

UNITED STATES DEPARTMENT OF EDUCATION
NATIONAL MATHEMATICS ADVISORY PANEL

Thursday, March 13, 2008

The meeting of the National Mathematics Advisory Panel came to order in Gym 2 of Longfellow Middle School, 2000 Westmoreland Street, Falls Church, Virginia at 9:00 a.m.

Panel Members:

LARRY R. FAULKNER, CHAIR
CAMILLA PERSSON BENBOW, VICE CHAIR
DEBORAH LOEWENBERG BALL
A. WADE BOYKIN
DOUGLAS CLEMENTS
SUSAN EMBRETSON
FRANCIS "SKIP" FENNELL
BERT FRISTEDT
DAVID C. GEARY (PRESENT VIA TELEPHONE)
RUSSELL M. GERSTEN
TOM LOVELESS
LIPING MA (NOT PRESENT)
VALERIE F. REYNA
WILFRIED SCHMID (NOT PRESENT)
ROBERT S. SIEGLER
JAMES H. SIMONS (NOT PRESENT)
SANDRA STOTSKY
VERN WILLIAMS
HUNG-HSI WU

Ex Officio Members:

IRMA ARISPE
DANIEL B. BERCH
JOAN FERRINI-MUNDY
RAYMOND SIMON (NOT PRESENT)
GROVER "RUSS" WHITEHURST (NOT PRESENT)

Staff:

TYRRELL FLAWN, EXECUTIVE DIRECTOR
MARIAN BANFIELD
JENNIFER GRABAN
IDA EBLINGER KELLEY
JIM YUN

CALL TO ORDER

Chair Faulkner welcomed the group to the 12th and final meeting of the National Mathematics Advisory Panel (Panel). He alerted the audience that there were signing services available, but they were not needed. He indicated that Dr. Geary was present via telephone and thanked Mr. Williams for hosting and arranging the meeting at Longfellow Middle School. He introduced Mr. Williams as a teacher in Fairfax County for more than 35 years and current algebra teacher at Longfellow Middle School. Chair Faulkner commended the school's math students, science and music programs. Finally, he introduced and thanked Longfellow Middle School Principal Vince Lynch for allowing the Panel to hold the meeting at the school.

OPEN SESSION

NATIONAL MATHEMATICS ADVISORY PANEL:

Chair Faulkner began by stating that the purpose of this meeting was to complete the Panel's work by adopting the report. He elaborated on the amount of work performed by the panel over the last 11 meetings and noted he has personally sent or received approximately 14,000 e-mail messages over the last two years. He then recognized Vice Chair Benbow and asked her to propose a final action on the report.

Vice Chair Benbow indicated that she believed the report was an excellent one that will benefit schools, the children and the children of tomorrow. She moved for adoption of the National Mathematics Advisory Panel Report, *Foundations for Success*. Dr. Gersten seconded the motion. The report passed with no members in opposition or abstaining from the vote.

Chair Faulkner stated that he would like to have each of the Panel members briefly comment on their view of important items they would like to highlight for the audience and for posterity.

He motioned to Dr. Irma Arispe from the Office of Science and Technology Policy to begin.

Dr. Irma Arispe spoke on behalf of Dr. Jack Marburger, President George W. Bush's Science Advisor in the White House Office on Science and Technology Policy and thanked the Panel for their effort and commitment. She believed that this report will be the foundation of scientific policy deliberations and the setting of federal research agendas for years to come. She indicated personally that she was honored to have worked on this report, and looks forward to working with the Panel and the broader federal agency community to translate these findings and recommendations into action.

Chair Faulkner motioned to Dr. Susan Embretson from the Georgia Institute of Technology to begin.

Dr. Embretson stated that she primarily worked on the Assessment Task Group and began to describe the work they performed. She discussed the Task Group's two general areas of interest, which were test content and performance categories, and item and test design. She said item and test design could be interpreted in two different ways. One way is a statistical way, such that a test is constructed to provide optimal information about the central construct. She explained that this was all the statistical hardware of

item response theory and the task group had no reason to look at this research because in education it has been implemented quite widely in its cutting-edge methods.

She continued by saying that the other way to interpret item and test design is to examine the actual item content. When the task group looked at item design, they looked at the content of the items and whether or not they had, for example, mathematical versus non-mathematical sources of difficulty. They should have mathematical sources of difficulty because that is the goal of the assessment.

She reminded the Panel that the National Assessment of Educational Progress (NAEP), NAEP Validity Study (NVS) was published just as the Panel began their work. The NVS report noted that most widely acclaimed tests contain non-mathematical sources of difficulty that lead children to not solve the items properly.

The task group's recommendation was that in the item design side, a much higher level of expertise be involved. More mathematicians and more curriculum specialists from higher education are needed to review individual items. She noted that she had been on many committees to evaluate tests, and it is rare that anyone examined the actual items. She stated her belief that this should be done more often.

She also spoke about another aspect of item design at which the task group looked, which was constructed response versus multiple choice format. There are many kinds of constructed response items, and they differ. There are short ones that require a fill in answer versus a more extended explanation of the phenomena.

Dr. Embretson reported that a wide search for relevant literature about the comparison of these formats and what impact they have on performance netted few published results that the task group could use to make conclusions. She said the task group found that the difference between the formats depended entirely on how both formats were designed. This led the task group to believe that, at the current stage, there is no evidence to suggest that constructed response gives much different information. It is possible that multiple choice items, when they are designed in certain ways, can pick up much of the information that was claimed to be the advantage of constructed response.

Chair Faulkner motioned to Dr. Daniel B. Berch, from the National Institutes of Health to begin.

Dr. Berch acknowledged that he was speaking as a representative of the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) at the National Institutes of Health. He indicated his gratitude to the U.S. Department of Education for permitting his office to participate in this effort from its inception.

He focused his remarks on the Panel's recommendation calling for more federally-funded, high-quality research on designing instructional practices for improving the performance of low-achieving students. He emphasized that there is a subset of these children whose impairments in mathematical learning are so severe and enduring, as well as unresponsive to routine instructional practices, that they can more appropriately be characterized as having an actual learning disability in mathematics.

He indicated that a colleague of his from the United Kingdom was struck by the comparative lack of awareness in this country about classifying some children as having a mathematical learning disability. He stated further that educators and parents need to recognize that mathematical learning disabilities exist for five to nine percent of school-age children and are, thus, as prevalent as reading disabilities.

He indicated that this subset of school-age children struggle with comparatively simple numerical skills, such as various principles of counting and basic arithmetic facts. He then explained that these children possess an even more deficient conceptual understanding of less straightforward concepts such as fractions and decimals when compared to low-achieving, but non-LD peers.

He reported that for close to a decade, his institute, NICHD, has been addressing these challenges by funding high-quality studies of the origins and development of mathematical disabilities. He explained that cognitive and brain mechanisms give rise to such impairments and said there were instructional interventions for ameliorating them. Some of the important advances that emerged from this research were discussed in the Panel's report. Moreover, consistent with the Panel's recommendations, he said they are currently running a grants competition that will permit NICHD to fund at least five more years of innovative research in this field.

He stated that working on this Panel was challenging, rewarding, and humbling. He believed the Panel produced a strong and impartial report that superseded individual biases or personal agendas.

Chair Faulkner motioned to Dr. David Geary from the University of Missouri to begin.

Dr. Geary stated it was a pleasure to work with the Panel during this two year process. He recognized that this report could not have been completed without an interdisciplinary team because not one of the academic or applied disciplines represented on this Panel is up to the task without the expertise of the others.

Dr. Geary surmised that the necessity of these panels arise because of a failure of universities and schools and the professors within these institutions to produce quality educators with knowledge of sound, proven, educational practices that are scientifically research-based. He further stated that schools of education must take the lead on developing and scientifically testing educational interventions, and should be held accountable for the success or failure of their work.

Chair Faulkner motioned to Dr. Sandra Stotsky from the University of Arkansas and the Massachusetts Board of Education.

Dr. Stotsky began by stating that it was her privilege and honor to serve on this Panel. She believed a basic implicit goal of this report was to promote equity in K-8 mathematics curriculum.

Dr. Stotsky mentioned two works by James B. Conant, *The American High School Today*, published in 1957, and *The Comprehensive High School*, published in 1967, as relevant historical predecessors to our document. She explained that Conant and the other members sought to promote equity in access to higher education for public high school students. She explained that the focus of the two studies was on the content of the curriculum and the availability of a calculus course and a strong course in physics. Their interest was in increasing the opportunity to study advanced math and science courses because capable students couldn't prepare adequately for some of the most demanding higher education institutions if these courses weren't offered in the tiny public high schools that dotted the country.

She stated that the focus of the Panel's report was the content of the curriculum in mathematics, which has received much less attention in recent decades than matters of pedagogy. She outlined that the goal of the report concerned how to strengthen both the

elementary and the middle school math curriculum in all schools in order to democratize access to Algebra I, the gateway course to advanced math and science in high school.

Dr. Stotsky highlighted five major recommendations toward accomplishing this goal. First, the specific components of Algebra I and Algebra II should be explicit. Second, the components of K-7 math that all students should master to do well in an authentic Algebra I course should be adequately described. Third, the content that should be included in mathematics course work for prospective elementary special education and middle school teachers of math, and what they should be tested on for licensure should be outlined so that they are qualified to teach the foundations for an authentic Algebra I course or the course itself. Fourth, all school districts should be urged to provide an authentic Algebra I course in Grade 8. Fifth, the Panel recommends that schools prepare an increasing number of students for success in an authentic Algebra I course in Grade 8, if not earlier.

She commented on equity and insisted on increasing the number of U.S. students who are prepared to take an authentic Algebra I course in Grade 8 or earlier, just as large percentages of students in the highest achieving countries on the Trends in International Math and Science Study (TIMSS) are. She said more high school students can then take the advanced math and science courses in their junior and senior years that qualify them for admission to the most demanding institutions of higher education in this country.

Chair Faulkner motioned to Dr. Joan Ferrini-Mundy, who represents the National Science Foundation (NSF).

Dr. Ferrini-Mundy indicated that despite the many different perspectives represented in the Panel, a common commitment to the need to improve mathematics education was held by every member. She explained that the use of the best available evidence about mathematics teaching and learning helped the Panel avoid slipping into the ideological positions.

She cited two major contributions the Panel made. First, an agreement was reached about specific mathematics content, particularly the recommended Critical Foundations of Algebra. She believed this contribution could have a powerful and profound impact on U.S. mathematics education through its potential to unify curricular directions, instructional practices, teacher education, professional development, and research.

Second, the report provides a foundation about instructional practices in mathematics based on evidence and it helps refute some of the starkly dichotomous contrasts that have sometimes been made about instructional practice in mathematics education. She indicated that a conclusion could be drawn that continued efforts to develop research-based instructional practices and materials, and then to study their impact, is a promising and needed activity that must continue. The work the Panel reviewed generated possibilities and hypotheses, and helped the Panel sharply define the kinds of questions that need to be addressed in this area.

Dr. Ferrini-Mundy thanked the Panel's leaders, Chair Larry Faulkner, Vice Chair Camilla Benbow, Tyrrell Flawn, Russell Gersten, and the Panelists. She closed by saying her colleagues at the National Science Foundation, Director Arden Bement and Deputy Director Kathie Olsen have supported NSF's involvement, and will be eager to participate in continued conversation and efforts to further the work of the Panel.

Chair Faulkner motioned for Dr. Hung-Hsi Wu from the University of California Berkeley to begin.

Dr. Wu stated his belief that this report confronts the major issues of mathematics education and does so with reason and scientific evidence. He stated that, most importantly, the report recognizes the central role played by mathematical content in the ongoing struggle for improvement in mathematics education. He added that this recognition is a rare and unique achievement among education documents.

He continued by elaborating on why this Panel managed this singular achievement while others have failed. First, the Panel has a rare combination of very knowledgeable scholars from diverse areas. Second, just as a school is only as good as its principal, any panel writing a report is only as good as its leadership. He mentioned that Chair Faulkner, Vice Chair Camilla Persson Benbow, and Tyrrell Flawn have helped the Panel navigate very treacherous waters to safety. Dr. Wu acknowledged that Chair Faulkner may have been exhausted performing this task, but the Panel and the children of this nation can only be grateful for a job well done.

Dr. Wu stated his pride in participating on this Panel and this report, and admitted that now it has come to the end, he would likely miss it very much.

Chair Faulkner motioned to Dr. Deborah Ball from the College of Education at the University of Michigan to begin.

Dr. Ball mentioned that she was honored to work with the Panel as a whole. She cited her experience as an elementary school teacher, teacher educator, researcher in math education and teacher education, and as dean of the school of education at one of the leading education schools in the country. She thought a great deal about the role and responsibility of schools of education, together with schools, school districts, school leaders, and the rest of the universities they inhabit, to take this report and take action. She indicated that she takes her responsibility very seriously.

She commented on the Panel's diversity and that it was a feat that such a diverse group reached significant areas of agreement and voted unanimously to adopt the report.

She stated that this report puts to rest some important myths that have plagued efforts to make improvement in mathematics education. She cites math-teaching as an example and agreed with Dr. Ferrini-Mundy that math-teaching cannot be reduced to simple dichotomies. She said that as long as that is the practice, they fail the children of this nation because they don't actually work on instruction.

Dr. Ball spoke on the pressing need to build on the agreements this Panel has forged, the knowledge, the will, and the action to actually make progress on mathematics education in this country. She noted the importance of continuing to work on instruction, to work on the delivery mechanisms, and to equip the nation's teachers and those who work with them to deliver the knowledge that they have about mathematics content and learning.

She added that she would be disappointed if the report is reduced to yet another "math wars story." She emphasized that this is a story in 2008 about the areas of agreement based on the research that's been done up to this point. She said she would be disappointed if people spent their time looking for all the areas of disagreement among Panelists.

Dr. Ball hoped the report is not reduced to simplistic slogans or messages about calculators or teaching styles. She added that it would disappoint her if the report is not

used to make progress, and she holds all of the Panelists and communities who have an interest in math education accountable for taking the right actions.

Her final comments reflected on a few things this report could enable. First, the report could enable the leveraging of collective will to begin building a much more common curriculum in this nation in mathematics. She mentioned that the founding creators of the nation's school system hoped in the 1840s to build a common school system, however this system has not been achieved. She agreed with Dr. Stotsky's statement on the significant equity issues and differences in the country in math.

She asked whether mathematics in Idaho is different than in Louisiana, and then commented that this country is clearly not ready to follow their colleagues in the rest of the world in building a national curriculum. She believed this report could be used to move forward with a common set of topics and skills that are foundational for students' success, and these topics and skills will be taught in every school, district, and state in this country. She cited her experience as an elementary school teacher and said it is centrally important that everyone must acknowledge that competence with fractions is absolutely essential to student progress.

Second, Dr. Ball believed this report could enable a recognition of the central role of teachers. She indicated that this report highlights teaching as significantly professional work, so this report should be used to work to build the kind of significant, disciplined knowledge and research that is needed on instruction. She noted that she was struck by the lack of and need for high-quality research on instructional methods to enable teachers to teach complex mathematical outcomes directly and explicitly to students. The research base simply did not exist and was also absent on the subject of teacher education.

She noted that in no other field would common sense enable one to do such skilled work—not about plumbing, not about medicine, and not about hair dressing. She noted the continued belief that the teacher quality problem could be solved by finding smart people to teach the nation's children, however this report made clear that instructional methods and teacher training methods need to be built.

Third, Dr. Ball believed this report could enable fast progress on one of the most straightforward parts of the teacher quality problem--teachers' mathematical knowledge. She said no one disagreed that teachers needed mathematics to teach. She questioned how they could teach if they didn't know what they were teaching. She indicated that this report finally made clear that it is not just about the number of courses elementary school teachers are required to take that would enable them to be effective with students.

She asked that the right solutions be sought for this critical problem. This Panel agreed that it should be ensured that elementary school teachers have the mathematical knowledge they need to hear their students, to teach the content clearly, to be precise, to teach them to reason, to solve problems, and to have the skills they need.

She believed this report could be used to build the research capacity that is needed around this country by practitioners in education schools, in research firms, and in school districts. The report could enable the same kind of progress that that was made in the medical profession almost a century ago. Practice-based, practice-oriented, usable research with proven methods that help students learn and prevents practitioners from making up their own ways of doing things is needed.

Finally, she acknowledged the work of the Panel leadership and the support from the consulting firms. She noted how helpful the consulting firms were in identifying the

resources that needed to be scrutinized and examined so that these report conclusions could be reached. She closed by saying it was an honor to serve on this Panel.

Chair Faulkner motioned to Dr. Douglas Clements, from the University at Buffalo, State University of New York to begin.

Dr. Clements began with a reference to Flannery O'Connor who said stories are considered not quite as satisfying as statements, and statements are considered not quite as satisfying as statistics; but in the long run, a people is known not by its statements or its statistics, but by the story it tells.

He referenced the thousands of studies the Panel reviewed and stated his belief that the statements and statistics contained in this report are satisfying and useful. However, the Panel was limited by the daunting scope of their work. Rigorous research approaches are necessary components for full scientific knowledge of mathematics education. He noted the importance of following comprehensive research frameworks in future research and development efforts so that a complete story may be told.

He specifically referenced technology as a case in point. He said the rigorous research reviews pointed to some effective approaches and some important cautions, however the full story revealed other effective approaches, and, more importantly, revealed why some are effective and some are not.

He pointed to one main theme in the report, which is the need for students to simultaneously develop conceptual understanding, procedural skill, and problem-solving ability. It is a story, which must be told and retold accurately to end the unfortunate habit of false dichotomies, the simplistic black/white divisions that harm our children's mathematics education.

He indicated his hope that the eventual story told about this report would be that U.S. education became more student-centered in the broader and more powerful sense that is often seen in East Asian countries. He stated that teaching is not just about what teachers do, but how teachers can encourage students to engage in effective learning activities.

He reflected that learning ultimately depends on what students do, so teachers, and all who support the teachers at every social and political level, need to structure all aspects of the teaching and learning context to maximize students' engagement with mathematics. He said this was his vision for the country's future, and stated that the country now needs the courage and will to realize this vision, as well as the understanding that profound efforts and changes will be needed at every level of the educational enterprise.

He affirmed that if these tasks are done, more personal stories like Chandra's will result. He told the story of how a student, Chandra, did not know how old she was at the beginning of the year. However, after just months of participating in a research-based, technology-enhanced math curriculum, she told her teacher, "I'm five now; five, that's only two less than my sister is now; she's seven."

Chair Faulkner motioned to Dr. Valerie Reyna, from Cornell University to begin.

Dr. Reyna thanked the Panel staff, fellow Panel members, and Panel leadership for their help and support.

As chair of the Subcommittee on Standards of Evidence, she acknowledged that it would have been easy for the Panel to give into the temptation of mediocrity and

compromise because low standards are easy. She gave credit to the steady leadership of Chair Larry Faulkner, Vice Chair Camilla Benbow, and Tyrrell Flawn.

She stated that the Panel stood strongly united in support of scientific rigor and standards. She noted that much of the research the Panel identified was not used because it was not relevant to their questions or it was of low quality.

She indicated that one of the most important contributions going forward is a commitment to scientific rigor because rigorous research generates the proven practices that improve achievement, which is ultimately the foundation for U.S. success.

She outlined three ways to continue to stand up for standards: 1) the amount of experimental research that tests hypotheses to prove that some ideas about education are wrong must be increased because disconfirmation is the source of progress in all sciences, including the educational sciences; 2) more research about the mechanisms of learning--how and why learning occurs--is needed (She explained that learning is the alpha and omega of education--it is the destination we want to get to. She added that learning processes are how to get to the engine of education. An engine cannot be built without understanding internal combustion, and a process cannot be improved if you do not understand it); 3) the next director of the Institute of Education Sciences must be an accomplished, clear-eyed, hard-nosed, bona fide researcher and scientist. She admitted that it would be hard to fill Russ Whitehurst's shoes, however his good work must be continued.

She concluded by thanking all the people who attended Panel meetings and sent comments, including the parents and the professionals, and asked them to continue to stand for both content standards and standards of evidence. She thanked her colleagues and indicated her respect for all of the Panel members for making hard choices.

Chair Faulkner motioned to Dr. Russell Gersten, from the University of Oregon and the Instructional Research Group to begin.

Dr. Gersten stated his belief that the rigor the Panel stayed with in conducting reviews is one of the major accomplishments of this report because there has not been anything like this in mathematics instruction before. The paucity of studies with adequate rigor was no surprise.

He noted that one of the interesting things in the Instructional Practices Task Group that he and Dr. Ferrini-Mundy co-chaired was the large amount of learning disability studies for average students, above-average students, and below-average students. He credited the Office of Special Education Programs at the U.S. Department of Education for ignoring the trend towards devaluing scientific research and actively supporting rigorous research. Their colleagues Marty Kaufman and Louis Danielson, who directed that office for more than 30 years, need to be appreciated.

There was a consistent finding in the area of learning disabilities, which was that explicit instruction consistently helps students with learning disabilities and students who are in the lowest quarter or so of their classes. There was an upside and a downside to getting a replicated consistent finding. The downside of that was no two people define explicit instruction exactly the same way. The Task Group noted, as they went through the studies, that the definition became more relaxed and in the more recent studies, advances in cognitive science were incorporated. He noted that he sees the field trying to unpack the concept of explicit instruction.

Dr. Gersten reported that another consistent and significant finding from high-quality experimental research was that as teachers used formative assessment, student achievement in mathematics increased significantly. This finding was particularly true when teachers had tools such as computers or other ways to review the data to help them identify which kids need more help.

He stated that this replicated finding was good news because it certainly gave states and school districts a way to act. The only downside was that this so far had only been done with one type of formative assessment. This type of formative assessment, which samples the year's state's standards, can easily be aligned to the Panel's Benchmarks and the Critical Foundations in their report. He noted that other formative assessments that are developed as part of most course series have not been studied. He added that it was important that people start doing those.

Chair Faulkner motioned to Dr. Robert Siegler, from Carnegie Mellon University to begin.

Dr. Siegler began by stating that one of the most moving experiences from his participation with the Panel was the immense patriotism present in the United States, not only among people on the Panel who spent hours and hours on this report for zero compensation. He also mentioned the immense amount of participation of people unofficially affiliated with the Panel, who came to meetings throughout the country for no reason other than that they were interested. Many testified, a larger number did not, and an even larger number sent e-mails because they were unable to come to meetings. There was just an incredible interest in increasing our children's ability to do well in mathematics, which was moving. He was amazed by how many people cared and how deeply they cared.

He called attention to two important lessons from this report. The first was the vital need to increase preschoolers' ability and their readiness to learn mathematics. Another lesson from this report he highlighted was that many preschoolers enter school with quite a bit of knowledge of mathematics that help them learn once they get there. They knew how to recognize numbers. They knew how to count objects and recite the number string. They knew which numbers were bigger than other numbers. They did a few simple addition and subtraction problems. But many others could not and this was especially true of children from low-income backgrounds.

He stated that these deficits would not matter so much if they went away quickly when the children entered school, however, the research shows they do not. The same children who were behind when they entered school in kindergarten remained behind in third grade, sixth grade, eighth grade, and high school. It was difficult for them to overcome these early deficits, and, in fact, they grew ever larger. The children who started out behind, fell further behind.

Dr. Siegler noted that relatively brief one or two hour interventions could make a substantial difference in low-income children's knowledge of mathematics, and their ability to learn more mathematics. There also were several very well documented curricula programs for preschoolers, which helped achievement in an even larger range of domains. Both of these kinds of programs need to be implemented on a wider basis.

The second main point Dr. Siegler made was the importance of improving elementary and middle school students' understanding of fractions. He was surprised that such a range of people on the Panel agreed on this. In fact, this was probably the single

point to which everyone on the Panel, including the mathematicians, the public policy analysts, the math education people, the cognitive psychologists, and the teachers immediately agreed. Fractions are a vital bottleneck in our students' ability to learn algebra.

He said that when algebra teachers were surveyed in a nationally representative sample carried out by the National Opinion Research Committee, they rated their students' poor understanding of fractions as one of the single largest impediments to their success in algebra. Students in the United States receive fractions instruction again and again. They receive it in 3rd grade, and in 4th grade, and in 5th grade, and in 6th grade, and in 7th grade, and in 8th grade. Yet, this spiral curriculum is not working. Many students emerge from this when they take algebra in 8th, or more often in 9th or 10th grade, without an understanding of fractions that they need for algebra.

He cited this lack of conceptual understanding of fractions as probably the single biggest impediment. A majority of eighth graders when shown $12/13$ plus $7/8$ ths and asked to estimate the closest answer chose 19 or 21 in preference to 2. They added the numerators or the denominators. They didn't even view fractions as single numbers. Similarly, a majority of fifth and sixth graders said .345 is bigger than .67 because of a flawed analogy with whole numbers. These were very serious problems. If a child really believed this, they could not possibly understand fractions, and that would really harm their ability to understand algebra. The lack of conceptual understanding of fractions also harmed their ability to learn fractional arithmetic, which was why students persistently confuse the algorithms for addition, subtraction, multiplication, and division. The algorithms made no sense to them.

He concluded by stating that research on how to improve elementary and middle school students' learning of fractions was urgently needed. The knowledge of how to improve learning is not yet known, but should be figured out quickly.

Chair Faulkner motioned to Dr. Tom Loveless from the Brookings Institution to begin.

Dr. Loveless thanked his colleagues for exhibiting professionalism over the last two years, and especially Chair Larry Faulkner for his wise stewardship of the group. He valued the experience of serving on the Panel, and also the friendships he made.

He went on record as dissenting from the press accounts he noticed recently that predict this report will end the math wars. First of all, this was not what the Panel sought to do. They did not wade into the arguments currently present in math wars, and say definitively that one side was right and another was wrong on particular issues.

He explained that the math wars, and all the other curricular wars across all subjects taught in schools are not just about best approaches. They reflect values and ideologies and beliefs about what knowledge is of greatest worth, which was Herbert Spencer's definition of these conflicts. They reflect disagreements about the role of teachers and students, and education's place in a democratic society. This Panel was not going to settle such arguments, nor should they have.

The report represented the Panel's best effort at dispassionately summarizing what is currently known about mathematics education. Much of the report was based on empirical evidence, but it was also informed by professional judgment. Arguments about beliefs that historically sat at the center of debates over what to teach and how to teach

were best settled by elected bodies and representatives, such as legislatures and school boards.

Dr. Loveless expressed his belief that the main message of this report was simple-content is king. This report defined the content of algebra, and the skills and knowledge leading up to the study of algebra. The report found that important tests, such as NAEP do not currently assess the content that they are recommending. Once the content of the curriculum is right, tests should be given to assess that content. These were the two most consequential recommendations in the report.

He indicated that there was something for everyone in this report. Federal policymakers should immediately begin a review of NAEP and NSF projects in mathematics education in K-12 to determine whether they are in accord with the findings laid out in this document. State policy officials should sit down with this report and examine whether their state's math standards or curricular frameworks reflect the mathematics described here for K-8 math.

School boards need to examine the chapters on how children develop mathematical abilities, and what is known and not known about instruction so that policies that support fads and myths can be swept away. Too often, the beliefs of school principals, math specialists, and school superintendents are based on little or unreliable evidence.

Teachers can use this document to check the content of their courses, to support lobbying efforts to get stronger content into classrooms, and to protect themselves from unwarranted mandates. Parents can use this document as a guide to what their children should be learning in mathematics.

He closed by saying many colleagues agree that more research is needed in the field of math education. This Panel's report represents a first step, but only a first step in improving the mathematics education of U.S. youth.

Chair Faulkner motioned to Dr. Francis "Skip" Fennell, from McDaniel College, and the National Council of Teachers of Mathematics to begin.

Dr. Fennell began by stating his appreciation for the opportunity to serve on this Panel. He remembered enjoyable times and frustrating times, but most of all he cited this experience as a tremendous learning experience. He acknowledged that this report would not exist without the able leadership at the head of the table as well as from all the Panel members.

He highlighted main points from the report by stating, "Validation, recognition, and support for the importance of focus and coherence within the pre-K up to algebra curriculum, as noted by the work of Conceptual Knowledge and Skills Task Group, and as was also noted and affirmed in the work of the Subcommittee on Instructional Materials."

Dr. Fennell indicated that states and school districts must strive for greater agreement regarding which topics will be emphasized and covered at particular grades. Only then will publishers produce programs that include a clear emphasis on the material that these states and districts agree to teach in specific grades.

He said that this report validated that curriculum must simultaneously develop conceptual understanding, computational fluency, and problem solving, and that the movements regarding the relative separate importance of these aspects of mathematical knowledge are misguided. He continued to say teachers should emphasize these

interrelations: conceptual understanding of mathematical operations, fluent execution of procedures, and fast access to number combinations together, which support effective and efficient problem solving.

He insisted that everyone recognize that the Critical Foundations found in this report are but a subset of the full preschool up to algebra curriculum, but they need to know how foundational such work with whole numbers, fractions, and particular aspects of geometry and measurement are as critical prerequisites to algebra. The Benchmarks for the Critical Foundations will serve as useful guideposts for educators and parents for focus and proficiency with foundational topics, regardless of where a child lives in this country.

He posed the question of how a reference to a scene in *The Graduate*, Dustin Hoffman's classic film fits. He recounted a scene in the movie, "Ben, it's about plastics." Well, fast-forward that DVD. Now it's about fractions, defined here as fractions, decimals, and percent. Do them well, develop them, understand them, and know how they're interrelated. They link so critically to higher-level mathematics. The work of the Conceptual Knowledge and Skills Task Group, the Learning Processes Task Group, the Assessment Task Group, the National Survey of Algebra I Teachers, all point to the important role fractions play for all of our students. It's about fractions.

Dr. Fennell thought the findings in the report are a first step with the importance of real world problem solving, and putting math in a situation where students can actually solve the problem. Context really does matter when solving problems. More research is certainly needed, but given the constant demands from students, the findings here represent a very important step.

Another important lesson learned from the Learning Processes Task Group is that effort matters. All children must not only be provided with the opportunity to learn important mathematics, but also it must be recognized that the effort students put into learning makes a difference in their achievement and in their own self efficacy.

Teachers and educators should take note that while teaching well requires substantial knowledge, existing research on the aspects of teacher education, including standard teacher preparation programs, alternative pathways into teaching, support programs for teachers, and professional development, is not of the rigor or quality to permit this Panel to draw conclusions. Based on available research, they could not report on the features of professional development and training that have effects on teachers' knowledge, their instructional practice, or their students' achievement. This is a clarion call for research in mathematics teacher education.

He indicated that the Panel worked extremely hard for close to two years. The work has not been easy. The findings from this effort must not be reduced to some sort of treaty or compromise in the so-called math wars, or yet another shop-worn story about reform versus traditional mathematics. These dichotomies trivialize this effort, and are disrespectful to my colleagues and all those associated with this panel.

This work was about important foundations, which lead to algebra, and about learning, teaching, and assessing mathematics. These foundations for success are the necessary ingredients for every student in every classroom in this country.

Chair Faulkner motioned for Bert Fristedt from the University of Minnesota to begin.

Dr. Fristedt began talking about two audiences to which this report was addressed: the preparers of books for K-12 math education, and the creators of NAEP and the various state tests. He indicated that it was important that the coherence and focus of topics encompassed in the Critical Foundations for Algebra portion of their report be reflected in the organization of and emphases in K-8 school materials, and in the types of items on assessments at various grades. There are other important aspects of K-12 math education besides algebra and the paths leading to it. Coherence is also essential for topics such as data, probability, trigonometry, and geometry beyond the aspects mentioned in the Critical Foundations and requires well-considered sequencing of topics.

As indicated in the Instructional Materials Subcommittee portion of the report, tables of contents in textbooks should reflect a coherent organization. Teachers, and especially math curriculum coordinators, should be able to discern from tables of contents a clear path through the items mentioned in the Critical Foundations of Algebra, both within grades and also from grade to grade.

He explained that even with good tables of contents, clear paths toward desired objectives can be severely obstructed by distractions in textbooks, which are only tangentially related to the essential mathematics at hand. He provided an example about children arranging a collection of objects. He explained that it is the objects, possibly in some arrangement on a table that might warrant a picture or diagram, whereas a picture of the children themselves can cause loss of focus on the math.

The report is very critical of the large numbers of pages in some books about instructional materials. The comments he made about coherence, and the undesirability of tangentially related distractions, are intertwined with the length issue.

While word problems constitute an important part of mathematics, the Instructional Materials section of the report also advises, for math textbooks, relatively few applications where the primary challenge is posed by the science or social studies content. On the other hand, learning how to convert relationships described verbally into mathematical symbolism is a central feature of mathematics.

Dr. Fristedt said that the distinction between math word problems and word problems where the math is peripheral is even more important in connection with assessments. Broadly given assessments will have students at the same level mathematically whose general cultural, science, or social studies background are vastly different. It is appropriate that some items on state assessments, and NAEP, be on the difficult side. But the difficulty should arise out of the mathematics itself, rather than some puzzle-type setting or non-math knowledge.

He fully agreed with the recommendation in the Assessment Task Group portion of the report that probability not be assessed on NAEP at the Grade 4 level, because basic knowledge of fractions and their operations is required for even an elementary, coherent understanding of probability. He cited his experience as a mathematician who has a tremendous liking for probability, and who has done probability research for several decades.

Dr. Fristedt commented that a sketchy introduction to probability that ignores some subtleties of language can cause students to get long lasting, erroneous impressions. He cited that some students might come to believe that it is quite likely that five heads will occur in ten flips of a fair coin, whereas the actual probability of that occurrence is less than one-fourth.

Chair Faulkner motioned for Dr. A. Wade Boykin, from Howard University to begin.

Dr. Boykin started out by apologizing to his colleagues on the Panel for being absent from the vote to adopt the report, which occurred earlier that morning. He stated for the record that he wanted to vote yes on the adoption of the report.

Dr. Boykin indicated that it was an honor and a privilege to serve on the Panel over the last two years. He was genuinely thankful for the opportunity to have served. The experience was truly a mind-expanding, eye-opening learning experience. He felt he took part in a very remarkable process with a collection of professionals who function from different disciplinary perspectives, who brought to bear different intellectual priorities, who saw the issues from often different conceptual frames, and who spoke from a variety of professional lexicons. They were still able to find common ground to converge their efforts with respect to the pursuit of what will actually lead to better mathematics learning and achievement outcomes for U.S. children in general.

He indicated that it was crucial to acknowledge that, within their society, persistent math achievement gaps exist. These gaps simply cannot be easily explained away by socioeconomic status, by income level, or by lack of material resources. In looking to close these important gaps, research clearly suggests that there seems to be promise in paying close attention to the dynamics of classroom life in terms of the daily transactions that go on between teachers and students, and among students themselves; transactions that are understood in terms of cognitive, but also in terms of social, motivational, and affective considerations. There is promise that math outcomes, to a notable degree, are linked to alterable, changeable factors, such as student engagement, student effort and student self-efficacy, rather than fixed factors. These factors are impacted by the quality and the quantity of teacher and peer classroom support.

Dr. Boykin was also struck by the fact that research on what is known about raising achievement and closing gaps has been available in the research literature on learning processes for quite some time. He added that for whatever reasons, these research findings have simply not substantially been translated into educational practices in U.S. classrooms. This matter requires future concentrated and concerted attention.

He commented that all his esteemed colleagues put forth considerable effort and expended considerable intellectual sweat. He believed that the work over the last two years has been a successful enterprise. There still is a lot that is not yet known about enhancing math outcomes, however, more is now known about the foundations for success than was known when they first started on this collective journey just two short years ago.

Dr. Faulkner motioned to Mr. Vern Williams from Longfellow Middle School to begin.

Mr. Williams explained he has been teaching in Fairfax County for about 35 years, and the school system has allowed and encouraged him to be the best teacher possible. He acknowledged Fairfax County Superintendent Jack Dale, who was present. He also acknowledged his principal, Vince Lynch, and Eugene Huang, a current math teacher at the school and former student of his in the 1980s. He also recognized and welcomed Mr. Huang's fourth period class and Mr. Williams' own fourth period class.

Mr. Williams admitted that the debate over how to teach mathematics to our nation's students will continue, but there should no longer be debate over its content. He

never envisioned that mathematics content could ever be compromised or trivialized, until he discovered that some mathematics educators had decided that correct answers were overrated. He further explained that some of those educators also decided that Algebra I topics, such as rational expressions and certain forms of factoring, were also overrated and should be deleted from the course. Algebra, as taught in many schools, was redefined to include data analysis, pattern recognition, and a host of other topics, while some of the more familiar topics were deleted.

He recalled that after the Panel's first meeting, he suggested that the Panel define algebra. He commended the Panel, especially the Conceptual Knowledge and Skills Task Group, for doing precisely that. Students with a strong background in algebra, as defined by the Panel, will be well prepared for the rigorous math courses that they will study in high school and college. A strong background in math courses is necessary if U.S. school children are going to compete globally in science, engineering, and technology.

He felt that teachers of math, at both the middle and elementary school levels, will be pleased that the Panel has suggested, through the Critical Foundations and Major Topics of School Algebra, a focused and coherent body of knowledge and skills that will include computational fluency, conceptual understanding, and problem solving. He hopes that teachers will glean from their report that it is not only acceptable, but crucial, to give major importance to mathematical content, and to require correct answers from their students.

He read the essence bullet under the principal messages section from the Instructional Practices Task Group of which he was a member. "Instructional practices should be informed by high-quality research, when available, and by the best professional judgment and experience of accomplished classroom teachers. High-quality research does not support the contention that instruction should be either entirely child-centered, or teacher-directed. Research indicates that some forms of particular instructional practices can have a positive impact under specified conditions." He hopes that everyone who reads the report agrees that classroom teachers should have a major role in deciding their instructional practices.

Lastly, he added that he had been asked many times whether he was intimidated by some of the people on the Panel because of the vast professional and academic achievements of the panel members. He said he always answered the question by saying he suspected it was probably the other way around. He explained that after teaching middle school math for 35 years to seventh and eighth graders, nothing on earth would ever intimidate him.

Chair Faulkner motioned to Dr. Camilla Benbow, Vice Chair of the Panel and from the Peabody School of Education at Vanderbilt University to begin.

Vice Chair Benbow began by saying that it was an honor and a pleasure to be asked to serve on the Panel, and to be able to assist their strong and effective leader, Chair Faulkner.

She explained that her experience on the Panel was simply amazing. She had never worked so hard on a committee in all of her professional life. The Panel was asked to cover a lot of ground--content, learning, instruction, assessment, and teacher education--in less than two years.

She commented that the Panel started this journey from such different places, perspectives, and backgrounds, yet, by the end of this adventure, the Panel had pulled

together. This report represents a consensus on issues where agreement is hard to achieve. All the Panel members heard the signal emerging from all of the noise in the research base, even if it was faint at times. The policy recommendations made by the Panel came primarily from experimental and quasi-experimental research.

She stated she was proud of what the Panel accomplished. She hoped that this report would result in the initiation of the dialogue necessary for implementing what this Panel has learned in the past two years and to move the schools into evidence-based organizations. The collective work of this Panel should be seen as a model for how this can be done.

She said it was personally gratifying, as someone who heads a leading college of education and human development in this country recognized for its work in special education and as someone who has worked with mathematically gifted students for her entire professional career, to see that the Panel made recommendations that did not just apply to the typical student in our classrooms. The Panel also made recommendations applicable to those who differ significantly from the norm.

The report recommendations span the range from benefiting those with learning disabilities, or at-risk, to the gifted students. With regard to gifted, there was support for allowing students to accelerate, if they so choose, and some indications that enrichment can be beneficial, as well, especially when paired with acceleration. Unfortunately, Panel members heard over and over again that there weren't that many studies they could consult on that topic. It was merely a signal they could not detect.

She noted that she led the Task Group on Assessment. She indicated that it was a critical assignment because what is measured often drives instruction. She likens it to the budget of many organizations—a budget is like a strategic plan. How money is spent actually shows the priorities and goals of an organization, whether intentional or not.

She said in education, what is measured is what is valued and what people will do. The Panel felt that high-stakes tests, like the NAEP and the state tests, could do a better job of measuring those skills and concepts that really count and are critical to success in algebra. The Panel came to the conclusion that current tests need to be improved in quality.

She closed with one last observation: the Panel could not cleanly resolve many of the big debates in math education because the research base just was not there. Over and over again, the Panel members lamented the thinness of the evidence. There has not been enough investment in educational research to build a solid research base. She hoped that would change in the future.

Vice Chair Benbow then motioned for Chair Faulkner from the Houston Endowment to begin.

Chair Faulkner began his comments by noting to the audience that this report is what the Panel has distilled and refined, and taken as its own from a much larger body of material that will also be shared with the public. Underneath the Panel's work as a whole is the work of several subcommittees and task groups. Five task groups were developed, and membership in these groups came from Panel members. Those task groups covered Conceptual Knowledge and Skills, Learning Processes, Instructional Practices, Teachers and Teacher Education, and Assessment. And three subcommittees were on the Standards of Evidence, on the National Survey of Algebra I Teachers, and on Instructional Materials. Each of the task groups and subcommittees has a report that is

still in the process of production, but will appear shortly, and they together constitute a body of material that is on the order of 800 pages or so.

Those reports are the elements of this Panel's work that have the documentation, the references, the citations to original literature, and much more detailed analysis and argumentation than exists inside this report. Chair Faulkner indicated that there is an underwater portion of this iceberg, and it will be available on the Web site today at 11:00 a.m., and while no substantive changes will be made, production refinements are still happening on those documents.

He stated that today the Panel is reporting to the Secretary of Education, the President of the United States, and to the public. The next steps in the improvement of mathematics education are in the hands of people in the audience and people all across the nation. This Panel expires after having done its work, having given the best analysis and set of recommendations that it can provide.

He referenced a comment he heard that day about the exceptional effort that this report represents. He did not mean for his comments to come across as simply bragging about the amount of time that has been committed by this body.

He made an important point that it is rarely possible, in the life of a nation or a life of any society, to assemble the resources that this Panel has been able to bring to bear on the problem of improving mathematics education. There is the skill and knowledge of all the people around this table. There is the time they have committed. There is the two-year time allocation. There is the scope of charge. There is a sizable dollar expenditure from the U.S. Department of Education and from external sponsors. There is the work of a set of dedicated and skilled consultants who were hired to help get this Panel's business organized.

Chair Faulkner commented that it is rare to see a group that can handle and actually address the scope of literature, the scale of literature, and the range of phenomena. All of those facts helped him realize how unusual an event this is, and how important it is that this Panel did everything it could to make the best judgments that it possibly could on behalf of the people of the United States. He believed this happened.

He stated his belief that this panel contributed every last ounce of energy and commitment that was possible for it to give, and that commitment has been given consistently, faithfully, to a standard of judgment that has been remarkable in his experience. This is the very best the Panel could do and now the public has a chance to do something with it.

He pointed out an important observation about this report's now being placed in the hands of a great many different players across the country, in individual districts, in individual schools, at the state level, at the federal level, in textbook publishing houses, in accountability and assessment organizations, and in lots of other places. All of that is knitted together, most importantly, by a set of associations. This Panel has consistently believed that one of the most important sets of constituencies is the collection of associations that bind together all these people who are important in bringing about improvement in the schools or carrying out the day-to-day work of the schools.

Chair Faulkner stated that he wanted to reinforce for those seated in the audience how important it is to think about the improvement of mathematics education as their responsibility. This report represents the best thinking about the next steps to take, what kinds of investments to make, and what kinds of changes to engage in.

He stated that mathematics education in this country is something that can be improved without an act of the U.S. Congress. Whenever a federal panel is created, there is a sense that the primary responsibility is with the federal government, but in this case, it is not. Rather, the responsibility mostly lies with countless people and organizations across the nation, and it's important for these messages of improvement to be thought about and acted upon by people other than Congress.

Chair Faulkner indicated that Congress might help. They could have a significant role by appropriating money to help mathematics education in this country, but they are not going to have the determinative role. The determinative role is local and no one should lose sight of that.

He believed quite a lot that this report could be implemented and acted upon tomorrow at almost no cost. The report is not really about dollars, but it is about getting ideas straight and making the right choices first. Expenditures are required for some of the things discussed in the report, but there are actions that can be taken right now, which are not dependent on legislation or pending financing.

Chair Faulkner closed by saying that mathematics education is not just about a school subject, although it is easy to think about this report that way. It is fundamentally about the chances that real people all across this country will have in life, and it is about the well-being and safety of the nation. Those are very important things, and are worthy of the best effort at mathematics education at every level in this country.

He thanked his colleagues on the Panel. All the members brought great skill, knowledge, dedication, and passion to a process that probably would not have turned out anywhere near as well without all of those things. He indicated that he would always remember the Panel members. He extended his thanks to the staff of the Panel and recognized the support staff in Washington headed by Tyrrell Flawn. That staff worked hard to marshal all the material, the logistics, occasionally curbed a little passion, dealt with government regulation, and did an outstanding job in support of this Panel.

He thanked the consultants involved with this report. Quite a lot of work was done by folks who were contracted to do it, and they did it with great skill. He thanked Abt Associates Inc. for being especially effective, the Institute for Defense Analyses Science and Technology Policy Institute (STPI), and Widmeyer Communications, the group that helped us get publications and other materials prepared. These have all been folks who have been very valuable to work with this Panel and he invited the Panel to give thanks to them.

Chair Faulkner thanked the audience and those who were especially faithful. Whether these familiar faces attended multiple meetings or just this one, public interest in what this Panel undertook was very important, and he stated that the members of the Panel appreciate the attention of the audience and their participation.

Chair Faulkner announced his honor in sharing the podium with a long time colleague and friend, U.S. Secretary of Education Margaret Spellings. Secretary Spellings is the first mother of school-age children to serve as Secretary of Education. She attended public schools, and is working hard to ensure that every young person in the United States has the knowledge and skills to compete and to succeed in the 21st century.

As a leader in educational reform at the state and national levels, she believes in setting high expectations for all students, and places a high priority on shrinking the

achievement gap. She understands the essential role of teachers and supports strengthening the profession.

It was her vision that led to the establishment of the Panel, with its charge to review the best scientific research and make recommendations on improving mathematics learning.

Chair Faulkner stated that this was a highly anticipated moment for the Panel. For the last several months, they have been entirely engaged in synthesizing the findings, drafting the report, negotiating the language, revisiting the research and revising the text countless times. The Final Report grew out of draft 90, which itself had several subsequent iterations. He indicated his sincere belief that the Panel members have all longed for this day when the report would be submitted for the next phase of action and implementation.

Chair Faulkner again commended the Panel for their dedication and commitment to the executive order. For the last two years, and especially since December, the Panel essentially put their lives on hold to complete this report, with generosity and good humor most of the time. They have given untold hours, as well as their expertise. He indicated that it was his sincere pleasure to have worked with the Panel members. The Panel produced a solid report that provides clear, cost-effective, and evidence-based recommendations to improve mathematics education in this country.

Chair Faulkner proudly presented U.S. Secretary Margaret Spellings the Final Report of the Mathematics Advisory Panel.

MARGARET SPELLINGS, U.S. SECRETARY OF EDUCATION, U.S. DEPARTMENT OF EDUCATION

Secretary Spellings congratulated Chair Faulkner, and indicated her pride in the Panel and the tremendous contribution of this report. She commented on the intellect and skill, in addition to Chair Faulkner's incredible leadership to get this report together. She also thanked Vice Chair Benbow for her leadership. She thanked Mr. Williams for his school's hospitality for hosting this event, as well as Jack Dale, the superintendent.

Secretary Spellings then thanked the Panel members for their contribution, sacrifice, and time given. She assured them that their collective effort has not been in vain. Secretary Spellings shared her intent to be vigorous about distributing this work. She looks forward to working with all of the organizations and groups that are represented here today, including the National Council of Teachers of Mathematics, the National Council of Supervisors of Mathematics, the College Board, the American Association for the Advancement of Science, the American Federation of Teachers, administrator groups, and parent groups. The responsibility now is to take this excellent work, this wonderful product, and make sure the world knows about it.

Secretary Spellings spoke of the importance of reframing and understanding who it is that wrote this report. All of the Panel members are experts who represent more than six centuries of experience in the field. The Panel members have published more than a thousand books and papers, together. The Panel members worked for free and on their own time. Since this Panel was formed, they have heard from more than 150 organizations, and looked at more than 16,000 studies. They have visited cities all across this country and left no stone unturned.

She stated that the report respects the role and the value that teachers play as the best people to determine how to teach a skill or concept, but it also provides a lot of useful information to teachers about the timeline on which students must master critical topics. The report correctly points out that in the early grades, students need rapid recall. They need facility with facts, and that students, obviously, should master fractions before embarking on Algebra I in middle or high school. By building on a strong foundation of skills, students will be ready for rigorous courses in high school or earlier.

She discussed why the report focused so much on algebra because that is one of the questions she is asked a lot. Research showed them that, if students do well in algebra, they are much more likely to succeed in college and beyond. That is known for sure. Algebra helps today's students learn problem solving and analytical skills that are so essential to the global economy. Research indicates that students who complete Algebra II in high school have much greater prospects for success. Increasing access to algebra and rigorous course work will help close the achievement gap and the opportunity gap that they often see in this country between poor and minority students, and their more advantaged peers. As job growth in the fields of science and engineering outpaces overall job growth by a rate of 3:1, work must be done.

This report weighs in on the long-standing debate in math education about the relative importance of concepts, or conceptual understandings, and more standard problem-solving approaches, and naturally, this report found that both are important.

She agreed with Dr. Ball's statement that the news from this report is not what disagreements there are, but what agreements there are. In addition to that, it is now known that work must be done to combat this idea that some students are gifted in math and some are not. She recalled that her mother used to say that you get to Carnegie Hall with practice, practice, practice. She stated her belief that responsibility must be shared to make sure that this myth is broken down by moms and dads, and by educators. This is a place where expectations matter a lot.

Finally, the report tells them that the earlier they start teaching children math, the better, and this is very important for parents. She believes that parents understand the importance of reinforcing reading skills and developmental skills around those topics, but who might pay less attention to the value that those early years play in math education. It is a commonly held belief that kids are not ready to take on those sorts of concepts, but every time you slice a pizza, or pour a glass of juice, or measure something, that's an opportunity for moms and dads to talk about math, even before kids go to school.

She stated that she believes that these insights, together, are all the more important today, where fewer than half of African-American and Hispanic kids are graduating from high school. Also, the nation's report card shows them that about half of 17-year-olds lack the basic math skills required to work in a modern automobile plant. She believes that is simply an untenable kind of result for this country.

Secretary Spellings pledged to do everything possible to share this information and to make it more available to moms and dads, teachers, administrators, and policymakers, so that greater results and greater understanding in math can be achieved. She said she looked forward to working with the organizations represented here and those not represented.

She also hopes the U.S. Congress will see the merit of the President's request for \$100 million for the *Math Now* program, which will do a lot to feed the early pipeline of

their little, young mathematicians. A lot is often thought about higher education and research, which are very important, but they have under-invested in math education in the early grades. She hopes that this report will help bolster that argument to policymakers, not only here in Washington, but also all around the country.

She thanked all the Panel members for their service. She thanked Tyrrell Flawn and her fantastic staff for this labor of love. She said she looks forward to continued communication around this important issue. She noted her trust that all those present will stand at the ready to continue to help carrying this message to the important public.

Secretary Spellings reminded the Panel that the executive order does not expire until April of 2008. She mentioned that there would be ongoing opportunities for the Panel members to communicate. She indicated her interest in having a summit on this topic. There will also be opportunities for articles and publications.

Chair Faulkner adjourned the meeting at 11:13 a.m.

I certify the accuracy of these minutes.

Chair Signature _____ Date _____

Vice Chair Signature _____ Date _____

ADDENDUM: PUBLIC PARTICIPANTS

Last Name	First Name	Organization
Ausnit-Hood	Christine	Thomas Jefferson High School for Science and Technology Academic Boosters
Au	Florence	
Balyah	Stephanie	U.S. Department of Education
Beers	Jack	Sadlier-Oxford
Birnie	Susan	Alexandria City Public Schools
Buckley	Michael	Houghton Mifflin Harcourt School Publishers
Budd	Karen	
Burt	Janeula	SRI Intern
Caldwell	Sally	Delaware and Delaware Council of Teachers of Mathematics and the Association of State Supervisors of Mathematics
Cavanagh	Sean	Education Week
Cinotta	Peter	Frederick County Public Schools
Clark	Holly	U.S. Department of Education, Office of Innovation and Improvement
Clark	Mary Jo	MathCounts and public schools
Cronin	Della	Washington Partners, LLC
Curry	Blair	Turnkey
Dano	Jack	TCPS
Dempsey	Kathleen	Longfellow Middle School and Fairfax County Association of the Gifted (FCAG)
Denson	Kelly	ETS
Dicker	Laurie	
Dillin	Gay	National Council of Teachers of Mathematics
Doore	G. Stanley	East County Citizens Advisory Board member, & CCA
Duckett	Paula	Educational Solutions
Epstein	Louise	Fairfax County Association for the Gifted
Evers	Bill	U.S. Department of Education
Farcus	Shirley	Organization Words & Numbers
Fasanelli	Florence D.	American Association for the Advancement of Science

Last Name	First Name	Organization
Garellick	Barry	NYC HOLD
Gill	Alice	American Federation of Teachers
Glod	Maria	Washington Post
Gomez	Robert	Office of Communications and Outreach , United States Department of Education
Gray	Ann	
Greene	Jennifer	Bayfirst
Greenberg	Anita	CompassLearning
Harvey	Patricia	National Academies
Healy	Mark	Kaplan K12 Learning Services
Huang	Eugene	Longfellow Middle School
Johnson	Pat	U.S. Department of Education
Kendrick	Diana	Maryland Council of Teachers of Mathematics (Maryland), National Council of Supervisors of Mathematics
Kepner	Henry	University of Wisconsin-Milwaukee
Korelitz	Jamie	Haycock Elementary and Fairfax County Association of the Gifted
Krehbiel	Ken	National Council of Teachers of Mathematics
Lemanowski	Vivian	Pearson
Long	Beverly	Frederick County Public Schools
Margino	Alyssa	American Association of Colleges for Teacher Education
Martinez	Alina	Abt Associates Inc.
Mayo	Colleen	Frederick County Public Schools
McCloskey	Peter	NS&TEP
McKelvey	Lynda	Sopris West Educational Services -- A Cambium Learning Company
Mitchell	Nyema	IDA Science and Technology Policy Institute
Morgan	Margaret	Elizabeth Forward School District
Morrow-Leong	Kimberly	Prince William County Public Schools
Natale	Marlene	Adelphi University(Garden City Campus)
Noonan	Peter	Fairfax County Public Schools

Last Name	First Name	Organization
Padgett	Michelle	FLPS
Palmer	Nelson	Frederick County Public Schools
Pang	John K.	Concerned Parent
Pelosi	Maric	Longfellow Middle School
Pickens	Michele	Frederick County Public Schools
Pittock	Janet	Scholastic
Roberts	Karen	Montgomery County Public Schools
Robertson	Patricia	Arlington County Public Schools
Rubillo	James M.	National Council of Teachers of Mathematics
Sagendorf	Jennifer	Suffolk Public Schools
Santee	Steve	Prince William County Teach Math Right
Saxberg	Bror	K12, Inc.
Schwartz	Andrew	College Board
Silbey	Robyn	Montgomery County Public Schools
Sprayberry	Diane	Renaissance Learning
Steele	Jeffrey	
Stiner	Karen	U.S. Department of Energy, Office of Science, Workforce Development for Teachers and Scientists
Stotsky	Janet	
Sugar	Ruth	MPR Associates, Inc.
Sullivan	Kay	IDA Science and Technology Policy Institute
Trigg	Timotha	
Uy	Erin	Education Daily, LRP Publications
Ward	Bonnie	Fredrick County Public Schools
Washington	Verna	Montgomery County Public Schools/Maryland Council for Teachers of Mathematics
Williams	Bruce	
Wray	Jon	Maryland Council of Teachers of Mathematics
Wurman	Zeev	U.S. Department of Education OPEPD
Yudof	Samara	U.S. Department of Education
Zimmer	Janie	National Council of Supervisors of Mathematics
Zuckerbrod	Nancy	Associated Press