELESS: I suspect it's from the Richard Murnane, Frank Levy book, The New Basic Skills, where they mapped the skills that they found the factories were demanding on their entry exams and put it in --

MR. WHITEHURST: So I'm just asking for a citation to the claim as well as the President's annotation.

MR. SCHMID: Just the -- the last clause would be a straight sentence with its reference?

MR. WHITEHURST: Yes.

MR. SCHMID: And then -- then if there is sort of a reference to the first part, that would be inserted?

MR. WHITEHURST: Yes. Thank you.

MR. FAULKNER: Well, what we need to do is make this accurate as a lead-in.

MR. WHITEHURST: Yes.

MR. FAULKNER: Right.

MS. BENBOW: Yes.

MR. FAULKNER: Okay.

MR. LOVELESS: I like Wilfried's idea splitting it into two sentences and documenting each of the two sentences.

MR. SIEGLER: Yes. We could just put a period after math test and say: This threshold is not met by almost half, and add the second reference there --

MR. FAULKNER: All right. Well, we'll see if we can get it that way. All right.

MS. BENBOW: The first part.

MR. FAULKNER: The first part about the job?

MS. BENBOW: Yes.

MR. FAULKNER:

I think does add to the concept that the workforce is going to need skills that are elevated above what has been historically true is a useful point for us to make here, if we can make it in a valid way.

MS. BENBOW: Absolutely.

MR. FAULKNER: Yeah. Bob, did you have your hand up?

MR. SIEGLER: (Shakes head negatively).

MS. BALL: What we are talking about here, we start with the evidence from NAEP. That's the first sentence, and then explain what that means and say: Approximately one-half of Americans do not meet the threshold and then explain by saying that standard is (inaudible).

MR. FAULKNER: Okay. Well, what I think we'll do is we'll get new language for this based on actual references. We will e-mail you that language, and we'll see if there is any objection in an e-mail. Is that a reasonable way to go on that particular element?

MR. SCHMID: I mean, I think -- for our suggestion, I think that I would prefer the present order. The point is that this kind of skill is now necessary, that it's a statement we should make; and then, of course, the fact that a substantial number of school children don't meet the standard. I don't think anybody is going to be surprised by that.

So that it's just, in some sense, an afterthought driving home the point that something needs to be done. The substantial statement is that we need new skills, and really a higher level of skill will be needed in jobs, when in the past that was not the case. That is the solution. I think it should stay in.

MR. FAULKNER: Okay. Well, let us work on trying to get this to what seems like a stable and supportable order, and I think it's not easy for us to produce new language here because we don't have the references. Is there anything else in 1, 2, or 3? Okay.

Item 4 is references. The only four references that are included here are the ones that are used to support the bullet points on page 2. There will be a fifth reference. Then we go to appendices.

Appendix A is the Presidential Executive Order. This is a scanned copy of the Presidential Executive Order. It's an image. So it's not in the book. We couldn't edit it anyway, as you know.

Appendix B is a list of Panel meetings, where the meetings will be held. By the way, this is a moment for me to announce to everyone here that the eighth panel meeting, the one in September, will be in St. Louis at the Washington University School of Medicine. It's a way for us to bring a biological medical site into our spectrum after we have been to Fermi Laboratory, which is, of course, the physics energy site in Chicago.

The ninth site we are working on right now, but we are not prepared to announce it at this point. It's not out of the question that we could get it done before this report is to be issued. Then Appendix B, after going through a list of meetings, actually provides brief meeting summaries of the five meetings we have held to date. It includes a list of the kinds of testimony that we have heard in various places. And that's the end of the report.

So the question I have, I guess, is: Are there comments on any of the appendices or the report as a whole? I wonder if someone would move the adoption of this report as we intend to edit it with the understanding that we'll show you the final edited version, including the change in that one bullet point before release?

MS. BALL: I'll move that.

MR. FAULKNER: All right. We have a motion in. Second? Do we have a second?

MR. WU: (Gesturing).

MR. FAULKNER: Is there debate, discussion on the question of adoption? All in favor of adoption please signify by saying I.

THE PANEL: I.

MR. FAULKNER: All opposed? (None opposed). The preliminary report is adopted with the understanding that those corrections will be made and that the Panel will see it, and then we expect to be able to release it, I think tomorrow probably. So watch your e-mail in the next 24 hours so that you have a chance to review and make corrections.

All right. Thank you. I appreciate your taking all of that and working through it seriously. We are now going to proceed to progress reports of the individual task groups. We have done this consistently at all of our meetings. The task groups, of course, are getting much more substantially into their tasks now, and there is more to talk about. In previous meetings, those discussions have been very limited.

In this particular setting, we have the opportunity to make some more substantial reports, and I will invite task groups to go forward. To allow the audience to identify who is on various task groups, I'm asking, in fact, that the whole task group go forward for the purpose of the presentation.

It may be that the chair of any given group is going to actually do most or all of it, but I'd like to invite Group One. Follow the agenda that is actually published here. Task Group One is Conceptual Knowledge and Skills. So I'm asking you and your colleagues to go forward.

I myself am a member of Task Group One. So I'm turning the chair over to the vice chairman.

MR. FENNELL: Good morning. It's our charge to present kind of a status report relative to essential knowledge and skills for pre-K through eight and also algebra. Our working group includes those on the screen, specifically this task group, including myself as chair, the chair of the National Math Panel is a member of this subgroup, Liping Ma, Wilfried Schmid you see to my immediate right, and staffed by Tyrrell Flawn.

Other contributors, and I'll define contributors as people who have found the time to contribute to some of our work, include Hung-Hsi Wu, a member of the National Math Panel; Joan Ferrini Mundy, also a member of the National Math Panel who will be assigned to our group; and several outside reviewers.

We will be showing you some lists, what I'm referring to as "topical lists," and I'll read this line to you. These were derived through careful analysis of state curricula standards in this country and also include the review of the American Diploma Project Benchmarks and K-8 Benchmarks and the intended math curricula for Japan, Korea, Belgium, Singapore, Chinese Taipei, the work of William Schmidt with TIMSS and beyond 2002 as well as his work with the international math and science study and the recent work of the National Council Teachers of Mathematics.

The next slide after this one will be a topical list of important mathematics pre-K through eight that would lead to algebra. I'll set that up with the following phrase, and that is: It's important to note that balance is expected between opportunities for students to develop concepts, solve problems, and compute among the mathematics that no one in this room could read. Perhaps Russell could.

It's organized according to numbers,operations, algebra, geometry, measurement, data analysis, and probability. I will not read that slide to you, but I will say that those are important elements of mathematics that children should receive, have access to, pre-kindergarten through grade eight leading to algebra.

MR. FAULKNER: Okay. Skip asked me to talk about this slide. I think what he's just covered is a list of essential elements, essential concepts and skills.

The task group is willing to make the statement that the NCTM, the National Council of Teachers of Mathematics, is judged to be on sound footing with its recent publication of the Curriculum Focal Points. That's not the same thing as saying that we are prepared to endorse a single curriculum, that one or any other at this stage, but we believe that the Focal Points represents a positive step.

The Panel's final report may articulate grade-by-grade expectations. We are not prepared to do that at this stage. If so, the Focal Points and other documents supporting grade-by-grade expectations would be a part or would be the basis of what we have to say.

MR. FENNELL: Moving to algebra. I'm going to have Dr. Schmid talk briefly about the next two or three slides.

MR. SCHMID: I must confess that the process of arriving at the language here was somewhat chaotic, and so I would like to explain the purpose of the language that's on the slide. The point is that, first of all, when we talk about algebra, what is algebra, that is really not so much a question to be decided by existing research. The definition of algebra is something that requires really expert judgment. In one of the later slides, there will be a list of, let's say, the topics that, in our opinion constitute algebra. The purpose of this language is to say, in effect, that there are different ways of slicing the pie, that some of the subjects go into Algebra I, some go into Algebra II. Exactly where or how this is divided up is not defined. It can be done in several sensible ways. Certainly this Panel should not be prescriptive.

There probably ought to be language specifying, let's say, the core of Algebra I so that certain subjects should surely be included in Algebra I. On the other hand beyond that, there is some return in the division between Algebra I and Algebra II.

Then the intent of this language that needs to be refined to make the point that not only in K through eight and K through seven mathematics, but also in algebra there has to be an appropriate balance between sort of the three pillars of conceptual understanding, problem solving, and computational facility.

And this language, which I think is to be continued, is to give examples of what, for example what mathematical thinking means in the context of algebra. So an example would be, let's say, factoring of quadratic formulas, completing the square and the quadratic formula are not separate components.

What really has to come across in the classroom is the connection, the logical connection, between the three. Similarly there should be examples of what problem solving in algebra means and what computation in algebra means.

So, finally, then, there is a list of components of algebra, which is even less readable than the K through seven list. And let me just summarize that algebra, of course, involves symbolic notation and calculating with symbolic expressions that is flushed out. There are linear functions, linear equations, then quadratic functions, quadratic relations.

The more general notion of a function, including exponential functions, logarithmic functions, trigonometric functions. Then finally dealing with polynomials. Obviously, the list here is not in a linear order. That is, these are the components, and eventually there has to be some language making clear some kind of partial order.

MR. FENNELL: Our next steps would include spending more time on the important elements of mathematics that lead to algebra with providing prose to give greater definition and sharpening of that mathematics, and the same thing would be true for what we are calling algebra. We will certainly be having discussion about the extent to which we take this into a grade-by-grade analysis of particularly the pre-K through eight.

For those who could not read the very long and relatively small typed list, this entire slide presentation will be made available on the web at a later time for more careful review. Questions from the Panel, anybody, Camilla?

MS. BENBOW: No. I was just going to ask if there were questions.

MR. WHITEHURST: I would suggest

some consideration of sharpening or eliminating language about the balance between the three components. That is such an ambiguous term. One cannot balance elements unless they have known weights, and so it is an invitation for people to do anything they want to do in terms of the distribution of activities across the day, as long as there is something from one of those elements in the week, then it's balanced.

So I think we need something with greater specificity. I don't know if it will come from your task group. I don't know where it's best found, but I do think greater specificity is needed.

MR. SCHMID: Well, the point of the language, of course, is to make sure that all three components are covered. What I mean is the intent is to make sure that there is not a choice to be made between conceptual understanding and computation. That is the message here.

MR. WHITEHURST: Okay.

MR. SCHMID: And, of course, exactly how it's gotten across that is surely a matter to be decided, but that is the point, that all of these three components are important. They reinforce each other, and that it's a false dichotomy to say that if you cover one in depth, we cannot spend as much time on the other.

MS. BENBOW: Yes, Tom.

MR. LOVELESS: I have a question about the slide that began with: While there is acknowledged sequence of skills in K, eight. I'm wondering who has acknowledged that sequence? I recall that in an earlier draft from your committee, you referred quite accurately to Schmid's curricula analyses of high-scoring TIMSS nations and noted that they do not share a common sequence in terms of their skills.

Now, some of what I mean by "sequence," is the order in which various concepts are taught. At the end, they all cover the same thing.

MR. SCHMID: Yeah. I think that language slipped in somehow. I agree that we are not making the statement that there is a clear-cut sequence of K through seven topics. So, I mean, as as I saw the language, I was also somewhat disturbed. It slipped through.

MR. FENNELL: Slipped through because I did it this morning at about 6:30, and you weren't alongside of me to help me out.

MS. BENBOW: Bob.

MR. SIEGLER: Yeah. I both wanted to echo Russ's point that I think it's important that we say something like that computational and problem-solving conceptual facility all need to receive substantial emphasis, and also to make the argument pretty explicitly that these are indeed not in opposition to each other but rather that they are mutually reinforcing.

There is research that I can point you to that shows that better procedural understanding helps people gain conceptual understanding, and similarly better conceptual understanding helps people gain procedural competence. And I think it's worth making that argument often throughout the report.

MR. FENNELL: That's helpful. We would appreciate that research. Deborah.

MS. BENBOW: Deborah.

MS. BALL: This raises a point for me that I actually have about other sections of our report, and I'm curious why we are not making more explicit reference to Adding It Up. I mean, the point that Bob was just making leads me to point out that we actually want. I at least hope that we are going to be cognizant of the fact that mathematic proficiency, as it's referred to in that report, includes more than a conceptual understanding and procedural skill and problem solving. It also includes mathematical reasoning, which we have not been spending much time on. So I'm really saying two things. One is: Let's not forget about mathematical reasoning, and the second is: It potentially gives us one way to make that clear because that already contains a concept that interweaves those in a way that we have been discussing.

MR. FENNELL: We have something in the draft yesterday that dropped out of there, and we certainly will acknowledge and continue to use that.

MS. BENBOW: Wu.

MR. WU: I think that the point is that there is no reason to reinvent the wheel. For ease of reference and I think that goes to perfect mathematical proficiency is pretty well-accepted, as long as I can tell, though I think it's an easy reference.

MS. BENBOW: Any other questions?

MR. BOYKIN: In many school systems, courses that are taught in algebra as well as in something called pre-algebra. Is that a distinction that's worth making or is that a false dichotomy?

MR. FENNELL: An opinion only, false dichotomy. What we are trying to do is we hope to get to the mathematics that would lead students to begin a serious study of algebra without a lot of things thrown in that one would argue pretty strongly are not necessarily algebra, without picking up things and fractions that should have occurred at the fifth grade level or fourth grade level, what have you.

So we are trying to speak very directly to algebra as we propose it. And as at least one member of this Panel knows when you say pre-algebra, it's wide open in terms of what's in such courses, and we are trying to really hone in on the way algebraic kinds of notions from the beginning through the end courses. In a very deliberate way, we are talking about algebra, and we have not sliced one versus two versus three or what have you. We are saying this is algebra.

MS. BENBOW: Any other questions? All right. Thank you, Task Group One. And Task Group Two, move on up to the podium, and I'll hand back the chair to our chairman.

MR. GEARY: Okay. I'll start by introducing my group. Dan Berch, who is not here as an ex officio member and was unable to make it from Washington to this meeting. Wade Boykin, Bob Siegler, myself, and Valerie Reyna have all contributed to this report.

I'm going to skip the first slide there and just go right into the goals of our charge. And as was mentioned earlier, our charge is to provide a review of the best available evidence on how children learn mathematics and mathematics-related material and how this learning may vary across different particular groups.

We begin this with a basic overview of learning in cognition, basic principles, basic concepts, and how learning actually occurs. That's one of our goals. We want to review and have a draft of the mathematical knowledge that children bring to school.

This is particularly important, as we'll see in a minute, because those who start behind tend to stay behind. We then do reviews of math learning and key content areas. These will include whole number arithmetic, fractions, estimation, geometry and algebra, and the latter two will follow the lead of the first group in terms of specific areas that are of high interest.

Related to the charge, of course, is better understanding of individual group differences and outcomes in all of these areas. Finally, it is often noted that brain science forms the basis for education, and that may well be the case, but the stated knowledge is such that such claims and such implementation will be premature. Nonetheless, there is interesting work in this area that can be used to test specific hypotheses regarding learning and changes in brain functions or cognitive functions, as a result of learning. And so we plan on reviewing some of that literature.

With respect to the kinds of methodology, the research we will review typically involves theory testing, and typically for acceptance in the field, it requires demonstration through multiple methods. These methods may involve studies that are just observation of children's problem-solving, whether counting on the fingers or whatever they might be doing that is observable while they are engaging in the mathematical process.

Maybe verbal reports from anything from “I just know that fact” to very long complicated analyses of problem-solving protocols. How long it takes them to solve the problems since reaction time and error patterns tell us much about, or can be used to tell us much about, the sequence of processes that may be going on during mathematical problem-solving. They tell us about areas of interest and so forth.

Priming implicit measures. So we quickly present an aid to somebody and a fraction of a second later present three and five or three plus five. Does it affect their processing? Three plus five. And if so, that says something about the way in which that information is represented in long-term memory.

There are various experimental procedures that are used to study these issues to task procedures where one aspect of working memory may be engaged and we think is involved in solving a particular type of task by engaging that task performance. We have experimental confirmation of that. There are more recent techniques that allow for a direct electromagnetic disruption of those systems.

We can look at the effects of practice, so forth, random assignment groups to different types and different levels of practice.

Computer simulations of learning and cognition in these particular areas is fairly common. These provide detailed descriptions of all the mechanisms we have hypothesized. They have been referred by empirical measures. The simulations are run and tested in terms of error patterns, produced by the reaction time pattern, learning patterns, and so forth, and these provide very detailed and rigorous feasibility checks of the models developed from the empirical studies.

Finally, brain imaging and related technologies are being used increasingly in this area, as we'll see that it may provide some very interesting information. Conclusions that we will draw will typically be based on convergence and results across one or more, typically multiple, procedures.

All right.

Some just very basics of what we hope to cover in the first section. Cognition is functional capabilities of the brain. Obviously, learning involves improvement of these capabilities as a result of maturation and experience. Some of that experience occurs in the classroom, and much of it occurs elsewhere, depending on exactly what is being learned.

We know a considerable amount about the aspects that affect learning. Working memory is particularly important. It's an attention-driven ability to mentally represent and transform information. It's holding information in mind and doing something with that information, whether it be a phone number or an algebraic equation. This is going to require attention-driven components of working memory. That information will be represented in one or several contents: Specific representational systems, the language base, the spatial base, or memories or personal experiences.

Working memory is distinct from long-term memory. They show different patterns and many measures, and that's just storage of information for later use. And even within the class of long-term memory, there are different types of skills, declarative such as verbatim recall of facts, procedural or arithmetic algorithms, that type of memory, and conceptual. There are different brain systems underlying these different forms of memory.

Principles of learning. Learning requires working memory and attentional focus no matter what the content is. Different experiences harbor are required for different forms of knowledge. Verbatim learning typically requires extensive practice that is distributed over time.

Gist conceptual learning may occur with insight, demonstration, exploration, instruction, discussion. There are different systems, different brain systems, different cognitive systems. There is no reason to believe that the same instruction will result in the skill development in these systems. Different things will be required.

Practice leads to the automatic retrieval of declarative information or the execution of procedures. That is important no matter what the memory system is. Long-term memory results in reductions in working memory and attentional demands for executing these particular skills. And when working memory is freed up, you free up the ability to learn more material.

Conceptual knowledge is important, not so much because of its effect on working memory, but because it allows for generalization of what has been learned to related materials.

One particular example in which this type of information is potentially useful is choking under pressure. We may yet see that happen here in the course of this talk. I don't believe it's happened yet.

Choking under pressure occurs, and it's happened to all of us, of course. It's situations that focus on one's competency. As long as that competency is of importance to you, and that involves high-stakes testing, and this has been exclusively tested in experimental studies of the types I described previously.

Choking occurs. We know why choking occurs. It occurs because competency-related thoughts intrude into working memory. As you are taking the test, doing a golf putting, whatever the case might be, if you have concerns about your abilities in that area, those concerns are difficult to suppress and will pop into working memory. As they pop into working memory, attention shifts from the task at hand to the internal representation. You start thinking things like, “I can't do this, and I’m not sure I'm going to get through this,” and so forth making that task, in a sense, a dual-demand task so such that the limited working memory you have or attention you have is split between two things, one task-related and one competency-related.

Experimental studies have shown that if you teach well the material on the content test such that the facts, procedures, concepts, or whatever is being assessed are retrieved or executed automatically, there is no choking that occurs because working memory demands it, processing the content material is reduced such that even if you have intrusive thoughts, they do not disrupt performance.

We know a considerable lot about what children bring to school, and just as an example of some of the material we will be reviewing and continue to review is the evidence that children have an informed sense of quantity from the first day of life. They discriminate in small quantities and are sensitive by five months of age to small additions and subtractions to these steps.

They know if you have three things and take two away, they know something has happened that has decreased the quantity. They have a basic sense of working relations. Preschool children can count, add, subtract, and make simple measurements. The early sense of quantity is a necessary but a not sufficient basis for learning mathematics at school.

This early sense of quantity does not vary as much across different groups, social economic groups, for instance. When we look at more formal mathematical knowledge, that knowledge that kids bring to school, such as knowing Arabic numerals or actually knowing number words one to ten, we see large differences, and we know from empirical studies that children who start behind tend to stay behind. We will also review our promising interventions that can reduce these early differences.

We are approaching completion of the review of whole number arithmetic, and that includes the factors that influence fast and efficient retrieval of facts which involves declarative memory. We have a very good understanding of the learning and cognitive mechanisms that are involved in this.

We also know that most children in this country do not achieve fast and efficient retrieval of basic facts, and this is a potential problem for solving more complex problems in which these basic facts are conveyed. This would be word problems or more complex computational problems.

Learning algorithms involves procedure memory. We know a fair amount, not quite as much, but a fair amount about the mechanisms involved in learning, addition, subtraction, and multiplication procedures. This involves a combination of those. Not enough exposure to some of these problems as well as a poor understanding of latent concepts such as base-ten and trading can cause problems.

Kids often make errors of inference (commutativity and subtraction). Addition is incorrectly inferred, or its use is incorrectly applied in subtraction.

Unfortunately, we know little about long division, although we do know a bit, which we will review. There are core concepts that we will review. Commutativity, associativity, distributive, identity, inverse relations, subtraction, multiplication, division, base ten, and training.

Most of the research that is available is on commutativity and addition. Some is available on base-ten. Additional examples of where much less is known are the distributive and identity properties. U.S. children and even college students do not do well on many tests that require knowledge of these skills.

Individual and group differences. We are going to do reviews of skill development in these particular areas as it relates to race and ethnicity, gender.

Learning disabilities. They have begun a review of learning disabilities. We know from multiple large-scale studies now that 5 to 10 percent of kids show significant problems with learning sometimes before graduating from high school, significant problems being relative to their peers who receive the same curricula and the same cognitive ability level. They are one to several degrees behind expected performance on mathematics tests.

We know a bit about why this occurs for simple arithmetic, a little bit about complex arithmetic that's related to a mixture of more procedural development, late acquisition of arithmetic facts, and it may be underlying brain and cognitive deficits for some.

We have also drafted our review of gifted kids, and we know just generally kids who are bright learn the same things, often the same sequence, but with less practice and less exposure to that material. So they move through the curricula at a much more rapid rate.

For the gifted kids in general, this ability to move through the curricula more rapidly is related to enhanced executive functions and attentional control, no doubt other things as well. The mathematically gifted but not so verbally gifted seem to have enhanced ability to represent information in a visual-spatial system and are quite facile at manipulating quantitative information such as the numbers in working memory. The verbally gifted have parallel gifts but related to verbal skills.

Finally, we will review a bit of the evidence on brain science and learning. As I said, it is premature to apply this to a classroom, but nonetheless it is relevant to our charge and is informative. We know now there is considerable evidence that initial learning, whether you are an adult or child or whatever, you are dealing with something that is novel to you, is going to engage the prefrontal areas of the brain, the front part right behind your sinus cavities and back just a bit, and this kind of consciousness is associated with effort. It's tedious, requires attention, and can be quite challenging, not a preferred activity.

We also know that the inborn sense of quantity may be involved in a strip called the intraparietal sulcus or at least part of that strip in the parietal lobe. So in an individual with medical problems both of these areas are engaged. Now we know from experimental studies where adults have learned these problems or novel problems over time, or we look at kids across grades that skill development involves reductions in activation of prefrontal area. Exactly those that would be expected for skill development are a reduction in working memory demands, attentional demands, some reductions in the parietal lobe, but increased engagement in the annular gyrus and other areas that I'm not going to mention here.

So the learning that we describe associated with cognitive studies is now being substantiated in the brain-imaging studies and results, to a large part, are very consistent with each other.

Our next steps are to review fractions, estimation, core areas of geometry and algebra and other core areas that the first group determines are key to the extent to which that knowledge is available in the literature. We need to move on to review differences and similarities across race, ethnicity, and gender for key areas and draw explicit links to the other task groups.

MS. BENBOW: Are there any comments by any of the other task group members? No. Questions? Tom.

MR. LOVELESS: The question on the choking --

MR. GEARY: Yes.

MR. LOVELESS: Are you going to include in that a look at the studies over the last ten years of stereotype bias? I'm thinking of Steele's work.

MR. GEARY: Yes.

MR. LOVELESS: Now, there is some new work on gender, the same type.

MR. GEARY: Yes, we will. I should have mentioned that we will be covering motivation, social affect, such mechanisms as related to mathematics.

MS. BENBOW: Wu.

MR. WU: To go back to the first slide, I wonder whether we can reopen discussion on the --

MR. GEARY: This one (indicating)?

MR. WU: The inclusion of estimation is something on the par with the other topics. Should we make estimation a key concept area? I think estimation both in terms of depth and scope is not on the same level. I would be happy to see the whole numbers and fractions. Estimation by itself I don't believe would be a key area. I think that one key area is actually missing, which is fractional numbers, or, if you like, negative numbers.

MR. GEARY: Yeah.

MR. WU: A gap.

MR. GEARY: Yes. Rational numbers would be covered in fractions. In the listing here, this does not mean that all of those areas would be given equal weight. They are just a list of areas that we will cover. And certainly estimation on content in and of itself --

MR. WU: Maybe take it away as a key skill because these publishers are going to see this and are going to have five chapters on estimation, whereas they don't have anything right at the moment.

MR. GEARY: Yes. It's not going to have five chapters on estimation, but certainly it is a key skill, and it's related to computational development, understanding, and other types of things is something that we have something to say about.

MR. SCHMID: From my point of view, I mean, the only problem here is the way the slide is arranged, which would suggest that estimation is coequal with algebra. This is surely not a message you want to send.

MR. GEARY: No. That was not our intent.

MS. BENBOW: Skip.

MR. FENNELL: I think what your intent is -- and, of course, it isn't to have folks with five chapters on estimation. It is to present the role of estimation, perhaps even now in mathematics, along with proficiency with whole-number operations and rational numbers and so forth. So I know that you and I had kind of a sidebar conversation on that.

I want to back up just a little bit and ask if it's too premature to ask you where you are with and what you found relative to algebra?

MR. GEARY: We found -- well, to tell you the truth, we started from the bottom and just were working our way up. We will get to algebra and geometry. There is some work on algebra, but not nearly as much as needs to be done,as in say, whole number arithmetic or fractions, but it will be there.

MS. BENBOW: Deborah.

MR. GEARY: Bob.

MR. SIEGLER: Yes. I'd like to respond to Dr. Wu's comment about estimation. I actually think this is a crucial dimension of mathematical development not just for algebra learning. Our charge goes beyond preparing children for algebra learning, though certainly that's the main purpose, but also preparing them for mathematical literacy in life.

And if you think about what you and what most people do with mathematics in everyday life, estimation is used constantly. It's also a false dichotomy given a large amount of research to totally separate estimation from computation, so that when children are retrieving facts, when adults are, too, it's not just you activate 14 when you hear 6 plus 8. Better students activate the numbers close in like 13, 12, 16, and they don't activate numbers like 8 or 24. What students do, there is a greater spread of activation. So being able to estimate the quantities is important. This becomes more important with larger quantities, for example, two-digit by two-digit multiplication helps people learn a computation in the same way that computational skills are crucial for learning estimation.

It's also important for learning algebra. So very often students generate totally implausible answers to algebra problems, and they don't have the estimation skills to check whether those answers make sense or not. So that for all those reasons, both within algebra itself and across the adult lifetime, I think estimation actually needs to be included, and it's a crucial skill.

MS. BENBOW: Wu, did you want to come back with that?

MR. WU: Exactly.

MS. BENBOW: If you could turn off your microphone when you are not speaking, that would help us here. Thank you. Because we can only have two on at one time.

MR. WU: Well, I just wanted to make clear what my comment was all about. The first one is certainly I don't want it to be listed as key content area because we are not discussing preparation for life. It is a mathematical statement that is supposed to be judged on a completely mathematical key content area, and I think it would be at best contentious to make that claim in terms of mathematics that estimation is a key content area.

Now, we are not talking about research mathematics. Approximation is the topic, but we are talking about year eight mathematics, and it will be open to a lot of debate to say that in K through eight mathematics estimation is a key area. So we can say that it is a content area of interest, just so you publishers and readers alike don’t confuse matters. I think I would have no problem with that.

And the other point I'm trying to make is I completely agree with what Bob was saying, that estimation should not be singled out. It should not be separate from numbers. My only comment is that I would be very happy to see estimation to remain a part of emphasis every time numbers are discussed, whole numbers, fractions, and rational numbers. That I think is the problem.

MS. BENBOW: Deborah?

MS. BALL: This is a question from earlier. I wanted to ask just a little bit more about when you talked about looking at group differences, I don't remember if it was based on race, maybe language. I'm not sure what the difference is. You were thinking of group differences.

I'm kind of curious what kinds of things are you thinking of looking at. In part because there is one thing I'm worrying about right now. I'm interested in both. I’m interested in the angle that the group is taking on this.

The one thing that doesn't seem to

follow anywhere right now in our work as a Panel is the opportunities, the differential opportunities, for learning that students living in poverty and students of color have perhaps students of English language. I'm not sure where across our groups that's falling. I'm not sure if that's your group with means or if you are doing something else. And maybe you are not far enough into it to say what it is you will be doing. But in any case, as a Panel, we need to say where we are going to work on this.

MR. GEARY: Yeah, I don't expect that we will cover everything that the Panel will eventually cover in these areas. Our thinking was we would look at whatever data were available in the content areas, whole numbers, fractions, algebra, where differences emerge. If we can determine whether those differences were larger for some areas than others, then that would certainly inform the other groups. And we will be exploring different ways of potentially narrowing down where differences are more likely and less likely to occur.

MS. REYNA: And I should add, too, we should have included socioeconomic status. We certainly should have included socioeconomic status in our discussions.

MS. BENBOW: Tom.

MR. LOVELESS: I want to go back to the exchange between Wu and Bob. I agree with what they both said. I think Wu's point, though, should be noted.

In terms of the way our report may be read, my problem is with the word "content." Estimation skill that is used to reinforce learning of numbers certainly it's important, but I think I would break it out of that group, that cluster of content. I just don't think I would consider it content.

People, state officials, or other policymakers who read this document are going to see if you discover through your evaluation of the literature that there is a real problem with estimation. They are going to take that as a content area, and they may make some decisions that you did not intend to.

MS. REYNA: Those points are well taken. I should add to this. We are referring not to mathematics, per say, but we are referring to topics that have been researched on learning processes. So that's an important clarification.

MS. BENBOW: Address?

MR. WHITEHURST: I wanted to follow up on kind of a throw-away line you had that you were also going to consider social and motivational processes and just encourage you to --

MR. GEARY: Yeah, it's not a throw-away line. We will have a considerable amount of material on that.

MR. WHITEHURST: There is an elegance to the information process model in a way that given it's theoretical construct can deal with how people learn, but the President's charge to speak to the processes by which children learn, I think, is not exclusively a charge --

MR. GEARY: Absolutely.

MR. WHITEHURST: -- to look at how information is processed. It's also to address, for example, what we know about dispositional differences among children, individual differences, and all of those things are sometimes framed in the context of other theoretical models, which I think could be very useful to the other task groups as we are trying to approach our responsibility.

MR. GEARY: Right.

MR. SIEGLER: That's in the process of being done, actually. There is a fair amount drafted on that in the section that wasn't this far along as the other three, but we totally agree with your point.

MR. WHITEHURST: Thank you.

MS. BENBOW: And you want to say something?

MR. BOYKIN: Yeah. Just a case in point, Russ, we will entertain other theoretical frames like gold theory, attribution theory, intrinsic motivation, social culture theory as well, and that certainly will play a prominent role.

MS. BENBOW: Wilfried?

MR. SCHMID: No.

MS. BENBOW: Any other questions? Yes, Russell.

MR. GERSTEN: This is partly as much out of curiosity, but have you found the same precision or any precision in the measure of conceptual knowledge compared to procedural or declarative?

MR. GEARY: In some areas, yes.

MR. GERSTEN: I just --

MR. GEARY: Yes, in some areas.

MR. GERSTEN: Yeah.

MS. BENBOW: Do you have a question?

MR. SIEGLER: Yeah. Just to answer Russell's, there are a lot of paradigms using judgment of the worth of various mathematical procedures by children that indicate conceptual understanding.

And, again, I can point you to some of the articles, if you would like. You’re right that it's not as far along in general, and it's a harder task, but there is a fair amount out there.

MS. BENBOW: Any other questions,

Task Group Two? All right. Thank you. You can return to your seats, and Task Group Three move on.

MR. GERSTEN: I will first introduce the members:
Diane Jones, Vern Williams, Tom Loveless, and Camilla Benbow. Three of us are going to share responsibilities for talking about some of the aspects of our progress to date, and we will begin with Camilla and Tom talking about two large areas where we are really going to look at the research. Then I'll give a sense of our methodology which we did agree as a group upon yesterday. So we'll start with Camilla.

MS. BENBOW: Okay. Our report is going to be rather brief. We have spent most of our time discussing how to frame our questions, and then what are the issues that we want to tackle and in what order.

First, in terms of trying to organize the whole literature on instructional practices and materials, we thought that the instructional triangle that was described by Ball and Cohen was a very nice way of organizing the issues. Basically, if you start thinking about instructional practices or even the materials, instructional practices are enacted by teachers. Students are part of the mix and influence the teacher's behaviors and, of course, the content is an important component of what actually happens in the classroom. So instruction is really an interaction among teachers, students, and mathematics. So we use this as a kind of an organizer of how to organize the materials.

Now, the task group considered a long list of topics and issues, and it had to kind of prioritize its work and pick two problems to tackle first. Now, I am going to present the two big issues that we are tackling first, but let me begin by saying that there are a lot of other issues on our plates that we will pursue later such as instructional materials, formative assessments, practice tools such as manipulatives, calculations, technology, but we have not begun that part of the process yet.

What we have done is focus our work on two key questions, and we have conducted a literature review. We are right now trying to organize that literature review. The first question that we are looking at is direct instruction versus inquiry-base instruction, or you could say explicit instruction versus discovery learning, or another way to capture this dimension is teacher-centered versus student-centered instruction.

Now, we want to be clear. We are very aware that what we are describing here are extremes of instruction, and hardly anyone does use just one extreme. Usually if you see instruction in the classroom, it's a mix of various methodologies. Nonetheless, in the field, this is a big issue that we have picked up. Which one is more effective, direct instruction or inquiry-based instruction, when, for whom, and are there differences, for example, for kids with learning disabilities, gifted children who some resonate to one approach better than another? So we are going to be looking at that in the next few months as we work together and prepare for the next meeting. I'm going to turn it over now to Tom, who is going to present the second problem.

MR. LOVELESS: The second problem is real-world instructions. Again, with both of these questions, the student-centered and teacher-centered and the real-world instruction question, we wanted to get at controversies, the number of people who say that they have -- on both sides of these questions -- who say research supports their point of view. What we want to do is provide a good summary of what the research actually does say.

In terms of real-world instruction, I missed yesterday, but two notations that I received that were concerns of fellow Panel members were, one, to talk about the relevance. In other words, why are these topics important? So I'm going to focus on that.

I'm also going to talk about a rationale and criticism of real-world instruction, and then finish by talking about how we are going to broaden out the topic.

First of all, real-world instruction is currently embraced by federal policy. The NSF, when they issued their request for proposals to middle school math curricula, for instance, in the '90s, stipulated that these programs focus on application of real-world problems that interest and motivate students, and all five of those programs on their web site say that their programs do just that.

The NAEP framework calls for real-world problems 12 times and across all three grade levels, fourth, eighth, and twelfth grade. The NAEP math framework, to give you an example, in eighth grade calls for the NAEP to assess whether students can, quote, “solve mathematical or real-world problems involving perimeter or area of plane figures such as triangles and rectangles, circles, or composite figures.” So it is embraced by federal policy.

Another example. Solving real-world problems is a criterion for differentiating student performance standards: basic, proficient, and advanced. So when you hear about the percentage of students who are at those various levels, those levels are in part determined by the students' ability to solve real-world problems.

It's also embraced by state standards. A recent review of state standards conducted for the Thomas B. Fordham Foundation by David Klein and a group task force that he put together -- and by the way, this group is critical of real-world problems, as you'll see in this quotation. They reviewed the standard of all 50 states, and they described an excessive emphasis on real-world problems in these standards.

The review warned, quote, “excessive emphasis on the "real-world" leads to tedious exercises in measuring playgrounds and taking census data, under headings like "Geometry" and "Statistics," in place of teaching mathematics.”

Now, the real question here is: What do we know about real-world problems? Do we know when they are effective, if they are effective, how they are effective, and the various interactions of real-world problems? Perhaps they are only effective with teachers of a particular kind. We don't really know. Those are the kinds of studies that we are looking into.

Now, the rationale and criticism of real-world instruction, first of all, in terms of the rationale, those who argue for a greater emphasis believe that it motivates students. So that's sort of a pre-lesson argument. The second is that it boosts student engagement during lessons, and the third is that it raises student achievement by make learning more meaningful and that kids, then, retain the long-term knowledge. We are going to examine these. These are empirical claims. We want to see if the research can shed light on this.

What do we think we'll find in research? We don't really know. However in the mid '90s, there was a spirited debate on situated learning between John Anderson of Carnegie Mello –- Mellon and James Greeno of Stanford. Carnegie Mellon is not mellow at all -- situated learning addresses some of the literature on real-world instruction, and they took opposite points of view on what that literature says. We want to review that, but also the research has been conducted. I believe that was in 1996 that we will add to that.

In terms of broadening the topic, one of the comments that came back from fellow tasks members of our Panel was that this topic maybe should be broadened, and if it is, we think here is where some of the direction may go.

First of all, in terms of sequencing of tasks, we may find out that it's appropriate to use real-world problem-solving at the end of the lesson to reinforce concepts and skills that kids have learned or, perhaps, at the beginning of a lesson as a way to boost motivation.

The second issue will be time. If instruction focusing on real-world problems takes more time, the time will become an element in any cost-benefit analysis.

I recall from my own experience teaching sixth grade receiving a unit, for instance, that took two weeks to teach bar graphs. As a sixth grade teacher, I felt that was far too long to spend on that one concept that I found that I could teach in a half hour to 45 minutes.

And, then, the third point, there is a subset of research on problem-solving. Of course, that intersects this topic of real-world instruction and also intersects with research on situated learning, as I discussed earlier.

With that I'll turn it over to Russell.

MR. GERSTEN: This will be a rather casual overview of the very serious issue of how we are going to handle this social science literature.

This is the plan that we agree to. We are going to call a set of studies, and we'll do some of the initial screening, especially on methodology. These will be the studies that are -- begin to indicate causal relationships, experiments, and quasi experiments.

Our standards will be related to those of the What Works Clearinghouse. We'll use that as a point of departure, and later on I can share with others the similarities and differences.

One important thing that Abt Associates will do and that we will then double-check is when studies are flawed. If, for example it is a study that tries to develop, you know, prove that A is more effective than B and there are some serious flaws and they are the identical flaws that the clearinghouse has that IES has identified, we will simply put them as flawed studies. We will not further discuss those studies.

On the other hand, we are now pulling more studies. We are having two other tiers of studies, which will be potentially used in our analysis. Tier two is other quantitative studies. They could be correlational studies, descriptive studies such as the TIMSS. They can be longitudinal descriptive studies.

Here we can include some parts of the beat-the-odds school studies, which are kind of correlational descriptive. Those are studies that we are right now calling tier two. They will not initially get the same rigorous analytic review that tier one will.

Tier three will be qualitative studies which include case studies including the more qualitative parts of beat-the-odds school studies, but including some of the very rich and insightful descriptions of either teaching and learning processes or kids' perceptions of things in a classroom situation. So those we are simply putting in tier three.

Two and three there is no reason to assume one is better than the other. It's just a quantitative and qualitative.

The next -- what we are going to do as we look at the tier one studies is not just what a simple meta-analysis does, which says which category do we put it in and what is the effect size? We are going to look carefully at some of the issues that Deborah raised, I believe at our first meeting, about the context, the type of students, who is doing the teaching, are these just typical teachers from the Nashville metro area, or are they two doctoral students getting a Ph.D. in special education or child development at the university. So we will look at all those factors.

Dr. Wu has agreed, though, maybe he's had second thoughts about this, to review the quality of the mathematical tasks when that's available in the study. In some studies it's clear. They clearly explained what and how they taught the students. Others say we use the fourth-grade curriculum for the state of Illinois. For those where there is a description, Dr. Wu will, perhaps, with some assistance from other mathematicians, will look at: Is the material they are learning mathematically sound?

I'm pushing the wrong button. Thanks.

The tier two and tier three studies, this is how we are seeing their role, and this is something, at least I've struggled with since the beginning of this Panel, is how are we going to use them to help frame research questions and issues. We are especially going to use them as we start to get findings and patterns of effects. We'll use them to help us interpret and understand what is likely to be going on. So those are the two ways we will use those studies, and that is our current work plan.

I believe it's commensurate with the work of the standards group, but that's our attempt, to operationalize it.

We are going to begin almost immediately now that Abt has found the first batch to sort these out and figure out how they fit our topics and questions and how many quality studies.

And unlike some of the other groups, we are going back 30 years because of some of the still relevant -- and it's certainly interesting -- research from 25, 30 years ago will be useful.

MR. WILLIAMS: Can I add one thing to Russell's presentation?

MR. GERSTEN: Sure.

MR. WILLIAMS: In terms of our literature research, all we have done is gathered research. We have not yet reviewed the research, and all we have research on is questions one and two.

We have the abstracts that Abt has provided us, and they number probably over a thousand, right?

MR. GERSTEN: Isn't it 150? I believe it's 155.

MR. WILLIAMS: Oh. Well, so much for my estimation. Yeah, the document I have is 50 pages long, and I counted about 10 per page. So, anyway, maybe I looked at something wrong. Anyway, the point is we have not yet begun to dig into this research, and that's our next task.

MR. FAULKNER: Are you finished?

MR. GERSTEN: Yes, we are finished for our presentation.

MR. FAULKNER: Let's go to Deborah first.

MS. BALL: An interesting feature of what your group is doing is that you seem to work on the desperate call-out for definition, and you acknowledge that they are not well-defined in the field, and I guess I have a couple of comments and questions. One is I really hope we are going to be really cautious about these. I thought the way you expressed that Camilla acknowledged the speciousness in a way of these distinctions of people who don't know very much about teaching often use to describe teaching, but I hope that as you dig into the literature that your group will help us figure out what's a more precise way to work on what's known about instruction.

I am actually quite worried about the way, Tom, that you talked about the real-world problems. I think as you proceed into that, too, requires a great deal of definition. Real-world instruction is a strange phrase, and you mixed quite a few phrases in there. I understand it's at the beginning, but given that presentation, you only told us about the problems with it and also didn't tell us what it was.

I'm just concerned that as we work forward into what I acknowledge is an area of lots of controversy that we see early on conceptualization, and I think it would be appropriate for us to be reviewing the arguments in favor of whatever this range of thing is and it gets called that, and I appreciate that it may be that we have a range of perspectives as we move forward. I didn't hear that today.

MR. LOVELESS: Well, let me allow

you to hear it now. What we intend to do is we want to cast the broadest net possible right now. So what we are doing in our review of the research is to look at when researchers said they have studied real-world problem-solving, we'll take a look at what they meant by that. In other words, what was going on in those lessons. There are some studies, even with randomized field trials on this question.

So you are quite correct. The definition of what is real-world problem-solving may differ a great deal from study to study, and, of course, we'll take that into account as we review their findings.

MR. GERSTEN: Can I just add something. I’d also like to respond to that. In both areas, it's less our framing of things. It really is just a way to sort through the actual studies, and we are going to stick not just to the data but to what the study is about, what really was studied.

So I don't think at the end we are going to say we found nine experimental studies on real-world problems. We are going to say nine studies approach this issue, which will be much more carefully thought through, and right now, including those who are very supportive of it in some of the work in cognition, etc. Then we are going to actually describe what these types of problems were, not every single one, but give the reader a clear flavor of the array of things that were studied and who they were studied with.

MR. FAULKNER: Wilfried.

MR. SCHMID: Well, I'd just like to add to this discussion. I mean, there are clearly a number of problems. I mean by problems on tests, etc. where the real-world context is a very thin veneer. For example, in the TIMSS videotape, the geometry lesson in Japan, the two farmers, I mean, the context is a very thin veneer. I don't think things like that should be classified as real-world context.

So you ought to be very careful to make the point that it's a common practice now to use real context as veneer. As long as it is just that, I think it should not be counted as real-world context.

MR. FAULKNER: Okay. We'll go to Russ, then Bob, then Skip.

MR. GERSTEN: Could I just respond for a second to Wilfried? What Tom gave very little time to, in part because much of the day he was in the emergency room at the hospital, was spent on expanding out the idea of the kinds of problems that students have, not the type of computational problems.

One other dimension we want to look at is the mathematical richness and complexity of the problem.
That is just one facet and, right, again, there are sometimes mathematically-rich problems with a very thin kind of just veneer, something about birds or turtles, but the whole idea is the mathematical concept.

But we are looking at the work. We are really looking at this whole issue of sequencing problems and the kind of problems that are taught and better ways to do it.

MR. LOVELESS: And also that's why we have Wu coming in to take a look at the content, because if this content is trivial and it repeatedly is trivial in these experiments, then we need to know that. It's similar to Deborah's comment as well.

MR. WHITEHURST: My comment and, really, expression of suggestion for change is with respect to the evidence standards, the tier one, the tier two, and tier three. I think it's very important for you as a task group, as well as for each of the task groups, as they are ordering types of evidence in terms of levels, whether we call them levels or tiers, to be very clear about the context in which one type of study is not as good as another type of study, and what I believe you are talking about with tier one, tier two, and tier three studies are studies of the effectiveness or the impact with particular instructional practices on outcomes.

But, for example, if you would like to characterize the difference in instructional practices in China versus the U.S., descriptive information of the TIMSS sort would be the highest quality. This would be tier one evidence, and something else would be a lower level. So I'm just suggesting clarity with respect to the goal to which the tiers are subordinate. Otherwise, people will think we are saying that there cannot be a high quality qualitative study.

MS. BENBOW: Good point.

MR. GERSTEN: Yeah, Russ, I think we all feel that's a good point and something that will be explicit. Insofar as we are looking at effectiveness on student performance, this is why this system is in place. And as we go, insofar as we go beyond that, that's where we will clearly say that's why we are using these rich qualitative studies, etc.

MR. FAULKNER: Bob.

MR. SIEGLER: I think the empirical review will be an important part of what your task group can accomplish, but I also think that the nature of the real world versus non-real world, for want of a better term, dichotomy is so vague and so multidimensional that it will be important to do some kind of conceptual analysis of the dimensions that flow through this. It would also help to look at the reasons why people might think that real-world problem-solving, however they defined it, was crucial and why it wouldn't be.

So, presumably, one of the reasons is that people think it will be highly motivating to students more than just problems phrased in terms of symbols. But it's not at all clear to me that reading about two locomotives going toward each other at 60 miles an hour from 300 miles away is actually very motivating at all. Why would you want to know the square footage of a playground, unless you are a grounds maintenance person? So I think that's one of the issues.

Like whether the research literature actually provides any basis for thinking that these arguments are valid that people have given. Maybe it does, but I'm not aware that there is any research evidence making that point.

The other point I wanted to make has to do with the fact that some quite high-achieving European countries such as the Netherlands and the Flemish part of Belgium base a large part of their early curricula on what I have read are extremely rich and complex real-world problems. I don't know much beyond that, but I think it would be interesting to find out what they are doing there and whether, in fact, the real-world problems do contribute to the quite high achievement that is characteristic of those countries.

MR. GERSTEN: Well, in terms of your first point, there is the engagement, the motivational factor about, you know, world problems, real-world problems. We also heard in the testimony the first hour that if students don't know

how to apply math to situations, they have huge problems in chemistry, physics, and engineering.
In order to function in the sciences, you have to apply mathematics to situations involving molecules, atoms, etc. So that's a totally different rationale for use of these problems and one that, you know, makes more than a little sense to me.

MR. SIEGLER: Yeah. The fact that there are multiple rationales is precisely why I think it's important to enumerate them separately --

MR. GERSTEN: Yeah.

MR. SIEGLER: -- and to examine the evidence for each one. But I totally agree that it's just as a matter of common sense that students have to apply the math they learn to real-world situations.

It's not clear to me that reading about the square footage of playgrounds or locomotives approaching each other at various speeds from various distances actually is all that helpful. Maybe it is, but I think having evidence on this is crucial.

MR. LOVELESS: Yeah.

MR. FAULKNER: Skip, then Deborah, and then Wilfried.

MR. FENNELL: What I'd like to say with the real-world issue, because Bob left it, the slide discussed real-world instruction, and then the discussion got into real-world problem-solving. I suspect that there is some difference there. I would see this issue in context. I would see the notion of problems situated in the context to be interesting and then the extent toward this particular context are more than interesting as others, as Bob sort of indicated.

Tom, you gave an illustration of when you were teaching where the context was timed in other words, it was suggested you spend "X" number of weeks, when here is something that could be done with a particular context in much less time.

So I think the role of the context

in problem-solving is really the issue here, and I think, frankly, the phrase "real world" is nothing more than a qualifier. And depending upon how you look at it and interpret it, it could be controversial. It could be exciting and all that, everything in between. So I just express care there.

I also express care, Camilla, when you presented an initial slide that said something direct versus inquiry instruction, and it was versus, and I would believe that any teacher is probably using elements of both however those two polar opposites are defined.

So to me the more interesting question or more interesting finding is: What are the elements of direct instruction? What are the elements of, if you will, inquiry mode of instruction where we have research that says this is important for this kind of mathematics, this kind of teacher in this kind of setting and so forth?

And I don't see it as a versus question at all. I see it as a way to gather information about these things, and there is a need to do some sharpening in terms of what we mean by them, but I also believe it's the elements within those that are critical to instructional practice. Vern wants to say something.

MR. WILLIAMS: I have a couple of comments first about what you just said. I had mentioned yesterday in one of our sessions that if you want a grant or if you pick up any in-service course catalog, most of what you're allowed to choose is based on not direct instruction or teacher center but more inquiry and student centered.

So it seems to be an either or in a world of school systems and in-service teacher preparation; that inquiry student-centered is a much better route to take than direct instruction. And, in fact, I gave the example that we are having an in-service in our school system, and in order to qualify to present, you had to answer certain questions. And when you answered the questions, you were almost forced to say we are going to use manipulatives, we are going to do groups, we are going to have students discover in order to present whatever topic you were interested in. That's one thing.

The other thing would be real-world problems that I have a concern with is the sequencing, of course, which is what we'll deal with. Many so called real-world problems in the newer textbooks are presented to introduce topics. And when you are introducing a new math concept, the one thing you need to focus on more than anything else purely is the mathematics and the procedures involved. You don't need to talk about the real-world situation when you are just simply trying to get the concept. And many times real-world problems are introduced to justify why a kid should learn the material.

I think problem-solving is

crucial, like everyone else, but at certain times, it almost infests the lesson and does not allow enough focus on purely the mathematics. You didn't seem too happy with my first answer, but --

MR. FENNELL: No, no. I'm sorry --

MS. BENBOW: I grabbed it. You don't have two people.

MR. FENNELL: I'm just saying --

MR. GERSTEN: This is a block move.

MS. BENBOW: Larry gave me power, and he should never have done that. Let me go back to the direct instruction and inquiry- based instruction and really reemphasize a point. This is a very sensitive issue, as you are being made very well aware of, and there are strong feelings on both sides.

And if I didn't make it clear, we really are dealing with definitions. We do have the definitional issues to deal with, and we are very concerned and aware of that, and we hope that as we look at the studies that we will have better clarity, and we can shine light on that and make this issue a little bit more transparent and understandable to people.

The other thing is we really realize that nobody does direct instruction in its purest, purest form, whatever that is, to tell you the truth, or inquiry base in its purest, purest form, whatever that may be. It really is a mix of methods.

And I think that when we look at the studies, we will see that there is a mix of methods used, and it's going to be, you know, it's going to be tricky to disentangle all of that. I just want to reassure you that we are very much aware of these issues and that part of the reason why this group has taken so much time is because this is such a tricky issue to get this right.

We are going to do our very, very best, and we are going to count on this committee. The other aspect of it I want to say is because there are such strong feelings and differing views, we are going to do our very, very best to look hard at the evidence to base our conclusions so that it isn't my views or feelings about what I think makes sense, but what is it that the evidence says. So let the evidence speak, and we are going to have to do our very best to organize that evidence in a clear fashion that you all will say, yes, we put it into categories. We did the comparisons in the right away.

But, again, because the emotions are high, we will stick to what the data said as much as we can.

MR. FAULKNER: Deborah and Wilfried.

MR. LOVELESS: I have one comment, Larry, before we go on. You are quite right, Skip, and your comment is right on the mark. These things are extremes. They shouldn't be pitted against each other. It's the mix that we are interested in.

In the experiments, however, where you have randomized trials, you do have random assignment of kids to an inquiry condition and a direct-construction condition, and that does, then, compare with the issue, again, for those two groups. In those experiments, then, you are running a horse race. So what we can learn from that, I think, still will be critical to report back in our final report.

MR. FENNELL: And then to me, Tom, it will be real important for you to take, if you will, that horse race data and parcel it out in such a way that says: Here is an element of direct instruction that's really effective. Here is an element of inquiry-based that's real instructive because I didn't hear Camilla, actually, you haven't said versus, and the only reason --

MS. BENBOW: I did say versus.

MR. FENNELL: That’s for you all to sort of think about, but I'm fine.

MR. GERSTEN: And if I --

MR. FENNELL: I'm sorry for the public schools that it is now on record about what a travesty that in-service sounds like.

MR. GERSTEN: I just want to

add that, for example, the horse race study was teaching one thing over a period of several days. So that it really fit as a component of teaching as opposed to a way to structure your full year of teaching. So we will stick to the facts of the studies, and right now we are still in this phase of personal opinions. We have only looked at the first two, but it's going to be an interesting transformation in this process, and input from others is critical.

MR. FAULKNER: Deborah.

MS. BALL: I actually am not completely satisfied with this last little round of discussion because the definitional questions go right into the research studies. So the fact that there isn't something, a clearly specified intervention, that you could call any of these things means that you are not going to be actually looking at horse races. You are going to be dealing with very significant problems of implementation and definition, and it isn't going to be as simple as saying students were randomly assigned a treatment because you are still going to take that same question and put it right into those studies.

And I challenge you to find studies that will be specific enough that you will know what those conditions are you are testing. That will be really important for us to all look at is what exactly was being done with students. It won't be satisfactory to be told by researchers that this was a random assignment to treatment because what they did under the name of either of those may be actually something that doesn't actually fit into a family of approaches.

And as someone who has done a lot of research in classrooms, I can tell you that such a wide range of things gets called these things, that one thing we can contribute is what I thought I heard you talking about yesterday, which is to not only, from the initial point, say you are looking at this in order to understand the controversies, but to be extremely analytic about the nature of the conceptualization of these studies.

And having read quite a lot of this work, I think you are going to find that it's very difficult to know what the treatments are at times. Most research I'm teaching, especially interventions, has been notoriously underspecified. So that's my first comment, and I really want it on the record because this is going to haunt us because you are quite right to have picked these flash point issues, but they are not going to go away when you put it with the data.

Second, I think that we really need to be cautious. There is a tone in our last set of discussions here of strong views on our Panel about these things, and our responsibility is to do what the words are saying, which is to investigate the evidence. An awful lot of our opinions are creeping in here, and we are going to need to be vigilant with each other to make sure that what we are really doing is raising to a new level of discussions and things that have interfered totally with the progress of helping kids learn.

MR. WILLIAMS: I'd like to state one thing. I absolutely understand the importance of research on the Panel, and we have tons of researchers here, and I think the Panel is amazingly intelligent; but being the only practicing K through 12 teacher on the Panel, I do need to bring just a little bit of opinion in the reality that's happening in classrooms.

So sometimes I might seem to be just a tad emotional, when everybody is presenting research; but I not only deal with this in my school system, in my classroom, but many, many other teachers K-12 over the last 30 years.

Camilla used the word "versus." People in school systems use the same word, that it's student-centered versus teacher-centered.

And for many, many years, if you leaned towards direct instruction, I obviously did both, and most people do both; but if you leaned toward direct instruction, you were considered not a good teacher. It's just a fact.

MR. LOVELESS: Just to comment on Deborah's point, I totally agree, and the definitional issues are there. However, I go back to my original slides, and that is these terms are used, in shorthand, by policymakers, they are essentially giving guidance to teachers, and they are telling teachers that they need to use real-world problem solving. This is true in all the documents that I showed you on the slides. It's true in state standards.

So if everything that Deborah just said is true, and I believe that it is, that would be important for us to state in our report that a lot of different research gets lumped together under one big term called "real-world problem-solving," and that in itself will be a contribution, if indeed that's what's happened in the research.

MR. FAULKNER: Wilfried.

MR. SCHMID: Well, I mean, what I'm about to say may be a trivial point, but I'd say Bob's remark struck me as follows. I mean, if you present a problem, for example, the two locomotives racing towards each other, one purpose that can be served by this problem and by a real-world context is just a quick framing of a question.

I mean, that is a perfectly legitimate use of real-world context, and maybe then it should be to make it a real-world context, we should make it cars, perhaps, rather than locomotives; but that is actually a much faster way of describing a problem than to describe it directly mathematical.

So that I would say is a legitimate -- very legitimate use of real-world context and should be recognized as such, the inefficiency of framing a problem.

MR. FAULKNER: Wade, then Bob.

MR. BOYKIN: Bob's is on the same line of discussion. He can go first.

MR. SIEGLER: Oh. First, I agree with Wilfried about the usefulness of those kinds of problems. I just think calling them real-world problems in contrast to problems that are used to take weeks and weeks to solve with many, many components.

It overloads the category.

MR. BOYKIN: Yeah.

MR. SIEGLER: It sort of makes the word mean nothing. That was the only point I was trying to make there. I wanted to follow up some of the things that Deborah said and reinforce this notion that the conceptual analysis of the dimensions that run through this sort of overused language, sort of bloated category, is really crucial because there isn't going to be any answer for sure if we just take problems that are called real-world problem-solving because they mean so many different things, and presumably some of them are useful, and some of them aren't.

So two of the dimensions that I think are particularly important to code studies within, when you are looking at them, is, first of all, the amount of time that is taken. So we have everything from the locomotive problems that take maybe 15 seconds to read and process the context to problems that take weeks, if not months.

So that's one dimension of difference among these studies that surely means that if you are going to compare apples with apples and oranges with oranges need to be distinguished.

Another is that real-world problem-solving is not trivially used. It's often used as a guise to get away from the math and turn it into art projects or other mathematically irrelevant activities.

And I think that Wilfried was giving me an example at dinner last night of a study in his daughter's classroom where they wound up with a big discussion of the floor-ordering system in Europe versus America because they were trying to use a version of a physical number line that was based on floors.

The analogy collapsed into things that are of a little bit of interest if you are going to travel, but that certainly had nothing to do with mathematics, except, I guess, the arbitrariness with which numbers can be used as labels.

So, I think, you know, one of the other key dimensions is how much engagement with the math there is as opposed to diverting attention toward non-mathematical activities.

MR. GERSTEN: Just one issue, Bob, that you set up. I really think our group is going to focus on research, published research, some of which maybe have terms that are ill-defined, ill-specified, as opposed to anecdotes, because I find problems with anecdotes. I mean, different things happen in different states. I think the less anecdotes at this stage of the game, we have heard many of them, the more respectable our process will be. I mean, the anecdotes I think are fine for after dinner or that kind of thing, but that really is going to be a key charge of our Panel, that we don't keep going back to personal stories and anecdotes.

MR. FAULKNER: Well, we need to actually move on. We still have the teachers' panel to go, and so Wade is going to get to ask his question. He is the last one.

MR. BOYKIN: In Tom's opening comments, he raised the issue of cost-benefit analysis, and that prompted me to think out loud, for the Panel as a whole, as to how important should that consideration be in our deliberations in terms of what conclusions and what recommendations that we make. We may find studies that get very robust findings, but are extremely expensive, are very time-consuming to execute in terms of the application of that intervention. I'm just wondering out loud how important should we bring that particular factor into our discussions and your deliberations?

MR. GERSTEN: I think that's an excellent point, Wade, and we will keep very close tracking on the training for teachers or preparation and some time issues insofar as there are in the article or report, but we can e-mail inquiries out to authors. We will report that as much is available and try to think that through, implications of that.

MR. BOYKIN: I think my comment transcends just your task. It's for all of us.

MR. GERSTEN: For all the Panel, yes.

MR. LOVELESS: Well, as the policy person on the task force, I think that that's a critical point. We almost need a separate subgroup that looks at policy, that looks at federal and state policy, and says: Now given all of our recommendations, what are the policy ramifications? How will they be implemented? What will those look like?

MR. FAULKNER: Okay. Thank you. I want to thank the Panel and the task group for a robust discussion. It is time to move on to the final task group presentation. That's from Task Group four, Teachers. Deborah Ball is the chair.

MS. BALL: I think we are set. Okay. On the slide up here, I have listed the members of the group that have been working on teachers and teacher education, on the professional education of teachers. It includes people who have worked on this in the past and who have worked on it now, and I'd just like to ask my colleagues who are here with me right now just to introduce themselves.

MR. WHITEHURST: I'm Russ Whitehurst.

MR. WU: Hung-Hsi Wu.

MR. SIMON: Ray Simon.

MS. BALL: Okay. We are going to give you a report now on the way that we have approached this topic, and I think to do that we wanted to start by just emphasizing why we see this as one of the important aspects of the Panel's response to the Executive Order.

To begin with, I think it's going to be quite clear from listening to the reports of the other groups that if we didn't address the question of teachers, we would be seriously remiss. Starting back with the instructional triangle that Camilla talked about, teachers have an enormous amount to do with students' opportunities to learn, with mediating the policy environment, with managing curriculum materials, and the like.

And what we want to do on our Panel is to review the evidence that helps to build the kind of teaching force needed to help American students learn.

On one hand, our group notes that there is incredible scale problem. Teachers are the largest occupational group in this country, and there are many areas of the country where not only are there teachers who lack the training they need but teachers who are wholly unprepared for the challenges they are facing. The urgency of the need to have a qualified teaching force has, perhaps, never been greater.

However, doing that and doing that well, from a policy and a practice perspective, means that we need to have the best possible evidence about both what constitutes quality teacher preparation, what it means to be a good teacher, and what kinds of programs help make it likely that we will be able to build the teaching force that we need.

There is, perhaps, more policy and public interest in teacher education than has ever been. It doesn't take very many days in the New York Times before you find one article or another about teacher certification or teacher development or teacher testing. And there are lots of debates about the effectiveness of different pathways into teaching, different kinds of programs, different qualifications.

What we think the Math Panel can do is to try to bring the best evidence to bear on the effectiveness of different kinds of programs and policies that are designed to do everything from attract and recruit the best qualified individuals into teaching, to prepare them and support them throughout their work with kids to be able to retain excellent teachers in the profession, and that gives sort of a frame of why our group sees our charge as particularly important to the Panel's work.

We have chosen for now four critical areas of focus, and I'm just going to mention what they are and then tell you briefly how at this point our group is working on each.

One area that we are reviewing is the evidence about teachers' knowledge of mathematics; the second is teacher education and professional development. The terms vary in the field, but here when I'm using these terms on the slide, I'm referring to both initial teacher training or teacher preparation and the ongoing education that teachers receive as they continue with their work.

We are also going to be investigating something that at times is referred to as elementary mathematics specialists. And when I get to that, I'll say a little bit more about what we mean by that, and we'll be investigating programs and policies and evidence about alternative ways to recruit and retain effective teachers of mathematics.

We are going to go through each of these one by one highlighting for you a few of the key areas which we are reviewing, available studies, and evidence, share with you a bit about what the directions will be for our work, and then ask my colleagues if they want to add anything.

So teachers' knowledge in mathematics is actually the first area, if we listed these in order, and we do that because in many ways understanding the relationships between teachers' mathematical knowledge and students' achievement is fundamental to all the other topics that our group is investigating.

So what we want to do under this heading is to review the studies that help us understand what's been learned about the relationship between teachers' knowledge and what they do in classrooms and what their students learn. This is an interesting question because so many people see this to be so obvious as to not require research, and yet there is a substantial difference of view out there about what constitutes the knowledge that teachers need that will actually make a difference for their effectiveness for students. It's possible to have endless debates about what would be nice for teachers to know, and yet in the end what the Panel will bring to bear is the best knowledge about the kind of knowledge and how it's used that makes a difference for what teachers can actually do for their work, which is to teach students.

So the kinds of things we'll be investigating are what kinds of studies have been shown to have effects on student achievement and other instructional practice and how large are those effects? We'll be particularly interested across these studies about the ways in which mathematical knowledge has been conceptualized and measured. This will be crucial.

We won't be able to simply report results without probing more deeply how mathematical knowledge has been conceived in these studies. Similarly, we will need to understand how student achievement or instruction has been conceptualized and measured. And we will be interested in understanding whether there are differences across a host of variables, for example, level of teaching, context, students' content areas, whether there are variables that mediate the effects of teacher knowledge or the kinds of knowledge that teachers need. So this is the first area in which we will be doing research.

I'll go on now to the second. For the second area we will be asking, given a better understanding of the mathematical knowledge and skills required for effective instruction, we naturally will want to learn what's known about the programs that increase teachers mathematical knowledge. Here we will draw on what we learned from the first studies we will have reviewed because what we will be interested in learning is what kinds of programs have been shown to help teachers develop the kinds of necessary mathematical knowledge and skills needed for teaching, and you'll see here our continued focus on not just the mathematical knowledge with an abstract sense, but the mathematical knowledge shown to have an effect on what teachers are able to do effectively to help students learn.

So we have a range of questions here. I'm just sampling a few of them for you. We will be interested in pre-service programs and what evidence there is of capacity or structure that influences the increase of teachers mathematical knowledge for teaching.

We'll also be interested in how in-service programs can provide for the ongoing mathematical learning of teachers and what sorts of evidence there is about the variables in those programs that make a difference for teachers' learning of mathematical knowledge that they actually use to teach students effectively.

We'll be interested in structural questions. Many people raise issues in a policy environment about length, structure, intensity of teacher education programs, but we'll also be looking to see what else has been studied. Is there evidence about the curriculum of professional development? By here, we mean what sorts of experiences and approaches to the teaching of mathematics, what content and such seems to have an impact on teacher learning. We don't know the extent to which this has actually been studied, but we are going into it trying to probe beneath the surface of what might otherwise not provide sufficient evidence on these questions.

And similarly we'll be looking at issues about how requirements for mathematical knowledge and skill needed for teaching affect the quality of teaching and teachers. We’ll be looking at how do licensure exams differ, how they might affect teacher quality, and what are the effects of different kinds of requirements. And here we may also be looking at descriptive information to provide a portrait of variation across the kinds of requirements that exist.

The third area that we'll be examining is what's sometimes referred to as the elementary math specialist. This idea shows up across recent reports and often in the discourse. For example, in Adding It Up, this was one of the areas that was mentioned in that report, and yet even in that report, it was already acknowledged by the authors that this term is used to refer to a wide range of kinds of roles.

For example, an elementary math specialist might be somebody like an art or a physical education teacher who has his or her classroom, and students move to that classroom. It might refer to the compartmentalization of the elementary level in which teachers don't teach all of the subjects of the curriculum but divide up the work much as one sometimes sees in middle or secondary schools. That's another model in which someone might refer to someone as a mathematic specialist, a teacher who then doesn't teach all eight subjects but teaches mathematics and, perhaps, one other subject.

Another might be a kind of model in which a specialist teacher is itinerant in a building and moves from classroom to classroom working with teachers assisting them in implementing the curriculum and/or working with individual students. Sometimes Title 1 funds are used for mathematics specialists.

So we'll be reviewing the range of models that are out there, but in addition to trying to provide some clarity for what might be meant by mathematics specialists, both in this country and others, we'll be looking to see whether there is any evidence on the effectiveness of different models comparatively or if any single one of these models impacts instructional quality and student achievement. We will be also interested to learn what sorts of knowledge we can build and pull together about the preparation programs or requirements to consider someone a mathematics specialist.

If there is evidence on the achievement effects of being taught by a mathematics specialist? We will also be looking for that kind of evidence.

The final area that we will be investigating is one that has attracted a great deal of policy interest, and that has to do with what's known about the different ways to recruit the kinds of people into mathematics teaching and will bring the mathematical skills and sensibility and the commitment to teach students that might improve the quality of our teaching force. And here we have a whole range of questions, and we don't at this point know what sorts of research we will be able to find on this topic, but everything from the kinds of programs that exist to recruit people into teaching, evidence on incentives and supports that are needed for teacher success and retention, approaches and supports that may be particularly important in districts that are hard to staff where students most need highly qualified mathematics teachers, and where we see currently a huge lack in teachers. We'll be interested in looking for that.

We will be comparing alternative pathways to teaching and trying to examine the evidence about their effectiveness as recruiting effective mathematics teachers into teaching and also looking at retention strategy. This is an area in which quite a lot exists about salary structures, about incentives, about programs, about attractions, about disincentives to enter teaching, and we'll try to see what sorts of evidence can be brought to bear on those questions.

One of the challenges we are going to face as we review this literature is that quite often research of this kind is not done by subject matter in particular, that there may be evidence about retention and recruitment in general or even in general across levels of teaching, and we'll have to, as a Panel, examine how to use research that's more general than the specific problem in which we are interested and how that might help us.

We will also try to be descriptive and to bring to bear knowledge about what actually is happening out there and what's known, but really what we would like the most to be able to find is evidence about the effectiveness of different approaches to recruiting people into teaching, and I'll stop at this point and see whether members of my group here want to amplify, correct, or change anything that I have said.

MR. WHITEHURST: I'll just add a bit of explanation on our interest in elementary math specialists, and it's really an attempt to deal with capacity issues. So there is a huge existing workforce. We have reason to believe that many teachers in elementary school have very poor preparation in mathematics, much less the teaching of mathematics.

And so to think about approaching that workforce issue by training a whole new generation of teachers who would take over the schools is both daunting in terms of the effort and quite delayed in terms of the payoff. And so the question would be: How could you increase capacity in a realistic way? And it might be that the evidence would show that specialists are a way to achieve that end.

MR. SIMON: As we proceed to reauthorize No Child Left Behind and look back in our five years of the history of that law, one thing is becoming very clear, and that is that the key element -- we knew this all along, but it becomes more obvious as the years go by -- is that the real key to No Child Left Behind, the mission of No Child Left Behind being successful is an effective teacher in the classroom. Anything that we can do to inform the debate over the teacher component No Child Left Behind is going to be sorely needed and sorely appreciated. As we do shift the debate from highly qualified teacher to highly effective teacher, it's going to be real important that we help inform that debate.

Hundreds of millions of dollars are spent every year in this country on in-service and pre-service teachers, much of which we believe to be ineffective. And so whatever we can do to help focus that money in better ways that's going to help kids, I think we have an opportunity to be of real service to the field here.

MR. FAULKNER: Are we ready to go

on, Deborah?

MS. BALL: Yes, we are.

MR. FAULKNER: Okay. Diane.

MS. JONES: I have a question. When you talk about recruitment of teachers, oftentimes that's, you know, a recruitment for teacher induction, recruitment into the classroom.

Will your group be looking at the elements of recruiting people into teacher education majors? For example, I know NCES has data on entering SAT scores for people who graduate with teacher education programs, and oftentimes that data gets extrapolated, probably incorrectly, to make some assumptions about what attracts people into teacher education programs that are really inaccurate and unfair. That seems to be the only data that are out there.

Will you be looking at if there is research and, if so, will you be looking at what helps people decide whether they will pursue a degree in teacher education or how they will recruit people into teacher education majors and not just into the classroom on graduation?

MS. BALL: That's a very good question. So are you asking whether we will investigate what's known about why people choose teaching, or are you asking would we look for evidence that intervention at that level has some impact on who goes into teaching; which is it?

MS. JONES: You know, I think it's both, frankly.

MS. BALL: Yeah, I think that's good, and I think, frankly, we have been talking more about exactly, as you said, recruitment into teaching itself. And although some of the programs we will be looking at like Teach for America, for example, are, in fact, at the initial entry point, but that might be a very good thing to look for, both of those questions that you asked. That's a good point.

MR. FAULKNER: Bob.

MR. SIEGLER: I'd like to ask you a couple of questions about this idea of math specialists. Your focus was largely on math specialists in the elementary school grades where there currently isn't this kind of specialization. I share Russ's concern about the sheer dauntingness of this task, but in addition a lot of data that Tom has written about and other data from NAEP and TIMSS show that U.S. math achievement in the elementary school grades has been showing pretty healthy growth, where we don't have math specialists.

The problem comes more in the middle school and high school period where in high school it's basically flatlining over the last 20 years, and middle school is somewhere in between, but not very impressive improvement.

So I wonder whether the real challenge is to upgrade the skills of people who are so-called math specialists in middle school but who actually their math background and, perhaps, their knowledge of math pedagogy is far from ideal.

MS. BALL: I'll provide an answer to you. My colleagues want to add things. I think that we would disagree with you about that, but the question you are asking about middle and high school teachers, those high school teachers for sure is already covered in our second question because there we are interested in interventions that improve teachers' knowledge and skill at any level. So the upgrading, or whatever you want to call it, training of people who teach who are considered to be specialists will be investigated here.

You may be focusing particularly on middle school and the questions there. We could be a looking at that as well. The reason that elementary math specialist shows up is because it's frequently cited as a potential area for, I think as Russ said, reducing the scale problems of equipping elementary schools with good teaching.

You are quite right that that data has shown that, and yet closer studies of instruction continue to show serious problems in the kinds of mathematical opportunities that students have at the elementary level, which likely are traceable into some of the issues that we see in learning when we get those sorts of things that your groups are doing.

I don't think we are choosing this over something else. It's just without having that on the list, we don't have a way of investigating that quite popular, quite frequently mentioned policy option.

MR. FAULKNER: Skip, then Wade.

MR. FENNELL: Just to kind of follow up with Bob on my own question. In the reports that you mentioned, particularly the mathematics education of teachers and Adding It Up for sure to a lesser extent the principles or standards for school mathematics, all of which endorse and support the notion of specialists, the first two describe at the middle grade level as well, partly because of the direction I assume you may move in that direction. It may be the role of our chair at the middle school level and the impact of that person.

I would also, Deborah, like to go back to your first four questions, and it just appears to me that question four is really sort of -- sort of like the --

MS. BALL: This one (indicating)?

MR. FENNELL: -- a deeper level of two.

MS. BALL: Question four, this one (indicating)?

MR. FENNELL: In other words, your question two, which is teacher education and professional development, and then your four gets at the recruitment and retention of -- of mathematics teachers. To some extent, I could see responses to four highlighting two and having some impact on two and the other direction as well.

MR. FAULKNER: Wade.

MR. BOYKIN: I guess it's more of a comment disguised as a question, but I'm just wondering about the overlapping goals of the work in the instructional practices panel and teacher preparation panel. It seems to me, for example, that no matter how great our instructional practice is, they are not going to be well-implemented unless teachers are well-prepared to deliver them.

By the same token, no matter how great is the teacher preparation program, it's not going to eventuate into something good for kids unless it's tied to the effective practices. I'm just wondering to what extent is that going to be an issue? Or, for example, is the problem solved simply by saying that teacher preparation group they use as outcome variables effective practices?

Because achievement is going to have to be mediated by the actual, you know, practices that take place that should be supposedly the work of the instructional practices panel, just to comment on the status question.

MS. BALL: I envy this question. It's a terrific question. I think it signals something that if the Panel could get ourselves ready to be able to do that sort of work would be fantastic because if you were to broaden our question under number two about the nature of teacher education programs, I think that one could properly ask the question: To what extent are those programs teaching teachers to do the things with the instructional practices group we will find are known to be effective practices. Here we don't have the knowledge that we can ask that question, but we could ask what are the practices that are taught in teacher education.

But I think your question suggests: As we learn more about what these effective instructional practices are, to what extent are they taught in teacher education and are they taught effectively, and are teachers able to use their mathematical knowledge to use those instructional practices in the classroom? So if the Panel could find a way to integrate our work over time, we would able to get more to this question of overlap that you are pointing to.

MR. WU: I just want to ask another footnote to this. What you are raising is I think it's a much deeper question than what I think we can handle at the moment. We have trouble teaching teachers the basic knowledge they need to do classroom teaching, and if we can get over that hurdle, clearly all the other things that you mentioned will come into focus. At the moment, I don't believe our universities are teaching teachers the basic knowledge they need for the most elementary functioning in the classrooms yet.

MR. FAULKNER: Tom.

MR. LOVELESS: First is one quick point and clarification on Bob's comment on NAEP. The fourth-graders have gained about two years of knowledge roughly -- that's a ballpark figure – since 1992. There are two NAEP tests. In the long-term trend, that progress has been much less. It's about half a year's worth, but nevertheless there are gains on both tests.

You've covered everything, and I think you have done a tremendous job of organizing and listening to what the questions are. One thing I would add, though, is that there has been a change in grading configurations over the last 30 years in terms of what teachers and kids encounter at grade six through eight.

Thirty years ago when we had junior highs, usually they were configured as grade seven through nine, that child in seventh and eighth grade would most typically be exposed to a teacher in mathematics who had a single subject math credential and who was trained as a high school teacher.

Today that is not true at all. Most teachers in grade six through eight, including teachers who are teaching algebra, have multiple subject credentials. They were trained as elementary schoolteachers. They were not trained to teach mathematics. That's true for most kids. So I would hope that you somehow add that into the mix of things to look at because grade configuration is shaping the kinds of math teachers that kids get.

MR. WU: Tom, how robust is this statistic about the percentage of teachers in middle school with the subject specialty or major emphasis in mathematics? Let me add a bit more. What, in fact, are they doing in the middle schools? Teachers in the middle schools approach the greatest problem because we know of no well-founded credentialing program for those teachers. In some states, I believe in California, for example, it's elementary teachers (inaudible) authorization, and I believe it was constant, I think, they have a clear-cut middle school professional program. So we need statistics. Do you have them?

MR. LOVELESS: Yes. You can get those. NCES collects those. They are in the school staffing survey. You can get data on the credentials, the teachers, and also some states collect this kind of data routinely. You can get it directly from, for instance, California, they have an extensive database on the credentials that teachers hold on the various grade levels. They have that for every teacher in the state.

MS. BALL: And the question is or what we want to know is: Who is actually in the classrooms? Because part of what you see across the states in places where although there are state requirements of a certain kind, the shortage is so great at that level that you have people who don't have any mathematics in their credentials. So in getting a sense of what's actually happening, the range of requirements would be a good thing for us to know.

MR. FAULKNER: Other questions?

MR. SIEGLER: (Gesturing).

MR. FAULKNER: Bob.

MR. SIEGLER: I wonder if you are going to be looking at the licensing requirement as reflected in practice scores and the cutoffs that are said and also the faithfulness with which universities are even enforcing those rather low bars.

A colleague of mine, Robert Strauss, is an economist, presents some really shocking data where there are whole universities within Pennsylvania where the average score on the praxis of teachers who get licenses is below the, in theory, state minimum.

MS. BALL: The last question on this slide is probably too vague to capture that, which is why you are raising the question. We will be looking at licensure exams and the range of things that are involved and the cut-off, and we will be looking for that sort of information.

MR. FAULKNER: Any last questions? Let me thank the task group and indicate that that draws this morning's session to a close. I would like to thank the public for its interest and attendance.

The Panel will adjourn now, being in public session will go back into task group work. Box lunches are available for the Panel in the Executive Conference Center in the area where we were meeting yesterday. We are set up for a working lunch. I know that many Panel members need to deal with the hotel. So we'll gradually proceed over there, take care of lunch, and get into the final sessions of the day.

For the public, let me indicate that we go back into public session in Chicago. Actually, in Batavia, Illinois, a suburb of Chicago, at Fermi national laboratory, Fermilab accelerator laboratory, which is the site of our next meeting in April. With that, I think I will say that we are adjourned.

(Whereupon, at 12:45 p.m., the meeting was adjourned).