UNITED STATES DEPARTMENT OF EDUCATION
NATIONAL MATHEMATICS ADVISORY PANEL MEETING

SUNDAY, NOVEMBER 5, 2006
SUMMARY

The National Mathematics Advisory Panel met in open session at the Schwab Residential Center, East Vidalakis Hall, 680 Serra Street, Stanford, CA 94305-6090, on Sunday, November 5, 2006, at 4:00 p.m., Chair Larry R. Faulkner, presiding.

PANEL AND EX-OFFICIO MEMBERS PRESENT:

LARRY R. FAULKNER	Chair
CAMILLA PERSSON BENBOW	Vice Chair
DEBORAH LOEWENBERG BALL	Member
FRANCIS (SKIP) FENNELL	Member
DAVID C. GEARY	Member
RUSSELL M. GERSTEN	Member
NANCY ICHINAGA	Member
TOM LOVELESS	Member
LIPING MA	Member
VALERIE F. REYNA	Member
ROBERT S. SIEGLER	Member
SANDRA STOTSKY	Member
VERN WILLIAMS	Member
HUNG-HSI WU	Member
DANIEL B. BERCH (PRESENT VIA CONFERENCE PHONE)	Ex Officio Member
DIANE JONES (PRESENT VIA CONFERENCE PHONE)	Ex Officio Member
RAY SIMON	Ex Officio Member
GROVER J. (RUSS) WHITEHURST	Ex Officio Member

PANEL AND EX-OFFICIO MEMBERS NOT PRESENT:

A. WADE BOYKIN	Member
WILFRIED SCHMID	Member
JAMES H. SIMONS	Member
KATHIE OLSEN	Ex Officio Member

STAFF MEMBERS PRESENT:

TYRRELL FLAWN	Executive Director
IDA EBLINGER KELLEY	
JENNIFER GRABAN	
HOLLY CLARK	
MICHAEL KESTNER	
KENNETH THOMSON	

CALL TO ORDER

Chair Faulkner welcomed all participants to this fourth meeting of the National Math Panel at Stanford University and called the November 5, 2006 Panel meeting to order at 4:00 p.m.

PRESENTATION ON AMERICAN STUDENT READINESS FOR COLLEGE-LEVEL MATHEMATICS: ARTHUR VANDERVEEN, THE COLLEGE BOARD

Mr. Arthur VanderVeen introduced his colleagues, Dr. Alfred Manaster from the University of California, San Diego; and Dr. William Speer from the University of Nevada, Las Vegas. Mr. VanderVeen shared some of the empirical research that they have done to support the design and development of mathematics and statistics standards for college success, as well as the kind of purposes and objectives that led the College Board to develop these standards.

He gave an overview of the data on remediation rates of entering freshmen taking non-credit-bearing or remedial courses in college, and suggested that remediation is not an effective solution to preparing students for college-ready work. Only 27 percent of those students will earn a bachelor's degree. By comparison, 58 percent who take no remedial courses will earn a bachelor's degree.

Mr. VanderVeen stated that College Board launched its effort to develop new standards in 2003 because its membership was struggling under these very high remediation rates. They were looking for a framework that they could use to try to coordinate the conversations between K-12 and higher education systems to better articulate learning objectives across the two systems and to reduce remediation. They also sought to increase the number and diversity of students who were prepared and ready for the opportunity to take Advanced Placement (AP). The ultimate goal was to offer a framework to better develop students for college-level work by the time they graduate from high school or are ready to take an AP course.

Mr. VanderVeen described their strategy, which was to identify the mathematics and statistics content that first-year college faculty expect of entering freshmen and to map back from these expectations. This was intended to then articulate a coherent framework of college preparatory courses beginning in grade six that would lead to these benchmarks for college readiness.

College Board convened a Mathematics and Statistics Standards Advisory Committee, which included middle school and high school teachers, college mathematics faculty, teacher education faculty, research mathematicians, curriculum and assessment specialists, and specialists in developing standards frameworks. The Committee spent hundreds of hours over the course of three years reviewing information, surveys and reviewer comments, and revising these standards.

The resulting *Standards for College Success*, which was provided by Mr. VanderVeen in his written statement, are organized as middle school math I and II, algebra I, geometry, algebra II and pre-calculus. In addition, they laid out the performance expectations within those course frameworks to align with an integrated approach. They also offered an alternative framework of six integrated courses to

support those states and districts that are using an integrated approach to math education. Statistics and data analysis are integrated into all of the courses because they needed to provide a preparation track for the AP statistics course. The standards are intentionally specific because they wanted to provide sufficient guidance to curriculum and assessment supervisors and teachers to design instructions and assessments in middle school and high school that lead toward AP college readiness.

Mr. VanderVeen stated that the validity of the standards is based on multiple alignments, including AP, SAT and PSAT. They also used curriculum surveys, course content analyses, national and state content standards, and the National Science Foundation (NSF) integrated curriculum. They conducted original research in the form of surveys, one of postsecondary faculty and one of high school faculty, to determine the mathematics knowledge and skills critical to success in their courses.

The postsecondary survey presented collegiate respondents with drafts of the *Standards for College Success* and asked respondents to rate the Standards for College Performance Expectations in terms of level of student mastery. One of the most interesting findings, Mr. VanderVeen stated, was that postsecondary teachers taught most of the performance expectations written for high school mathematics courses as new material due to students' lack of strong mathematical foundations.

An open-ended question was also presented in the survey asking about the content or process knowledge they would suggest students have mastered prior to entering the respondent's collegiate course to be successful. They found that 29 percent indicated that students need greater mastery of algebra and functions, particularly by instructors of college algebra courses. Another finding was that 18 percent of calculus instructors reported a need for greater student mastery in geometry and measurement. They also found a need for greater mastery in problem-solving.

Mr. VanderVeen also described the eight case studies conducted to gain greater insight into the findings of the postsecondary surveys. A number of these studies emphasized computational fluency and dismissed the need for conceptual understanding in K-12 preparation while others emphasized the ability to reason conceptually and solve problems. All eight institutions noted that students lack a deep theoretical understanding of math as a language, which inhibits their ability to think critically and apply mathematics to solve problems.

The high school teachers were asked the same questions as the college teachers to allow for comparison. They over-sampled highly-qualified teachers, who were asked to rate whether a) they taught the material in their course as new, if they taught it in their course, b) they don't teach it, or c) they expected it to be taught in a later course. VanderVeen et al. found that most of the teachers responded that they do teach this material as new in their course, which confirmed the sequencing of the coverage of the content knowledge.

Using the standards and some SAT questions, Mr. VanderVeen explained that they tested algebra II students in high schools. They performed well on operations with real numbers and polynomial expressions, linear and quadratic equations and functions, systems of equations, and exponential functions. However, they had difficulty with matrices, complex numbers, permutations and the normal distribution.

Mr. VanderVeen concluded there is fairly common agreement among highly-qualified high school mathematics teachers that a real disconnect exists between college

calculus faculty and high school pre-calculus teachers regarding the importance of geometry and pre-calculus courses. They also found that college mathematics teachers knew much of the same material as high school mathematics teachers. There is a need for a coherent, articulated framework defining expectations across middle school, high school, and first-year college mathematics courses to reduce remediation and re-teaching.

PRESENTATION ON AMERICAN STUDENT READINESS FOR COLLEGE-LEVEL MATHEMATICS:
CYNDIE SCHMEISER, PRESIDENT, EDUCATION DIVISION, ACT

Ms. Cyndie Schmeiser gave an overview of ACT's research on preparing students for college. The first level of their research asked -- what do we know about college readiness in mathematics, what factors increase college readiness in mathematics, and what is the relationship between college readiness and college success in mathematics? Their data source is the 2006 ACT-tested high school graduates. The composition is 54 percent female, 43 percent male, 63 percent white, 12 percent African American, 7 percent Hispanic, 3 percent Asian, and 1 percent American Indian.

ACT has defined college readiness by looking at a nationally-representative sample of postsecondary institutions' course placement data and the ACT scores of students who went into those college courses. The ACT test is a part of ACT's college readiness system, which looks at the pipeline to college, includes the tenth grade program called PLAN, and an eighth grade program called EXPLORE. When looking at all these data and the progress made by students, ACT can tell what students look like who are, or who are not, prepared for college. In 2006, only 42 percent of ACT-tested students who graduated in the class of 2006 were on target to be ready for college-level math when they left high school. And for the other groups tested, the numbers were even more sobering.

Ms. Schmeiser stated that students who take core courses in math are far better prepared for college than those who do not. Core courses are defined by the *Nation At Risk*, or three years of high school math. Students who take upper-level math courses are two to five times more prepared for college than those who simply take algebra I, algebra II, and geometry. Students who are college-ready are more likely to enroll in college, 77 percent versus 60 percent.

Ms. Schmeiser believes that we are losing students in math because they are not being exposed to high-level mathematics standards needed for college readiness. When they looked at the 49 sets of state standards, only 19 states fully defined course standards in math through high school and only 25 states required students to take any math course in high school at all.

ACT also conducted a longitudinal study with Education Trust. The longitudinal study was of ten high-performing high schools identified through ACT data that were also high minority and high Title-I-funded high schools. However, they were producing high school graduates at greater than average proportions than seen nationally. ACT looked at courses, teachers, and classroom work to find that their courses were all aimed at high-level, college-oriented course content. There were well-qualified teachers in the classroom. They used flexible pedagogical styles, and they were available to their students after school. ACT found a high degree of consistency in algebra I, algebra II,

geometry, and pre-calculus courses. A model course syllabus was created from that work and they are basing a new program on those rigorous course objectives to help identify what needs to be done and what is actually having an effect when these students go to college.

Ms. Schmeiser concluded that there needs to be early monitoring of college-readiness to identify students who are not on target to become college-ready in math. She noted that more attention should be given to aligning K-12 state standards to college work and to assessments. Also helpful would be an improvement of the quality and intensity of high school core courses.

PRESENTATION ON AMERICAN STUDENT READINESS FOR COLLEGE-LEVEL MATHEMATICS:
QUESTION AND ANSWER PERIOD

Dr. Robert Siegler asked about the students in the EXPLORE, PLAN and ACT group. He asked if they did make their way to the target by the ACT, was there an idea of how that happened. Ms. Schmeiser responded that she will follow up with that data, as she did not have it in front of her.

Dr. Tom Loveless asked about College Board's decision to integrate statistics into its standards when the surveys show that high school teachers do not teach it, and it's not included in state standards

Mr. VanderVeen said College Board will not revisit that decision because he sees the state of K-12 statistics education growing to respond to the number of courses in postsecondary that demand both the computational mathematical skills as well as the probabilistic reasoning skills that come with data and experimental design. Dr. Loveless followed up by asking whether College Board has thought that by adding more topics into the curriculum it would just be exacerbating the problem, namely the addition of statistics. Dr. Speer responded that when statistics is integrated into coursework, it is related to math concepts that were already there, so it is not necessarily new content. In addition, College Board *Standards of College Success* looks at success in college, and statistics is an important part of many majors beyond the mathematics area. Dr. Manaster responded that a reduction in the number of topics that are repeated would create space in the curriculum.

Mr. Vern Williams asked why so many things have been taken out of the basic courses such as geometry because of the addition of topics like data analysis. Dr. Manaster responded that they have tried to have a progression of treatments of data analysis throughout the curriculum.

Dr. Hung-Hsi Wu said that there is never enough time to teach the basic curriculum. He said that in mathematics that is fatal because everything is built on the previous step, and this is one of the reasons for underachievement. He feels that schools do not have the personnel in high school to teach statistics well. Mr. VanderVeen responded that they recognize the issue of capacity and how it could be grown through professional development and teacher training.

Dr. Wu then asked how much of the ACT test is free response. Ms. Schmeiser responded that the mathematics components of the ACT test are all multiple choice items. Dr. Wu showed concern about the disconnect between the predictability of an ACT

multiple-choice test and performance in college as colleges do not usually test through multiple choice. Ms. Schmeiser stated that there are ways in which multiple choice items can be constructed that focus on higher-level thinking and analysis.

Vice Chair Camilla Benbow asked whether the people who took the EXPLORE, PLAN and ACT were comparable populations. Ms. Schmeiser stated that they looked at cohorts of students who had taken all three tests over a period. While it is not nationally representative, it is large enough to provide useful information. Vice Chair Benbow also asked that when they looked at the course-taking data and college preparedness by the number of courses taken in high school, did they adjust for previous achievement. Ms. Schmeiser stated that they did not control for achievement. More information, she said, can be found in their handouts.

Dr. Francis "Skip" Fennell asked College Board if they have any record of preliminary work by states using this research to revise state frameworks. Mr. VanderVeen said they are sharing drafts of the frameworks with a number of states, including Florida, North Carolina, Texas and Virginia. Dr. Fennell asked if they have seen any push back from those states in integration of data analysis and probability. Mr. VanderVeen said they have not received any pushback on that, but he cannot say that that is representative of their final opinion.

Chair Faulkner asked about the ACT longitudinal study and whether students who are not college-ready at the earliest stage don't recover. Ms. Schmeiser answered that that is correct. ACT is seeing that for students who are not on track to become college-ready in eighth grade, between 30 and 35 percent never recover to become college-ready in high school.

Dr. Russell M. Gersten asked College Board about re-teaching in college and what they think the pros and cons of doing that are. He also asked about the disconnect between how high school teachers felt and how university people felt about the importance of geometry. Dr. Manaster answered that the disconnect on the importance of geometry refers specifically to the geometry that should be taught in a pre-calculus course. Dr. Speer answered the first question by saying the issue is in what spirit we are re-teaching. If it is repeating the content as if it were new, then that is where he thinks there is a problem.

Dr. Siegler stated that it is important to make sure students understand a concept before moving on because math is all about building understanding. Dr. Speer agreed, but clarified his statement in saying that a teacher just cannot keep re-teaching something the same way if that is not working.

Dr. Deborah Loewenberg Ball asked about the ACT study and the analysis of why students are losing momentum in high school. She asked how the conclusions were arrived at and if they were related to the lack of rigorous standards or the lack of exposure to rigorous topics. Ms. Schmeiser said those conclusions come from national curriculum surveys, which she did not have time to talk about. They are about to publish the 2006 survey in which they asked high school teachers what they are focusing on and what amount of time are they spending teaching it, among others. They then compare that to what university faculty members of entry-level courses report. They look at lack of momentum by comparing eighth grade and twelfth grade data.

Dr. Ball followed up by asking if the survey would have picked up other causes for the lack of momentum such as the quality of instruction or the quality of teacher

preparedness. Ms. Schmeiser answered that no, it would not have picked that up because it is self-reported information from high school teachers. ACT's *On Course for Success* study would pick up that type of information as they actually went in and studied practices in schools for an 18-month to two-year period of time. They learned that in high-performing schools, teachers were teaching to higher-level skills than what they saw in low-performance, average or below average schools.

Dr. Ball stated that she would like to see more about that study because the Panel will need to know if they can draw conclusions about curriculum and whether they can make inferences or recommendations about teaching and teacher preparation.

Chair Faulkner thanked the public for attending the open session. The meeting was adjourned at 5:07 p.m.

I certify the accuracy of these minutes.

Chair Signature_____Date_____

Vice Chair Signature_____Date_____

Addendum: Public Participants

Last Name	First Name	Organization
Antink	Suz	Palo Alto Unified School District
Appleyard	Sara	Widmeyer Communications
Bass	Hyman	University of Michigan
Baughman	Marcy	Pearson Education
Beers	Jack	Metropolitan Teaching and Learning Company
Belcher	Terri	National Council of Supervisors of Mathematics
Blakely	Robin	Holt, Rinehart, Winston
Blaunstein	Phyllis	Widmeyer Communications
Bradley	John	National Science Foundation
Carroll	Cathy	Leadership Curriculum for Mathematics Professional Development
Chou	Rachel	Menlo School
Collins	Carla	CTB/ McGraw-Hill
Collins	Bob	iLearn, Inc.
Conry	Tamra	National Education Association
Crotti	Patti	California Comprehensive Center
Dhaliwal	Jivan	Santa Clara County Office of Education
Duckhorn	Pat	Sacramento County Office of Education
Easterday	Joan	Sonoma County Office of Education

Last Name	First Name	Organization
Evers	Williamson M.	Hoover Institution
Flattau, PhD	Pamela Ebert	Institute for Defense Analyses (IDA)/ Science and Technology Policy Institute, Social and Behavioral Sciences and Education
Fular	Bob	N/A
Gilliland	Kay	National Council of Supervisors of Mathematics
Hill	Peter	KLA-Tencor
Johnson	Erin	N/A
Kammerzely	Jon	Renaissance Learning
Katzir	Avivit	N/A
Kel-Artinian	Anne Halley	N//A
Kel-Artinian	Sarkis	San Jose Unified School District
Kelly	Shawn	Nexus Educational Publishing
Kessel	Cathy	Association for Women in Mathematics
King	Marsha	Sacramento County Office of Education
Kohlberg	Gavi	Digi-Block
Lenhertz	Elizabeth	Pearson Prentice Hall
LeTendre, Ph.D.	Gerald K.	Pennsylvania State University
Lowell	Mandy	Palo Alto Unified School District
Luce	Tom	N/A
Manaster	Alfred	University of California, San Diego
Martinez	Alina	Abt Associates

Last Name	First Name	Organization
Menvielle	Linda	N/A
Milgram	Jim	Stanford University
Mitchell	Nyema	Institute for Defense Analyses (IDA)/ Science and Technology Policy Institute, Social and Behavioral Sciences and Education
Morton	Erwin	Commission of the California State Parent Teachers Association
Morton	Erwin	N/A
Munger, Ph.D.	Charles T.	Curriculum Development and Supplemental Materials Commission
Nanny	Margo	Interactive Learning Design and Learning.com
Newton	Xiaoxia	Stanford University
O'Reilly	Fran	Abt Associates
Panduro	Luis	Imperial County Office of Education (ICOE)
Rusczyk	Richard	Art of Problem Solving, Inc.
Sarginger	Kirsten	Santa Clara County Office of Education
Schmeiser	Cyndie	ACT
Schwartz	Richard	University of Southern California
Slack	Ellie	Palo Alto Unified School District
Speer	William	University of Nevada, Las Vegas
Spencer	Cherrill	Expanding Your Horizons Network
Tepper	A.S.	Stanford University School of Education

Last Name	First Name	Organization
VanderVeen	Arthur	College Board
Veater	Carl	Fresno County Office of Education
Wurman	Ze'ev	Community activist, active in math education in California
Young	Lorelle	U.S. Metric Association, Inc.