U.S. DEPARTMENT OF EDUCATION

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NATIONAL MATH PANEL MEETING

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Arizona State University
Memorial Union Alumni Lounge, Room 202
Tempe, Arizona

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October 24, 2007
8:15 a.m.

Panel Members:
Dr. Larry Faulkner, Chair
Dr. Camilla Persson Benbow, Vice-Chair
Dr. Deborah Loewenberg Ball
Dr. A. Wade Boykin
Dr. Douglas Clements
Dr. Susan Embretson
Dr. Francis (Skip) Fennell
Dr. Bert Fristedt
Dr. David Geary
Dr. Russell Gersten (Not Present)
Dr. Tom Loveless
Dr. Liping Ma
Dr. Valerie F. Reyna
Dr. Wilfried Schmid
Dr. Robert S. Siegler
Dr. James Simons (Not Present)
Dr. Sandra Stotsky
Mr. Vern Williams
Dr. Hung-Hsi Wu

Ex Officios:
Dr. Irma Arispe
Dr. Daniel (Dan) Berch (Present via Conference Phone)
Dr. Joan Ferrini-Mundy
Mr. Raymond Simon (Not Present)
Dr. Grover (Russ) Whitehurst

Staff Present:
Tyrrell Flawn, Executive Director
Ida Eblinger Kelley
Marian Banfield
Jennifer Graban
Holly Clark
Jim Yun

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

8:17 a.m.

MR. FAULKNER: Let me welcome everyone to this second public session of the 9th National Math Panel meeting. We are very pleased to be here in Arizona at Arizona State University. We will have the pleasure of hearing in just a moment from the president of the university, Dr. Michael Crow.

Let me begin, though, by reminding everyone that we have signing services available. If signing services are needed we will continue them, if not, we will discontinue them; be advised though that we can restart them if necessary. Is there anyone who they are required for? If not, we are going to discontinue them then. Thank you.

We are very pleased to be here at Arizona State. President Michael Crow is a friend of some years standing, and over the years I've had many opportunities to watch at close hand what is going on here at Arizona State. This university has got the leading edge of rethinking the relationship between a university and its public. Tremendous things are going on here at Arizona State. Things that are not going on anywhere else at anywhere near the same level of intensity or invention.

This geographic area is an area of

exceptional dynamism; the growth pattern here is beyond imagination in most of America. And Dr. Crow came to Arizona State with the intention of harnessing the energy that is in that dynamis, and using it as a basis for building a very strong coupling between Arizona State University and this growing community.

He frequently talks about the new American university with key themes of access that connect to excellence, placing an emphasis on innovation and making connections to the youths of society.

Like the Panel, this University is concerned about American's competitiveness and recognizes the critical role education plays in keeping the country strong.

I'd like to introduce Mike Crow here. He became the 16th president of Arizona State University on July 1, 2002. Under Mike's direction, the University's teaching, research, and creative excellence focused on the major challenges and questions of our times, and certainly those central to this region.

Since he took office, Arizona State University has marked a number of important milestones, including the establishment of major interdisciplinary research initiatives, such as the Biodesign Institute, the Global Institute for

Sustainability, and Metrotechnology Works, a program of integrated science and technology for large-scale applications.

Under his direction, Arizona State University has initiated a dramatic research infrastructure expansion to create more than one million square feet of new research space. Also a sizable effort that I don't have in these notes, but I want to call your attention to, is construction of a major league downtown campus. In our odyssey-like bus ride last night on the way to our restaurant we actually drove by, when we were near the ballpark, a very large construction zone; I don't know if you actually noted it but that is the downtown campus. There's about 400-million dollars worth of facilities down there.

Prior to joining Arizona State University (ASU), Mike was the Executive Vice Provost of Columbia University, where he was also professor of science and technology for the school of international and public affairs. He's a fellow of the National Academy of Public Administration, a graduate of the Maxwell School at Syracuse. He's the author of books and articles relating to the analysis of research organizations, technology transfer, science, and technology policy. He's definitely carrying out public

policy right here in Arizona.

Mike, it's a pleasure to have you with us, and we appreciate your hospitality.

DR. CROW: Thank you. Thank you, Larry. I'll stand over here, maybe, so I don't have to talk to so many people's backs. I apologize to you all.

So, welcome to Arizona State University (ASU). It really is fantastic that you all -- when Larry called and said you might have an interest in being in this part of the country for at least one of your sessions, I said it's fantastic, you know, we're in that part of the country that a lot of people from other parts of the country sort of haven't figured out yet, because we're not done. We're not shaped, and we're still evolving. We've got 4.1 million people living in this county, and the county's population in 1970 was under a million, and so -- substantially under a million. So basically, you're in the middle of a place where the city is being born and the state is being born in real time.

And you'd say, well, that's fantastic everything should work out. It's tough, very tough. We're in a period of intensive re-conceptualization of what a university should be, what a research university in particular should be, intensive re-conceptualization of education.

There are huge educational challenges in Arizona that are derivative of significant diversity in the population, as well as growth, as well as inability to keep up with growth and so forth. So the issue for us here has been to move into the, what I call, the design-build mode.

So in K through 12 education, we're near the end of a P-20, what we call the P-20 council that the Governor has established. That council will recommend a number of things like Algebra II is the minimum math skill for high school graduation, that will probably recommend four years of high school math for graduation from high school. That will put on us the requirement of adding or producing 400 new math teachers a year out of this institution.

So we certify 1600 teachers a year from our three educational preparation platforms, and I'm going to talk a little bit about what that means for us, but to figure out how to produce 400 high quality, high intensity, very capable math teachers and science teachers is very challenging, so we're taking that task on.

A little bit about the university itself. You're in an older part of one of the three largest single university campuses in the United States in terms of population. We have 52,000 students on this

campus. Everything here happens rather quickly. And because things happen rather quickly, we basically decided the following:

So in 1925 we offered no degrees whatsoever; we only certified teachers. We offered nothing outside of education until roughly 1960. We had no funded research until 1980. We were Research I in 1994. And have more than doubled our research enterprise twice since 1994. And so the institution is advancing.

Now you'd say, well that's fantastic, you must look a lot like other places. And so it's anything but. We don't want to be like other places because those models of the past don't necessarily work for the world that we're facing. And to some of the points that Larry made, let me give you some examples.

So we have these three driving words that most universities have, but we have actually pushed them all together.

Academy excellence, which means to us not just replicating the excellence of others, but also actually driving new areas.

So we have a new school of earth and space exploration, which merged geology, astrophysics, astrobiology, and astronomy and systems engineering

into a single school with exploration as the theme, which attracts students by the hordes.

So just to give you some idea of scale. We have 600 chemistry majors, 1700 biology majors; we have 2,000 technology majors, 7,000 engineering majors. And so we have a large enterprise here that we're advancing.

But we also have a new school of human evolution and social change; I'm focusing on excellence now. A new school of family and social dynamics, and a new school of sustainability. These are all new ways of organizing ourselves together, and that creates, basically, mental shock waves in the minds of everyone else, because they say, well, how will that work? How does that happen? What we look at is what -- where do we attract students? How do they succeed? How do they move forward?

So for us, excellence means designing what we need, versus what someone else designed in the past. Designing what we think will be more interesting to the students, more exciting to the students, more powerful, more impactful.

The second word for us in terms of our core mission is access. So we're in this high growth state. We are one of the Research I universities, and so there's 100 or so of these research universities,

and you know, we've gotten our research activity up to a significant volume. And so people will basically be telling us at this point in our evolution, cut out the bottom. Cut out the weak. Set them adrift. Send them to the access-only schools, because they're going to kill you as you advance the institution.

We said anything but, that'll be the last thing that we do, you'll do that over our dead bodies. Because we're going to make certain that we have one university in the United States, perhaps others are trying this also, probably not quite as big a scale, where you actually can have an outstanding faculty of the first rank engaged in research-orientated programs and curricula, where we actually have egalitarian admission standards.

So let me tell you what that means. We have 9,400 freshmen. 9,400 freshmen. It's not just a function of size. I'm going to talk about what it means. So we guarantee financial access.

If you come from a family from below $25,000 a year in income, you pay nothing to attend this university. No tuition, no books, no fees, no room and board, nothing. You'll just do work-study. If you come from a family under $80,000 of family income, you pay no tuition.

So because of grants that we give and

granting that the federal government gives, there's no tuition cost to you. So we have made financial access a non-issue to the institution. Now, we have a long way to go because we have other issues relative to the college going rate.

But the second thing for us relative to access is not just financial access; it's what we call intellectual access. And I'll give you a couple of examples. We don't have time today to go through everything, but just to give you some idea.

About 20 miles from here, we have another campus that we just renamed the Polytechnic Campus, and that sends shudders through everyone's brains. How could anybody be building a polytechnic campus in the 21st century? Aren't those, you know, vocational schools or something? Far from it.

So what we're building there is a second engineering program, built around -- we have an engineering school already, we're putting 75 new faculty positions into that engineering school. We just hired a fantastic new dean. She's really moving us forward in that engineering school. But we're building a second program.

One school will be a modeling and research-orientated school, and the other school will be completely learning by doing, a studio-focused

engineering school, the way they used to teach engineering long ago.

It turns out that if students come along and they weren't math enabled in the environment that they went to K through 12 in, for whatever reason, but they're math capable and they're spatially intelligent and tactically intelligent, they can still be a fantastic engineer; so we built a second platform.

We've built three education school platforms, one with a leadership curriculum, and one with a teaching, math, and science curriculum, and one with a traditional curriculum. We did the same thing in business, three platforms. And so we're doing this consciously and deliberately as we try to broaden the way that we have access.

The other thing that we did, is we have 52,000 students on this campus and then 12,000 students within 20 miles of here on three other campuses; including the new campus that Larry mentioned being built in downtown Phoenix.

What we did was we didn't name a main campus. We're the oddest ball, the weirdest institution on the street. Everybody else has their sort of main campuses. That used to be the name of this campus, but we did away with that. They're all just called the same now. They're just Arizona State

University, and they have different addresses. This is Tempe, one is Phoenix, and one is Mesa. They just have different addresses.

We are distributing our colleges. We did away with all campus infrastructure, all campus leadership. There's no provost, there are no chancellors, there's nothing; there are only deans, 23 colleges. The 23 colleges are distributed on the four campuses. Each of the 23 colleges has a niche and a mission, a niche and a mission unique to itself.

We have a very large college of liberal arts and sciences, with 20,000 students on this campus. A large school of engineering, a large school of business, a large art school, a large design school, and so forth.

But the reason I'm giving you this notion is that here's what happens in the structure that we used to have when I took office. Oh, well, you got into Arizona State University (ASU), but you had to go to the west campus, and so therefore you're an idiot. You're labeled forever by the function of the institution that you were assigned before your abilities had even been tested. They were tested in high school, but is that the end of the game? Are you labeled in the European modality for the rest of your life based on your high school performance or your

middle school performance? And so we think not.

And so what we tried to do is to eliminate social hierarchy from within the enterprise. Now, you can't do it completely, because the faculty cannot get it out of their thinking some times, and it's understandable. But we've done it by niching the schools, building mini-schools and distributing the schools. And then setting up the schools to be complementary with each other, as opposed to hierarchical with each other. And then we've asked each of the schools to work forward in their own path. And so those are some of the things that we're doing here.

We're also doing something that creates all kinds buzz and stresses and strains and so forth. That is, we're adding 40,000 more seats to this university. But we're not doing it in knockoffs. Access orientated only campuses, where 25- or 30-percent of the students hope to graduate, maybe. We're not building knockoffs.

We are building schools and colleges that are successful within their niches and empowering those schools and putting those schools into the right environment.

So we took the journalism school, the Walter Cronkite School of Journalism, we're spending

$85 million on a world-class facility in downtown Phoenix. It's within walking distance of all the major media outlets in this part of the country. The major papers, newspapers, radio stations, multilingual everything, whatever it happens to be, you can -- it's all going to be engaged. We're melding these things together. That school will prosper in that environment. And so we're taking a different approach to the way that we're advancing the institution.

And you all, by the way, your work is extremely important to us, because we look at this whole thing about math preparation and math skill as essential to the evolution of this region. It's extremely challenging. It’s extremely challenging because we have such highly variable levels of preparation, and we have huge cultural barriers to math in families, in communities, in entire school districts.

And so I'm sure you all have worked your way through all these things, but any advice you can give us out here on the front lines and any input that you can give us in this sort of design build place would be much appreciated.

And by the way, by 2030, if you came back then, the State will be 11-million people or 12-million people. So we're faced with that also. And

by the way, they didn't build any state colleges, so there's only three universities here in the entire state.

So some of the things we do because we have to do them, and because we have to do them, why don't we do them right?

So welcome again to Arizona State University. I think it's only going to be in the 90s today. If you stay until Saturday for whatever reason, we're playing the University of California at Berkley here, and hopefully we'll win; and they're a very good football team. So welcome.

DR. FAULKNER: Thank you, Mike.

Okay. Let me point out that we have the rest of the document to go through, and we will. We're going to -- I'm putting this group on a budget of time. We, I think, cannot afford to leave Phoenix without having discussed every part of this document, so I'm going to slice the time up in a way that allows us to get to everything. But it means that we probably won't be able to take every discussion until it reaches a natural end. At least I hope we'll identify all the major contended points and ideas, at least get them cataloged, and we can continue the debate by e-mail and other means. But we do need to visit everything.

Now, where we are is with fractions. If you're working with what's on the screen, starting with line 253 in the printed copy that you have, the section on fractions.

What I'm going to do is give us until 9:15 to get through the sections from 4 to 9 in the learning section of this report.

So let me ask if there are comments that people want to make about the material that's in the fractions section. That's A through I in section 4.

Well, I know that from experience that I don't have this group intimidated.

There's general agreement with the fractions material?

DR. GEARY: Larry?

DR. FAULKNER: Yes?

DR. GEARY: Just a point of clarification. I'm -- for example, (I) under fractions, relative to estimation of the magnitude of fractions and so forth. As we reconfigure the number sense area, that may go under that.

DR. FAULKNER: Okay.

DR. GEARY: With "may" in capital letters for each.

DR. FAULKNER: Okay. Sandy?

DR. STOTSKY: I would just recommend that

I go with a research section. Whether you want to have all of the research questions at the very end of the document is another question I also wanted to raise, because we end up with a huge pile, and I'm just thinking in terms of the effectiveness of the document and how it communicates. Whether you want to consider thinking about having groups of recommendations that logically follow each major section, as opposed to having them all that relate to the content, all at the very end in one long laundry list.

DR. FAULKNER: Well, we might want to do that.

DR. STOTSKY: Just a suggestion.

DR. FAULKNER: I do believe that the most important recommendations have to be gathered in one place, at least in the executive summary. It is possible to put individual sets of recommendations in sections where they relate when they're in the regular document, and we may want to think about doing something like that.

DR. STOTSKY: Okay.

DR. FAULKNER: Okay. Camilla had a question or point?

DR. BENBOW: Actually, I don't have a question. I'm just -- if we have -- I would like to

say, in order to be able to focus on the substance of the report, maybe if you can later on highlight things that you think might have to go to another place, we can pick those up by e-mail, and let's look and see if we can focus on the points that we have differences of opinion about. Thanks.

DR. FAULKNER: Okay. Anything else on fractions? It looks like you're more or less happy with fractions. Okay.

That takes us then to geometry and measurement. Geometry and measurement is a relatively short section. Three points, (A), (B), (C). Any points to be made? Bert?

DR. FRISTEDT: This section on geometry is there to focus on aspects of geometry that can build towards algebra. But if you read that as geometry sort of sitting alone, it gives a very unbalanced view of what geometry is, because there are other aspects of geometry that sort of don't tie in with arithmetic skills and on the way to algebra.

And I think the Conceptual Knowledge Skills document, as opposed to this document, makes that point a little bit, and they also make the point about data -- what's the word -- that that also interacts with arithmetic skills, but it also has the same problem, but that's only part of the story. But

I know why it's -- so there's a balancing that's not coming through in this document.

DR. FAULKNER: No, and we need to make sure that it comes through. I agree with you on that, Bert. And I think we can do that. Wilfried?

DR. SCHMID: It seems to me that, let's say, some of these paragraphs are closely related -- what's done in Conceptual Knowledge and Skills, but then not maybe taken from an earlier version.

For example, (A) is not consistent with what's in Conceptual Knowledge and Skills. The issue of analysis -- I mean, to determine the surface area of general quadrilaterals is -- I mean, so it has to be said much more carefully and in line with what is in the Conceptual Knowledge and Skills.

DR. FAULKNER: Well again, the language is going to be brought out of the working papers. This is not the language. This is a catalog to show what the flow of development looks like.

FR. CLEMENTS: Given that it's not the language, this might be a point we can put off too.

But in B, I wouldn't agree that students must eventually make transition from concrete or visual representations to internal abstract representations as a valid statement for geometry. Geometry never loses its spatial nature. And I think

that this could be misconstrued as that the abstractions leave aside that kind of thing. And I'm not sure what -- it probably came from IP -- I mean, LP, excuse me.

DR. FAULKNER: Learning Processes, do you want to comment? Valerie?

DR. REYNA: We can just take out the word "abstract" and just put "internalized representations," and that would fix the problem.

DR. FAULKNER: Okay. "Abstract" goes. Wu?

DR. WU: Yes, I just want to make a point, that what Wilfried was pointing to is the fact that it's not a matter of the flow of ideas, but rather the fact that this emphasis on -- for the privilege of learning algebra. I'm not sure that you want to emphasize three-dimensional shapes and all that; it's quite irrelevant. I hope I represent you correctly. Is that what you said?

DR. FAULKNER: That's what's in the Conceptual Knowledge and Skills document.

DR. FENNELL: In a much earlier version. We need to -- there's language here that has been changed to that statement. That's Wilfried's point.

DR. FAULKNER: In Conceptual Knowledge and Skills?

DR. WU: Yes, I think it must have been changed.

DR. SCHMID: It was, yes. I think that -- so the point is really it has to go -- it has to be brought in line with the language.

DR. WU: Yes.

DR. SCHMID: And that also takes care of Bert's because again, what worries you is certainly taken care of in CKS, and that then has to transfer into this document.

DR. BENBOW: If everybody could keep in mind, we're going to use the most current document.

For example, in the assessment we've done a lot of work in the last month, so we need to be able to update that document. So just keep in mind that we're always -- when we go back to capture this idea to the text, we will go into the most up-to-date version that you have.

DR. WU: I'm sorry. I didn't finish. So the point I'm really trying to make is that I'm sure at some point you will have to minimize, and you have a 30-page document that you might have to leave out some of the things. I mean this represents the pool you can draw from.

And if it ever comes to that, I want to make a point of saying that (A) really is the primary

piece of information we need, and (B) and (C) relate more to general geometric learning. And so I don't think (B) and (C) are directly related to algebra, learning of algebra.

DR. FAULKNER: Deborah?

DR. LOEWENBERG BALL: I just had a question to Conceptual Knowledge and Skills, since Larry is going to be using that. Do you discuss definitions? That's kind of related to Doug's comment. But I would think part of the point was for kids to develop definitions of these shapes, not to be relying purely on visual images, which is one of the historical problems they've had. But I don't know what you have in Conceptual Knowledge and Skills. I don't have that at my fingertips.

DR. GEARY: We don't.

DR. LOEWENBERG BALL: Okay.

DR. WU: Can I say something on that?

DR. LOEWENBERG BALL: Yes.

DR. WU: I think the most important thing for the learning of algebra is to get the concept of slope and then the equation of straight lines straight, and the correlation between an equation and straight line. And for that purpose, there's a great emphasis on how to define slope correctly. But the other things, I mean, that's general learning of

geometry that was considered a little beyond what Conceptual Knowledge and Skills could cope with at that point.

DR. SCHMID: Yes. I mean, the way Conceptual Knowledge and Skills was written, it was made very clear that we're talking about the aspects of geometry that are important to algebra. And then the way it's phrased, I think the question that you are asking really doesn't come up. Because viewed through that lens, it's really very clear what needs to be covered.

DR. FAULKNER: Yes. We are, I think in Conceptual Knowledge and Skills, quite explicit about the fact that items of curriculum that we're emphasizing do not make up a whole curriculum for the earlier grades. That is what we're focusing on as the most essential elements for preparation for entry into algebra, not everything that should be addressed in an early grade education. Yes, Bob?

DR. SIEGLER: With regard to Wu's point about points (B) and (C), I think that point (C) actually should be profitably moved to the general principles of learning section, because it doesn't just apply to geometry, it applies as the statement already says, to algebra and other mathematical skills and would make sense to put it there.

With regard to (B), I think there's a specific reason to include that. And that is a very widespread view among educators that these manipulatives somehow inculcate an understanding of geometry, and the evidence just isn't there.

DR. FAULKNER: Okay. Other points. Wade, you look like you're about to say something?

DR. BOYKIN: Well, I guess I was going to make a similar point that Bob just made, that I think it's important to take out this issue of distributed practice in the superior to open math practice as a general principle. That should be put into the general principles section.

DR. FAULKNER: Okay. Bert?

DR. FRISTEDT: I know you've mentioned several times that you're going to lift things from the working papers, but I think this conversation and several others that we have -- could have about various things, indicate that I think it would be -- we'd get a much better document if at certain places you go back to the original full reports. I know that we're just dumping work on you, but since it's not on me, and I think it will make a better paper.

DR. FAULKNER: Well, we're going to have to see how practical that turns out to be. What I probably will do is draft something from the working

papers, and you probably will get, to recommend where we go back to the original report.

Okay. Liping, did you have your hand up? No. Anyone else? Okay. That's done on geometry and measurement.

Benchmarks we basically covered yesterday, I think. We're moving benchmarks up. Is there anything more that needs to be said about it here?

Social, motivational, and affective influences we actually basically talked about in the discussion of the Clements' group order, and I think we probably covered it. Is there more to discuss here? Okay. That gives us integrated curriculum versus single subject approach. Comments on that? Wilfried?

DR. SCHMID: Indeed, these is no discussion of let's say the practice in foreign countries. And I think for this question of integrated curriculum versus single subject approach, many of the proponents of integrated -- with an integrated curriculum point to foreign countries. And therefore, I think it is very important that the comparison with foreign integrated curricula be included here. And again, in the Conceptual Knowledge and Skills report that is done, and it's been done with considerable care. That aspect of the question

of integrated curriculum versus single subject approach needs to be included indeed.

DR. FAULKNER: Okay. Any other points? Tom?

DR. LOVELESS: And I would just add to that. Similar to our discussion in St. Louis, that the people who often point to the high achieving nations that have an integrated curriculum, often leave out the countries at the bottom of the distribution; the lowest scoring countries also have integrated curriculums.

DR. FAULKNER: Bert, then Sandra.

DR. FRISTEDT: The word, "integrated curriculum" bothers me a lot, because publishers have taken that name on and they characterize their own materials with that adjective. But at least in many cases, I don't think the adjective fits at all. And yet it now has the label, "integrated curriculum." Actually, I know one of them that I would put in the word "fragmented" rather than "integrated," and there's -- so, that's the end of that point.

DR. FAULKNER: Sandra?

DR. STOTSKY: A slightly different point. I would wonder in terms of coherence, whether this whole topic would belong better under discussion of textbooks. I don't know exactly where it fits here in

terms of what we've been discussing, but it does relate to textbooks in some way, more certainly when we're talking about high school textbooks.

So I'm just suggesting that maybe this particular, which also needs to be reworded in some ways, because what you've got here doesn't even reflect carefully what is in the main document in other respects, in addition to the definition that Wilfried mentioned. But I'm just suggesting that we think about grouping all of the things that relate to textbook practices.

DR. FAULKNER: Camilla?

DR. BENBOW: I think curriculum -- integrated versus single subject curriculum, it's a bigger decision than just the textbook. You have to make a decision which approach you're going to use, and then you select your textbooks. So I'd be a little hesitant to stick it as a textbook issue.

DR. WU: I just want to add to the emphasis that other people have already given to this point. The fact that any time we mention independent curriculum, we have to make sure that it's understood that the way it's understood -- this term is used in the foreign countries differently from the way it's --

DR. FAULKNER: Well, there's language in the CKS document.

DR. WU: The Conceptual Knowledge and Skills document actually has a specific reference to it, and I just want to make sure that that's in it.

DR. FAULKNER: Right. Wilfried did you have another point? Skip?

DR. FENNELL: I want to agree with Wilfried's initial comment, but also suggest, as Camilla just indicated, that the issue is broader than textbooks.

There are states now that are suggesting that their state frameworks at the high school level are integrated, and so I think it stands on its own somewhere.

DR. BENBOW: Somewhere?

DR. FENNELL: Yes.

DR. SIEGLER: I'd like to reiterate a version of Tom's comment. That if we have this in the learning section, all we could possibly say is that there isn't research to say anything, because there is no research on the effects on learning here. And the international comparisons, I think unless you have a correlation between whether there's an integrated or segmented curriculum and students learning, it's impossible to draw a recommendation either way. There are logical arguments on either side of a position.

DR. FAULKNER: But they're arguments.

DR. CLEMENTS: Are you saying, that is one of the main points you wanted to make? Or are you advising none, emphasizing this point?

DR. SIEGLER: Well, I could see leaving it the way it is or I could see moving it away from the learning processes section here altogether because the statements -- I think if we want to say anything beyond this, we're really not relying on learning research.

DR. FAULKNER: But it's a question of learning isn't it? I mean, isn't the reason you would be interested in an integrated curriculum is that it facilitates learning, supposedly?

DR. SIEGLER: Yes, that would be fine. It's fine to leave it here, as long as we're not coming out on one side or the other. Because the learning research certainly does not entitle you to do that.

DR. FAULKNER: Correct. Skip?

DR. FENNELL: I would at least question that. I see it as a delivery issue, more than I do a learning issue.

I mean, I think it's an attempt to take what someone has defined as appropriate mathematics for these levels, and frankly package it differently. Looking at it from an approach that is integrated

across levels or areas of mathematics, as opposed to single subject. I suspect the same learning issues would apply.

DR. FAULKNER: But isn't the motivation that students would learn better, supposedly? Or is it to save money? It seems to me those are the only two motivations.

DR. FENNELL: That's coming from a former college president, I'm sure.

DR. SCHMID: Well again, I think that in the Conceptual Knowledge and Skills report this question is discussed, and I think the statement there is quite cautious. I mean, it is that there are no obvious arguments either way. And I think that needs to be said here.

And then the question of where (D) belongs, augmented by a discussion of practices in foreign countries. It needs to be augmented, and then we can decide where it goes. But the discussion would not be complete unless we talk about foreign practices, and again, the Conceptual Knowledge and Skills conclusion is very clear, that there is no good evidence either way.

And then obviously we can't make a recommendation other than that there is no obvious reason to change.

DR. FAULKNER: Vern, then Sandra.

MR. WILLIAMS: If you look at the very last sentence, wouldn't it be a recommendation to change? Basically you're saying that the integrated math doesn't cover as much material.

DR. FAULKNER: That's a single case study in a single state, Vern. I think in principle it could. Sandra?

DR. STOTSKY: That was why -- one of the things that I was saying was that on the basis of some evidence, there needed to be a better qualification than has been in several versions of this document.

But to get back to the placement issue, I'm wondering whether this and the next one belong right after the introduction of the major topics, because that is thematically what they relate to. When we have them in the Conceptual Knowledge and Skills document, it's a return to issues of algebra and above. It's not about development before algebra. And it seems to me that these two might logically follow at this point, for lack of any other place, not as a learning process issue, but as a curriculum issue, relating to algebra itself, and therefore follow before we get into the concepts and skills, the fundamental -- critical foundations that these two both belong, somehow, with the exposition of the major

topics, because of the thematic relationship to them with this point.

DR. FAULKNER: But with respect to this report, these are kind of railroad sightings, and I don't really want to get -- interpret the flow of the report from the major topics to the critical foundations to the benchmarks to learning with these relatively smaller issues that we can say relatively little about. So I'd rather they were further down in the document than that.

But I want to get this closed out here. I think we've got a segment here that's actually pretty straightforward, in what is possible for us to say, which is nothing. And so I don't want to spend a lot of time on it. Tom? Quick.

DR. LOVELESS: Yes. Very quickly. What they both have to do with is course taking, and how mathematics are packaged into courses. So we may have a section and maybe call it course taking, and (A) is point 8 and (B) is point 9.

DR. FAULKNER: Okay. That's possible. All right. Is there anything that just has to be said about this? Bert?

DR. FRISTEDT: I suggest us removing it.

DR. FAULKNER: Okay. Let's go on to the next one. The next one was a contended issue, that's

why it's in red.

When we came back -- we had the meeting of the censuses team chairs yesterday, one of the teams wanted to move this out and other teams didn't, and so it's been highlighted for discussion here. Let's discuss it.

What is your thinking about the availability of Algebra I for grade 9? I didn't propose it, one of the synthesis teams proposed it. I've forgotten which. Wilfried?

DR. SCHMID: Well, if this is included, and I'm saying "if", then there has to be very careful language about what it means to present Algebra 1 before grade 9, and that there are very serious issues of preparation. So again, I'm not speaking either way for including this, neither pro or against.

DR. FAULKNER: Well the language in Conceptual Knowledge and Skills does have the emphasis on courses offered --

DR. SCHMID: And it must be there.

DR. FAULKNER: It needs to be a real course, and --

DR. SCHMID: It must be there.

DR. FAULKNER: -- if students take it, they've got to be prepared. Tom?

DR. LOVELESS: I like this language better

than the language of earlier versions because the earlier versions dealt with having states provide incentives for schools and school districts to offer a course.

And look, the problem here is this, we could just as easily wish that all kids take calculus by grade 2; this is a wish. But what happens with these wishes when they're converted into policy is they create perverse incentives. And the example that I've given, and this has to do with algebra, was the District of Columbia had a mandated, all students will take an algebra course by grade 8. Now that sounds wonderful, but in the National Assessment of Educational Progress (NAEP) test, the District of Columbia scored at the very bottom of all 51 states and the district on their math scores, even though all 8th graders were taking an algebra test and that continued to happen.

So my point is, you don't necessarily get the results that you think you're going to get because there's no one out there to police. Who's going to police the authenticity of these courses? No district has the capacity to do that. Most school principals don't have the capacity to do that in their own buildings. So that's the danger of this kind of recommendation.

DR. BENBOW: But there's another danger on the other side too. And if you put out the recommendation like this, people could say that no one should have algebra before 9th grade, and that would be a very damaging situation.

So I think you need to have algebra by the 8th grade for some, not all students, and even 7th grade for some, but even fewer students.

But I think the issue has to be that the students have to be ready for it, well prepared, and that the course has to be a rigorous course that we would accept. It shouldn't be a watered down course to have it at 7th grade, then you're defeating yourself.

So I think that this is a very important issue. Many countries touch on real algebra before 9th grade. And if you don't get algebra before 9th grade, you preclude getting calculus in high school, and that precludes many career options.

So I think if we don't have it in there, I think there is another unintended consequence.

So what we have to talk about is phrasing this in such a way that everybody can accept it and that we can minimize poor implementation. Because what we're talking about is not the concept but the fact that they think it's implemented poorly.

DR. FAULKNER: The Conceptual Knowledge and Skills language covers all of that. Vern?

MR. WILLIAMS: I think it should be offered at grades 7 and 8. But when you start mentioning large numbers of students taking it, it takes on a different meaning, and you end up having teachers pressured to do the grade inflation thing, because you have these students who are not really qualified, but on paper it makes the school system look good.

So of course they should be offered in middle school. But to state that large numbers of students should take it -- larger, largest, doesn't matter, more, students are going to be put into a course who shouldn't be, who aren't ready, especially if it's an authentic course.

And what's going to happen, whatever we say about authentic algebra, just from experience, it will be watered down if you have students who are not qualified to do the authentic course.

DR. FAULKNER: Skip?

DR. FENNELL: I really support what Vern just said. We have more and more students in this country doing something called algebra at the grade levels that he teaches every day. And so I think the language that refers back to those critical

foundations are essential as prerequisites in here.

I also like the sort of soft revision that he's stated, although not directly, by stating, "professional judgment supports the value of preparing students to complete." Deleting the phrase "larger numbers of" so you don't get into this legislative dictum of all kids doing Algebra I by grade 8 or whatever, whether that's a statewide or a school district decision. What happens there, you're legislating course taking without necessarily the prerequisites to do so. And I think that's the issue that Wilfried has expressed earlier as well.

DR. FAULKNER: Tom?

DR. LOVELESS: Well, unfortunately I don't support offering either as an option because many buildings do not have teachers who can teach this course. And what you'll wind up doing is creating the course first, without a teacher who can teach it.

I surveyed algebra teachers, did a random survey of algebra teachers cross the country in middle school, and the percentage of them, I can't remember off the top of my head what it is, who had any kind of degree in mathematics is abysmal. So we already have a problem with teachers in middle school, who really have not been grounded in mathematics, teaching algebra.

If you create a mandate that every school that has a 7th grade needs to offer algebra to 7th graders, or even to 8th graders, what you're going to do is just exacerbate that problem.

I would propose that the language be something, again, this is a bromide, it's just sort of pie in the sky, but something more general about, "we think more kids should be prepared for an authentic algebra class at an earlier age than currently happens."

DR. FAULKNER: That's what we say.

DR. LOVELESS: Well no, we get into policy stuff in terms of offering classes, or in terms of -- I'm responding to Vern's suggestion. But anyway, I've made by point.

DR. FAULKNER: Sandy?

DR. STOTSKY: Excuse me. We don't have a lot of elementary teachers in grades 6 and 7 who can teach properly what they are teaching. Would you suggest that therefore we couldn’t offer material on slope and ratio and proportions because we don't have teachers who are prepared to teach it properly? No.

The point is, we know we have problems with teacher preparation. And one of the later suggestions is to -- as the president indicated earlier, to try to improve the preparation of teachers

so that they are capable of teaching what we think we should offer, and which apparently many other countries also offer.

And the question is, if other countries can offer this course legitimately, the question then is why shouldn't we be able to offer the course? There's no mandate, the wording "of the original" as Larry has suggested, is certainly much more careful than this, with a lot of qualifications, and that is part of what should be looked at are all the qualifications.

DR. FAULKNER: I think we've heard the concerns. Wade, you're going to have a moment here to comment. We're going to -- we've heard the concerns largely here. We're going to end up putting language in here, specific language, and let's see how that ends up flying eventually. But I think that the test that we're going to end up having to make is on the real language, not on this marker.

DR. BOYKIN: Yes, just a small point, but at least one I think needs to be made. I just wonder about the necessity for including experience as a form of evidence in this particular claim. It's going to open up sort of a can of worms, because we typically haven't talked about experience as a source of evidence.

DR. FAULKNER: Well, the language actually -- Wade, this is an abbreviation of -- it says "from research results, experience in other countries, other leading countries, and professional judgment." That's actually what the language says. So I think we'll just -- let me get the real language there, and then let's talk about the real language. Okay? We're actually doing debates here on language that won't survive this. Okay?

All right, then that means we have arrived five minutes ahead of time at the teacher's section. So let's talk about how can teachers facilitate learning, and how can they be supported to do so?

Let me try to break this down. We're going to have until 9:45 to discuss this section. Let me try to break this down. Maybe I can't break it down. Maybe we just go at the whole thing. Tom?

DR. LOVELESS: This is a wording thing, but it's important, because it changes the nature of the point. Under (A), those studies actually show 12 to 14 percent of total variability in students learning, not in their gains, because many of them didn't gain.

DR. FAULKNER: What's the wording, Tom?

DR. LOVELESS: I would -- since -- in the studies many of the kids actually -- their test scores

go down, so they didn't have any gains. So I'm just saying it's the variability in their scores, not in their gains. So why not call it students' learning or students' test scores or something --

DR. FAULKNER: So it's mathematics learning, right?

DR. LOVELESS: Mathematics learning, right.

DR. FAULKNER: Okay.

DR. LOVELESS: Or mathematics achievement. It's about change as opposed to gains.

DR. FAULKNER: All right. Bob?

DR. SIEGLER: I have concerns about including this point at all, the point (A) for two different reasons.

One is that giving a parameter estimate here, which we don't have -- I don't think in any other place in the report, it's not clear about the reliability of this parameter estimate. It's not based on a huge database, and whether a new study that examined the same thing would get 12 or 13 or 14 percent is highly questionable.

The second point is that I think including the numbers will actually have the opposite effect of that that's intended.

As scientists, we understand that

accounting for 12, 13, 14 percent of the variance in this domain is quite impressive. As laymen, my guess is that people will think, is that all? One-eighth of the variance, who cares about that?

So I think that this won't accomplish its goal, and I think the broader statement above it will carry the point we really want to make.

DR. FAULKNER: Russ?

DR. WHITEHURST: On the first point, there is a substantial body of research. Larry Hedges has reviewed it and capped it off with an examination using the Tennessee class size experiment data involving randomized trials. And so the variance accounted for here is a well-founded estimate based on first the strong randomization study using the store data and then looking at the meta-analysis of weaker studies. And it all came to estimates within this same area.

One of the comments we got from reviewers of the Teacher task group material was the importance of providing some anchor for what large gains mean. The second sentence here talks about a 10-percent difference over the course of the school year. My feeling is that we need something other than just a vague adjective about large, to talk about the importance of this.

DR. FAULKNER: Okay. We have a for and against.

DR. BOYKIN: I have a question to those that know this database. These are generic statements about students in general. I'm just wondering, do these numbers vary as a function of students' ethnic background?

DR. FAULKNER: Russ knows the data, I think.

DR. WHITEHURST: I'm hesitating, because I'm not sure whether I'm constructing this on the fly or whether it's something I actually remember, and maybe that's more than you need to know. There are some racial ethic differences here, but they don't change the overall point and they're not particularly large. That's my recollection of the findings.

DR. BOYKIN: The reason I raise it is because it might relate back to earlier points scattered in the ethic and racial differences section, because my suspicion is that these numbers might even be higher for black and Latino children. That's why I raise the issue.

DR. WHITEHURST: As I recall, they are higher.

DR. BOYKIN: And that might be worth pointing out in the report.

DR. FAULKNER: If we're going to put in data like this, it would be worth making that point if it's true. Okay. Wilfried?

DR. SCHMID: Would it be possible to make the point of the importance of this phenomenon without giving numbers by saying that, in effect, that it is a larger affect than almost any other variable in school curriculum, textbooks, you name it? I think this is the biggest one, and maybe if that point is made, then we also avoid the pitfall that Bob just mentioned.

DR. WHITEHURST: I'm certainly okay with that. Though I do kind of like the second point, because it's so specific, that over the course of the school year you get a 10 percent difference in achievement from being in the classroom of a higher performing versus a lower performing teacher. But I think we're spending -- the debate I'm concerned about is the debate about whether it's in or not, not so much wordsmithing how best to express what the magnitude is.

DR. SIEGLER: Yes, I think Wilfried's solution is an excellent one. And percentiles, I think people do understand what those mean. And so my concern about the 12 to 14 percent doesn't apply to that.

DR. LOEWENBERG BALL: I just wanted to say

that we got this -- this section, which is now the beginning of our task Group report. We got this independently reviewed in addition, because we added it somewhat late in our work, and we sent it out to people who are experts in value-added studies to ask them to consider what we were doing, and we have three reviews of this.

So I think that if we can find a way to write it in a way that -- you know, in response to your comment and does what Wilfried said, that might help the common reader understand, well, why this is actually really an important point to preface what we're doing.

DR. FAULKNER: Okay. Skip?

DR. FENNELL: We're commenting on the whole section, right Larry?

DR. FAULKNER: Well, we're doing the whole section.

DR. FENNELL: Okay. Can I draw your attention to where it begins, line 403?

DR. FAULKNER: 403, more needs to be known.

MR. FENNELL: What we have there is an opportunity, I believe, to talk directly and strongly about the need for -- not necessarily the need -- the need for research about professional development and

the impact of professional development.

What we see in the text is the statement that I'm looking at on line 403 that then merges into a lengthy statement on professional development and then picks up the issue of math coaches. And I think that needs to be separated out.

In other words, I support strongly something there relative to the importance of professional development.

Do you understand what I'm talking about? Those are merged statements.

DR. FAULKNER: I don't understand what you're talking about. What impact does it have on --

DR. FENNELL: Well, look at -- do you see where it says, "it is widely"? Do you see that?

DR. FAULKNER: "It is widely," yes.

DR. FENNELL: Okay, then if you look down to "in addition, there's no evidence from available research to support the issue of math coaches."

I think those are related but different, and I would like us to make some statements relative to professional development, and then we can decide how to talk about the issue of math specialist, math coach, math specialist teacher.

DR. FAULKNER: You're suggesting breaking that as a separate --

DR. FENNELL: That's correct, yes.

DR. FAULKNER: Okay.

DR. CLEMENTS: But also tying the more needs to it, "it is widely."

DR. FAULKNER: The more needs to --

DR. CLEMENTS: He's saying two things.

DR. FAULKNER: You're saying --

DR. CLEMENTS: The two paragraphs should start at "more needs" and then continue through "it is widely" and then a new paragraph should start, "in addition."

DR. FAULKNER: Yes. What you're suggesting is no paragraph break after the first paragraph, and a paragraph right down below. And those have to do with the way this gets amplified. Yes. Okay. Wilfried?

DR. SCHMID: Is that sentence the only place marker for comments about professional development?

DR. FENNELL: I think so.

DR. SCHMID: If it is, then I think certainly more needs to be said for the intended audience.

I mean, I think that we know, but maybe much of the audience really doesn't have a full understanding of how large an industry professional

development is. That an enormous amount of money gets spent. That there is very little or no evidence that this money is being spent efficiently. That point really needs to be made.

And if we say more needs to be known, this is just a very, very pale suggestion of really what needs to be said here.

DR. FAULKNER: Other comments? Deborah?

DR. LOEWENBERG BALL: It might help to go back to the task group report where there's more detail about the whole teacher education section. Because in fact, we probably want to be making something -- saying something about teacher education more generally. This is not only about -- we shouldn't be saying only professional development, but also preliminary preparation of teachers, and we also didn't find evidence about the induction program.

So we have a whole section on teacher's education, and probably want to slightly expand that. And I think you can lift it out of our task group report or out of the working paper, either one.

DR. FAULKNER: Okay. Did Wu have his hand up?

MDR. WU: No.

DR. FAULKNER: Okay. Sandra?

DR. STOTSKY: I just wanted to ask a

question on little (c) before, on page 395. It wasn't clear to me whether this was one study or more than one study that was being referred to, and this is just a general point. I think we need to be clearer when the report is amplified whether some of these statements come from just one or two studies or a body of research, because this is one of the issues in standards of evidence that has, I think, been discussed. Valerie, you can clarify on this that there needs to be a body of evidence to really put forth, a positive statement about something. And if there's a hint, fine, but it should be clear that -- how many studies feed into it.

Maybe Russ can tell us for number (c). This is number (c), it says something about compounding dramatically.

DR. FAULKNER: Which (c)? The pay bonuses (c)?

DR. STOTSKY: This was line 395. I don't know how many studies that refers to. Perhaps you could tell us.

DR. WHITEHURT: Sure. They're all cited in the work group paper. So it's -- we cite three, I believe, I don't have the paper in front of me.

DR. STOTSKY: I'm just suggesting that we need to make sure that we have some indication of the

base of the number of studies. I'm sorry.

There needs to be a better sense of the base for making a study -- for making a judgment or a declarative statement.

On the professional development issue I agree with what Skip said and also with Deborah's point about separating that out and having earlier statements on what the research does tell us about either teacher preparation, and to separate recruitment, which I am seeing muddled all the time with retention. This is just a general question. I'm always seeing recruitment and retention coupled together. They are two totally different phases in the process of dealing with teachers.

When you're recruiting people, they haven't taught yet, so you can't use value-added measures to judge, because they haven't been teaching yet. You're talking about different kinds of approaches to recruitment, and I think those need to be broken out as separate phases.

Recruitment gets into certification issues, what the evidence is for certification, which has been mentioned. I don't see anything that deals that clearly with recruitment here. And this is a major, major issue. This whole section doesn't address that.

Then there is teacher preparation. Then you get into induction as a separate topic. And then you get into professional development, which is for practicing teachers. And then there may be master teacher issues.

But there are at least a number of stages that have not at all been broken out here with what we know or don't know or what can be said. And professional development is the last one, and the one that the most money is spent on and for which we have the least amount of evidence from a large number of studies.

So there's a lot more clarity that I think needs to be here, as well as break up into various sections.

DR. SIEGLER: I think that the language between 403 and 413 has an implication that I don't think is justified by, at least the date I remember from the Teacher's report, in that there's a kind of presupposition built in that professional development really does work and we just don't quite have the evidence to know exactly how it works.

So for example when you say more needs to be known about professional development of teachers that equips teachers with the knowledge and skills they need to facilitate student learning, it implies

that it's a good thing and we need to know more about it. And I'm not sure that there's evidence that that's true.

Similarly, in 410, although professional development may lead to some positive effects on students learning, there's not sufficient evidence to clarify which forms or approaches to professional development are most effective. Again, it's saying it probably is a good thing, but we don't know the details. This is what we would say if there were evidence that overall it works but we really don't understand the specific mechanisms. And I don't know that the evidence that was reviewed indicated anything that strong.

DR. FAULKNER: Deborah, do you want to respond to that? If you're not, then I'm going to go to Doug and then to you.

DR. LOEWENBERG BALL: I guess I don't completely understand, Bob, what you're saying. It's not a normative statement about anything one might think of as Professional Development, but you can't have a profession in which -- or an occupation in which people don't get training to do the work.

So all that report is filled with knowledge about learning. Knowledge about the mathematics, like our earlier discussion about

algebra. We actually need a system in this country that reliably equips an enormous population with the skills to carry out what this report says. So that's all that's being said here. It's not an alliance with any particular form, that's exactly what we're saying.

I don't quite understand what your point would be. What would be the alternative to having systems of actually training people to do the work? What conceivably could be the alternative?

DR. SIEGLER: Just to respond to that. I think it's a reasonable idea to say that we need to find out what forms of professional development will allow teachers to achieve their goals more effectively. But I think at present, we don't know how to do that. At least I didn't see any evidence in the teacher's report that we do.

DR. FAULKNER: Bob's comment has more to do with tone than it does the statement.

DR. SCHMID: Well, I mean, to amplify on that. I think that, you know, elsewhere in here there is a statement about - a hedged statement, as there has to be, about the effect of teacher knowledge on student learning.

And I would say that if you just sort of order of magnitude, compare the language, the suggestion, as it is phrased now, is that well, there

are two components, subject knowledge and professional development, and you know, we don't know much about either. Both are probably okay, and more needs to be known.

And I think that if we augment what is known from studies with, let's say, our own sense of what is going on, there's a huge difference between the two. That with subject knowledge, maybe we don't have overwhelming numerical evidence, but I think all of us are quite certain that subject knowledge is a huge component in successful teaching.

In professional development, I think there is certainly plenty of suggestion that much of the professional development is misguided.

And so the language, I agree, has to be based on what we actually know. But I think beyond that, then the way the language is pitched, has to convey our sense of what the evidence actually means when we apply our own sense and knowledge of what's going on.

DR. FAULKNER: Sandy, are you talking on the same subject?

DR. STOTSKY: Yes.

DR. FAULKNER: Okay.

DR. STOTSKY: At table two in the teacher report, which deals with the effects of professional

development on student achievement, and there are a number of specific studies, it turns out that only nine of them had reached statistical significance in positive effects on student learning. That doesn't make for an -- it's nine out of 42 specific findings, something like that. I counted them up, but I may have missed one. But the point is, that does not make a strong case for the value of professional development for improving student learning. That's a weak case, which suggests that we have to, in some way, acknowledge that we don't have, as people have suggested, much of a case for professional development, which is a separate point, as Bob has been pointing out, from saying we should try to find out more about it.

But at this point we have to say we don't have much evidence for its value, and that's the more, you know, the more basic statement.

Which then raises the question, which is a very important one that Deborah raised, well, what do you do if you don't find professional development doing much for your teacher core? There is one obvious implication, and that is, maybe you need to do more in preparing teachers, because we don't have much evidence that trying to fix them up afterwards is doing much. And even though we don't have any basic

evidence, apparently, about any kinds of programs for preparing teachers, it would be obvious to many people that you strengthen the incoming teacher, that might be a more likely way to improve their overall knowledge base for the rest of their teaching lives, than trying to do it by a back-loading measure. That's it.

DR. FAULKNER: Deborah?

DR. LOEWENBERG BALL: I just wanted to say that Wilfried's points are actually linked.

So the fact that we're aware that content knowledge, that all the signals are in that direction, means that we actually need a system. Our report has to say that we need a system of preparing an enormous population of people to know math well enough to teach it, and to know the things in the learning processes report well enough to pull it off. If we don't say that, we're going to look very foolish.

So there's something going on in this conversation that I hope you can clarify when you write, because we're not endorsing something called Professional Development (PD) as we currently know it. We're in fact saying just exactly what you're all worrying about. That is, current investments are really not doing the job; therefore, we have to have a system that will - that can reliably do that.

So something is going on with the way we're talking about it, but I'm going to trust you to find a way to say that, Larry.

DR. FAULKNER: Well, I'm going to take your language.

DR. BENBOW: I'd just like to point out, that certainly we need very strong pre-service programs, but we also need very strong programs that allow people to update their skills. And so there has to be a mechanism. And maybe we're not doing it in the most effective way, but there's no -- I don't see any alternative but to have something there.

DR. FAULKNER: Well, I think we are debating the substance at this point on language that isn't the language we'll use, so I think we probably shouldn't go a lot further with it.

But Tom, if you're going to speak to it, you're the last guy, and then we're going to Doug.

DR. LOVELESS: Just one quick point. We talk about recruitment, we talk about retention, we talk about professional development. We don't talk about or take a stand on or discuss the evidence of getting rid of demonstratively ineffective math teachers. And perhaps that is linked to the lack of an effect of professional development. If we're trying to professionally develop teachers who are

unlikely to ever be effective teachers, then that may explain its general ineffectiveness.

And there actually is some research on that. There's the Cain/Stager study looking at -- beginning teachers up through year three and showing through value added, that you really can identify effective teachers by the end of their third year.

DR. FAULKNER: Compounded pessimism you've got there.

DR. CLEMENTS: Can I just respond to that?

DR. Faulkner: Yes, go ahead Russ.

DR. WHITEHURST: That's in the Teacher task group report. And in fact, a recommendation to that effect was taken out from the synthesis group.

DR. FAULKNER: Okay, Doug, you've been very patient.

DR. CLEMENTS: No problem. It might be a trivial thing we don't want to address, I'll ask Deborah actually about this. If you could scroll up for the other people to the paragraph that starts, "teacher's knowledge of mathematics."

Deborah, you were, I thought, fairly interested in rephrasing that. Is that an important thing to bring up now, or is it just wordsmithing?

We rephrased it, "teacher's knowledge of mathematics (directly measured, not indicated by

proxies) does appear to be a positive factor in students achievement." And then the last sentence, "however solid evidence and that remains uneven, we just took out and replaced with, "further, there is a dearth of knowledge about how teachers' particular mathematical content knowledge affects instructional quality, students opportunities to learn, and their gains over time."

I don't know if you consider that -- is that consistent so if he is using language from the working paper we'll be fine? Or is that something that needs to be discussed?

DR. LOEWENBERG BALL: I think Larry will be able to get it from the working paper. This was just too abbreviated.

DR. CLEMENTS: Just be careful of this. I think this is kind of badly stated the way it's presented; that's all.

DR. FAULKNER: Okay. Russ?

DR. WHITEHURST: There's a factual misstatement online 426. The statement says it's with respect to salary schemes on differential pay. It says, "They do not appear to attract teachers in the high need areas."

There was nothing in the underlying task group report that either made such an assertion or

provided evidence with respect to such an assertion.

The research we reviewed indicated that in some circumstances it might be impractical to do it, because of the size of the salary differential that would be necessary, but there's plenty of evidence around that if you pay enough, people with come. It's not the only factor.

But to conclude that there's no evidence suggesting that salary differentials affect location choice by teachers is an incorrect statement.

DR. FAULKNER: It's 426?

DR. WHITEHURST: 426. It starts with --

DR. FAULKNER: Well, what do you think we should say?

DR. WHITEHURST: Well, the statement is in both the -- there are a couple of short sentences in the task group report, as well as the five-pager that Deborah wrote about the task group report, and I would suggest that language would be best.

DR. FAULKNER: So there's language?

DR. WHITEHURST: Yes. I mean, it says it's affected by gender and location, and whether it's a one-time bonus or a continuing opportunity to earn extra pay. There are lots of variables that would affect it.

DR. FAULKNER: Okay. Sandra?

DR. STOTSKY: Something that hasn't been discussed here in this section as it is now, alternative certification is a major, major issue, and there's nothing on that at all. How it gets related through whether there's evidence for getting more teachers into the pipeline, which is one finding, and the effects on students, which is another. There is something that needs to be said here.

So again, this whole section has to be broken down. Recruitment, which might affect alternative certification, but there are a lot of people that are going to look for phrases like that, and they're not, so far at that point, seeing any of them here. Pre-service education and so forth.

They've got to be here in some way with whatever we can say from the research, and there is at least something to be said from the research.

There isn't anything that, apparently from the research, supports either certification or non-certification, which then suggests, why do we need it at all? I mean that's one implication of the research findings on that.

But those are important issues right now today in every single state, and they affect the recruitment of math and science teachers.

DR. WHITEHURST: I'll defer to Deborah and

pick up anything, or that she doesn't say that I wish she had.

DR. LOEWENBERG BALL: Well, in the question of alternative pathways, there's a very clear summary of that -- our investigation of that in our working paper, which you can use. So it didn't find its way into the thing we're reviewing today, but you can lift it directly, or you can go further back. So do you want some more?

DR. WHITEHURST: I mean, I would add to that, and I think it's related to Sandra's point.

That one of the findings from the Teacher's task group report, which I think is very important is how little evidence there is of a positive nature on the effectiveness of most of the current industry for preparing and placing teachers. And that doesn't come out in this summary, which focuses on particulars, and largely positive instances of conclusions.

And yet when you look at the body of evidence and find that the pathway into teaching doesn't seem to make any difference, that examinations of professional development don't seem to make any difference, it suggests an industry for preparing and training teachers that needs to be substantially changed. And that point, from the negative evidence,

I think, is lost in the way that this is described. And I think it's a policy point that's important.

DR. FAULKNER: Okay. Vern?

MR. WILLIAMS: I absolutely concur with both of you. In fact, I could never prove this, but my suspicion is, if you were a fine engineer and you want to go into teaching after being an engineer for about ten years, the first education course that you take, you're going back to being an engineer.

DR. FAULKNER: Deborah?

DR. LOEWENBERG BALL: Let me just remind you, that one of the things that our report does show, which is at risk here, is that course-taking and content knowledge, as its typically measured, did not have an effective K-8 teaching.

So the thing that we have to be careful about here is that that's one of the logical things that falls out, is we don't have a system that works, so why don't we just let anybody in.

Our report shows very clearly in a way that the policy discussions fail to pick up over and over, that the typical measures really don't show effects on student achievement. So that's course taking and degrees.

So we have to be careful about that and make sure we carry that forward. That's very, very

important in the teacher task group report.

DR. FAULKNER: Okay.

MR. WILLIAMS: Which is why we need alternative certification. I'm not saying just let anyone with a bachelor's degree teach. But the certification that we have now is abysmal.

DR. FAULKNER: Bert?

DR. FRISTEDT: I was somewhat disappointed in the Teacher's group, that they didn't take advantage of the expertise they had on it to make as many professional judgments, as, say, Conceptual Knowledge and Skills was willing to do. And I think it was a lost opportunity in some sense, if they had just marched forward with their professional judgments, because the four people on that task force actually are extremely competent.

DR. FAULKNER: Any competent people willing to speak?

We're about at the end of the time block for the teachers. Are there any critical points that have to be introduced that haven't been introduced?

Okay. We're moving forward then. We're going into instructional materials. I've laid out the time until 10:15 for us to discuss this.

Let me suggest that we break this up according to sections and first talk about the

material that has to do with textbooks, instructional materials generally. And coming down, that would be lines 444, starting with accuracy of textbooks, down to line 477, before the heading on formative assessment.

So, are there comments people would like to make about the textbook section? Bert?

DR. FRISTEDT: I'm happy with subsection 1. And even though I was involved in subsection 2, it doesn't have -- now what's left of what was originally done -- doesn't have the emphasis that I think I would have liked. I think Bob and I differ somewhat on this.

He's put a lot of emphasis on length. Length is important, but coherency is more important; and that's not coming through as clearly.

The other thing is that there's this material that seems to indicate that U.S. books have more topics than foreign books. I'm not sure that that's right. It could be just the way they're broken apart. And so it gives the appearance that's still a problem, but it's more in the coherence direction.

So I -- what's come here from our original report in this section is not having the kind of weight that I would have liked.

DR. FAULKNER: This section 2 is a little

bit long for the kind of emphasis you'd want to put on this in the main report, but we -- I'll just make that comment.

Skip, Valerie, and then Wade.

DR. FENNELL: I would just like to remind the Panel that -- Bob Siegler's group, that looked at particular instruction materials, was commissioned way after many of the task groups were moving forward. And essentially were asked to do a review of this issue. And at one point I think it was an eight-paragraph review, it was even limited to paragraphs.

So I just wonder about how much -- how this is going to be highlighted in the report, given the reality of its review in the overall work of the panel.

DR. FAULKNER: Well, I think we're going to decide what goes in the report.

DR. FENNELL: So should it be a sidebar rather than an element of the full report, as one example?

DR. FAULKNER: Well, it's a possibility. Wait, I've got Valerie, Wade, then Wu, then Bob.

DR. REYNA: I was convinced by a conversation I had earlier today with Bob. I think our group thought that the Clements' group, that focus and coherence was the real issue, and length was sort

of, you know, not really it. But Bob made a very compelling point to me. And that was that if you make the textbooks long enough and say, well, people can skip around and cover different content, the problem is, you can't write the material in such a way that you presume certain background knowledge on the part of the student, because the student may have skipped that particular chapter.

So really the issue is about being able to refer back and know that students have mastered certain things when you cover subsequent material.

And length, in fact, does have -- he convinced me, that length in fact creates that problem in being able to presume background knowledge. But we probably need to make that explicit.

DR. FAULKNER: Let's see, it was Wade, then Wu, then Bob.

DR. BOYKIN: If Wu and Bob's comments are about the issues of length, I'll defer to them for continuity sake. My comment is about the accuracy issue.

So if your comments are about the issue of textbook length, you can keep going on that particular point, because I'm going to take us to point 1.

DR. FAULKNER: Bob, length?

DR. SIEGLER: Length it is. As Val said

before, the reason why the version of the Instructional Materials report that we submitted emphasized length to the extent it did, there are a few different reasons.

First of all, I think the general public would be shocked if they knew how long these books are. I've informally asked people, how long do you think the average 8th grade textbook or 9th grade textbook in math is? No one has been within 500 pages. And when I tell them the data that textbook publishers -- the Instructional Materials subcommittee went to four different publishers of widely used textbooks. We asked them how long is your Algebra I textbook and how long is your 3rd grade textbook and also how long were they in the 1960s and '70s. What we found was that, in all cases, the length was extraordinarily high at both levels. I believe 760 or 700 pages was the shortest in grade 8. And they ranged upward of 1,000, so pretty amazing.

And I do think, as Val was reflecting from our earlier conversation, that in addition to the issues of cost and, likely, back strain that young children carrying such enormous books has -- and as someone pointed out to me in an earlier discussion here, it isn't just that these books have a lot of pages, but they're very large pages. The size of the

individual pages has also grown. And it makes it impossible for a textbook writer to have a coherent presentation.

I mean, I actually view the most important issue here, not as cost or back strain, but rather the effect of length on coherence.

Now, coherence is a very hard concept to quantify or to judge. And length, on the other hand, is a very easily understood concept. And because -- when you have to have a superset of all the topics that are in any of the 47 states that don't have state-specific editions, that this adds 200 some pages in the estimates that we got, to the length of the textbooks, and it also makes a coherent presentation literally impossible. Because if there's one thing we know from studying cognitive psychology, it's that your existing knowledge influences your ability to learn. That is one of the absolute bottom line facts.

And if the textbook writer has absolutely no idea which subset of particular chapters a given student has gone through, it makes it impossible to do anything in a very modular approach for each chapter, rather than alluding back to concepts that were covered in the previous chapter or two. You have to treat each chapter as a little kernel all by itself. And that, to me, precludes a coherent presentation.

DR. FAULKNER: Can you write that down? Anything on length before Wade takes up something else? Wade, go ahead.

DR. BOYKIN: Yes, I want to go back to the issue of textbook accuracy. This particular point is taking to task a billion-dollar industry that's going to be anxious to respond to these concerns here. So I'm wondering about the metric for the statement here. Is this something that was found in a few books with a whole lot of errors in these books? Or is this really widespread across the books in the field? And if that's the case, I think that needs to be stated. This is really endemic to the field at large.

DR. FAULKNER: Well, I think that there was a -- the Conceptual Knowledge and Skills group actually chartered a pretty systematic examination of error frequencies in books -- in algebra books, Algebra I books. And the top four or five were all examined. There's a whole report.

DR. FAULKNER: Liping?

DR. MA: I have a short question.

Yesterday we heard that some low-achievement countries also use small textbooks. I was wondering what are those low achievement countries using -- is there any research of that? I mean specific research of that.

DR. LOVELESS: When you talk about a textbook for a country, it just doesn't work for most countries. There's more than one, as far as I know. But I'm not -- I don't know the answer to your question.

DR. MA: Is there any specific, published research on this?

DR. LOVELESS: Oh, on the length of textbooks?

DR. MA: The low achievement countries are also using small textbooks.

DR. LOVELESS: Well, the closest research I can actually think of is in the book that I gave out, and that's Bill Schmidt's chapter on coherence, but it's really not from textbooks, it's from frameworks. So no, it's really -- I don't know of any research like that.

There have been comparisons -- international comparisons of textbooks, but it hasn't necessarily been tied back to achievement scores.

DR. SCHMID: Well, the issue is not really whether there can be bad short textbooks. The issue is that there definitely are examples of very well written short textbooks.

So let's say coherence and brevity are positive quantities and there is extant proof of

having coherent, short textbooks in high-achieving countries, and I think that is really the issue.

The fact that -- I mean obviously, you can have terrible textbooks that are short, but that doesn't invalidate the consideration of brevity and coherence.

DR. MA: Yes, based on my knowledge, I only know those little textbooks written very well, coherence, but I'm very curious about the example of badly-written, small textbooks. I want to know the scientific study data about that.

DR. LOVELESS: Well, just to reiterate, if we can assume that the textbook -- if you look -- read for instance, Bill Schmidt's chapter in the book, you'll find that the effects of coherence, when you compute correlations, it's not as powerful as you might think. You just don't get a huge effect.

And probably this is because the low-achieving countries, because they are based on, for the most part on European models, many of them also have small, coherent books. They certainly have frameworks that are coherent. And if the textbooks are following the frameworks, then they probably do. But it doesn't examine textbooks.

DR. FAULKNER: You're been very patient.

DR. WU: That's okay, just a brief comment

in answer to Wade's question about textbooks.

Of course -- well actually, I wanted to ask about the appendix that's supposed to go into Conceptual Knowledge and Skills of what Natasha did. Shouldn't that go into Instructional Materials instead? It's about tabulating the errors of textbooks. I mean it really belongs there instead of to CKS. Any way, that's a question.

But what I want to say is that in terms of textbook errors, I cannot offhand -- I don't have a written statement. I have examined about ten series of elementary textbooks, K to 6. Every single one of them I assure you -- I made this public statement in Boston -- every five pages you have a small error. I think every thirty pages you have a major error. And these are textbooks tallying up to about 700 pages. And of course, that's the very, very conservative estimate. I mean, if you bet me, I'll reduce the numbers by half, and I'd still win, I think.

DR. FAULKNER: Are there other comments on texts? We are going to need to move on to the other part of instructional practices materials. Bert?

DR. FRISTEDT: Two quick comments.

One, a request to Bob: when you recast the language, could you include me in the loop?

And second thing, that didn't make it in

here, but has been a concern of mine on the equity issue is, textbooks that are written, designed to get parental involvement on specific subject matter aspects of the course. And since we're raising our grandson, I can see what advantage he has just from the way the materials are presented and what he brings home. And it's a big equity issue.

DR. FAULKNER: Valerie and then Liping.

DR. REYNA: Just a quick clarification on that issue.

I think Bert and I agree that we're not against parental involvement; parental involvement is a wonderful thing. The problem is when crucial aspects of the curriculum, when one depends on an available parent at home to deliver crucial, fundamental aspects of the curriculum, that there can be an equity issue.

DR. MA: I also would like to add one point about the goodness of having small textbooks.

The textbooks now we have are big, and very expensive. Children cannot personally own it. They have to use those used by others, and they cannot write on that. They don't have their own. They don't own that. They have to pass down. That also makes learning, I think, less efficient.

I don't know whether -- did I make it

clear?

Like Chinese children, they have very small textbooks, but they own that textbook; that's mine. And they can do whatever they want to do, take notes. But our children cannot do that. And I assume it's not good for learning either.

DR. FAULKNER: I think we've made comments on the textbook section. Let's move to others.

We have formative assessment, explicit instruction, and team approaches. That's a paragraph or two. Let me ask if there are comments there. Susan?

DR. EMBRETSON: Yes, this concerns the formative assessment.

Working with the first concept paper and Wu's group, Russell Gersten pointed out that he wanted wording on formative assessments that reflected the review of the studies, which was not quite included in the statement here. The caveat is, they also should be linked to state assessments, and I think that's very important.

And there's some wording in their working paper from Instructional Practices, like lines 358 to 361, is -- actually goes further than that, the exact statement about that linkage. So this is based on experimental evidence.

DR. FAULKNER: So it would be -- the important thing is to take the language out of the working paper or the report, right?

DR. EMBRETSON: Well, there is language in the working paper that you could use. There's another statement about when teachers link it to assessment.

So the statement that we put in response to the first concept paper had a statement about formative assessments that was very brief. And it had, they should be reliable and valid and linked to state assessments. That was his point.

DR. FAULKNER: But I mean when this gets drafted, can I go to the working paper and take the language out of the working paper?

DR. EMBRETSON: I would say not quite. Lines 358 to 361 have some of that language.

DR. FAULKNER: Of the working paper?

DR. EMBRETSON: Yes, of the working paper.

DR. FAULKNER: Okay. 358 to 361. And then you're saying it's going to have to be modified?

DR. EMBRESTON: Yes, a little bit.

DR. FAULKNER: It'll have to be modified by people who know it.

DR. EMBRETSON: Exactly.

DR. REYNA: Yes, I was just going to suggest that we can go back to Russell and get those

lines for you.

DR. FAULKNER: Okay. That's probably a good idea. Send them to me or something by e-mail. Yes, Sandy?

DR. STOTSKY: In relation to this point, Russell also indicated in our group that, correct me Susan if I'm wrong, that these apply to grades 2 to 6.

It was a question of, again, qualifying these findings, and I'm not sure if that was in the working paper, but it is in the main report, and that's the problem of abstracting from the main report to the working paper, which left out important details in terms of the grade levels that many of these things could be qualified by.

The focus for what formative assessment was good for, what kinds of math issues, and what grade level, all of which, I think, belong as important qualifying details in a consensus report.

DR. EMBRETSON: Yes, that's my recollection too, that only one study was outside that age range, and that was high school, but that was learning disabilities.

DR. FAULKNER: All right, and are there other items on this particular topic or set of topics?

Okay, let's go to the team approach, that's lines --

DR. GEARY: On line 483, students who have math difficulties.

There are issues regarding the diagnosis of learning disabilities and difficulties in this area. So we may add math difficulties in low achieving, just to make sure we get, you know, the full spectrum of kids who may benefit from this.

DR. FAULKNER: Okay. All right, what about team approach? Tom.

DR. LOVELESS: That just has to be clarified with capital letters. This is one particular approach, and it's T-A-I, team-assisted individualization.

DR. FAULKNER: Okay. Bob?

DR. SIEGLER: Will people reading this have an understanding of what this TAI approach is without a quite a bit of explanation?

DR. LOVELESS: No, I doubt that they will. My assumption is, that description is in the working paper order, and my assumption is that'll be lifted out.

DR. FAULKNER: What'll be here. And then we can see if you think people will understand it.

DR. STOTSKY: The other part of the -- I'm sorry.

DR. FAULKNER: Go ahead. Then Wade will

go next.

DR. STOTSKY: The other part of the qualification is also what is it being contrasted too?

For this one, I believe there were a number of other approaches that showed no effects at all. And I think it's important that this should not be highlighted and erroneously generalized for people to think that, you know, team approaches are good, when it turns out that whatever it is, three, four, five, other kinds of team approaches apparently did not have significance from what you looked at. But I don't remember what your latest study or your latest synthesis of that --

DR. LOVELESS: No, that's not -- no, that actually is not true.

The finding was based on a meta-analysis of all of the studies and a pooled effect size for all of the studies of team assisted individualization.

So this effect size, which was significant, captures all of the studies of -- experimental studies of this particular method.

DR. STOTSKY: For this method. But what about the other kinds of small group work?

DR. LOVELESS: That's why the other kinds aren't being mentioned here. But this particular method is called team-assisted individualization.

DR. STOTSKY: No, I understand.

No, my point is that the other forums of small group work do not show, and that to me is as important to mention as the fact that this one showed. That's the point I'm trying to make.

That teachers use small group work today, all kinds of small group work. And it's important for them to know that whatever it is, five other kinds, don't have evidence to support them, this is the only kind that does, then it's clear that this should be a much more limited strategy until either there's better evidence or whatever. But that's the issue that I want to get at.

DR. LOVELESS: I agree completely. And in the working paper, of course, you will see that that caution is given several times. That this does not mean that group work is --

DR. STOTSKY: Okay. Then that has to be in the final paper in some way.

DR. LOVELESS: Yes.

DR. FAULKNER: Wade?

DR. BOYKIN: Yes, just to follow up on that. I think that the section titled for this should not be team approach; it should be cooperative learning or group learning. And in there you can contextualize the fact that overall, you didn’t find

any of the effects, but there was one strategy that was successful, and that they had the brand name of Team-Assisted Individualization (TAI).

DR. LOVELESS: But you're quite correct. The caution has to be there.

DR. BENBOW: Sometimes it's hard to pick up things that are missing, because we're so much focusing on things that are here in the paper.

But I think there is one very important conclusion that has been presented over and over again that needs to be added into the paper. And that's basically the analysis between, you know, teacher-directed, explicit instruction versus child-centered, maybe discovery learning or whatever, these two very, you know, two polls.

And I think the research came forward with findings that said that there is no data to support the ideology that is out there. And I think that is very important that that concept gets put back into here.

It is, in all the findings, a very powerful finding. There is no data to support either way, in terms of this war that is out there.

DR. LOVELESS: Well, and of course the status of that finding is currently in flux somewhat, but that's quite correct.

And the reason why we even looked at that in the first place was from anecdotal evidence from teachers, that they are often urged as a policy matter to be more student-centered in their instruction. And those kinds of sweeping recommendations are simply not warranted by research.

DR. FAULKNER: But Camilla's point is that the report shouldn't remain silent on these things. Okay. Are we finished with team or cooperative learning -- do you want cooperative or do you want group? I have to choose.

DR. STOTSKY: The small group worked out. That's the word that appears in curriculum guides and much educational material, and that would capture the attention --

DR. FAULKNER: Small group work.

DR. STOTSKY: Small group work, and then you make your --

DR. LOVELESS: Or cooperative -- cooperative learning is a more specific phrase, and elementary teachers will know what that means.

And I think that's -- in terms of the search when you do literature searches of this, and if you want to replicate it, you'd have to use cooperative learning as the --

DR. STOTSKY: Have it as and/or, because

small group work is the common phrase that is used in most guides and other things that I see, as general educational material.

DR. FAULKNER: Do you want both of those terms, small group learning or cooperative -- small group or cooperative learning? What?

DR. BOYKIN: Well, the notion of cooperative learning speaks to the type of work for which people have belief that there is evidence to support that it's effective. It's very different than small group work.

Small group work sometimes could have five kids at the table working in silos.

Cooperative learning implies that there is some collaborate intellectual exchange going on among students, and that's what I think they were looking at.

DR. LOVELESS: That's right. And small group work also encompasses teacher-directed small group work, which this definitely is not.

However, there's a teacher-directed component to it. It is a specific intervention that involves a combination of several things.

But I'd be more comfortable with cooperative learning. That's really what it is.

DR. FAULKNER: Okay. Cooperative learning

is the nomination here. Okay. Thank you. I have to get some guidance here. Okay. Go ahead. No wait, we're going to technology? Okay. Okay, Dave's already bid for the first position.

Technology and applications of technology, that's all the way to the end of this section, line 489 down to 526. I understand there's another replacement section.

DR. CLEMENTS: Yes, it's questionable whether we want to make anything but a few general statements because this doesn't represent what the present reviews say.

DR. FAULKNER: So would you tell us what the future holds for us and then we can --

DR. CLEMENTS: I think we're still in flux on that. I'm hoping that what the plan is that people accept, but it hasn't been presented to the full Panel yet, is that these calculator -- even the calculator statements come from a paper before the last version. So I'm, you know, those need to be changed and updated to the latest version.

And then the software review. What the plan is to conduct new analyses in the eleventh hour here and to try to do a meta-analysis so that the reviewer software, which is the rest of this stuff on which this is based, fades into the background. And

our own meta-analysis of regular studies, in keeping with all the other Instructional Practices reports, replaces this entire section. That's the plan.

DR. FAULKNER: But you're hoping to really basically regenerate this section on the basis of additional work.

DR. CLEMENTS: Yes, it's just not up to date and probably not worth the Panel's time now.

DR. FAULKNER: Between now and like the 3rd week of November?

DR. CLEMENTS: Yes, that's the plan.

DR. FAULKNER: Right? That's the plan. So we're going -- this is going to end up being a late submission to the Panel. You'll end up getting that product from Doug, and then we'll end up having to consider what this section looks like on the basis of new and extended work. So there is a limited value to kind of critiquing exactly what's here, but I think some general comments can probably be useful at this stage.

DR. CLEMENTS: Either the role or what you'd like to see would be welcome. But the content here, like I say, even the calculator stuff comes from two versions ago, and is not accurate the way it's on the screen.

DR. FAULKNER: Okay. And Dave has staked

out with his flag quite a while ago, his right to speak, and then we'll go to Wilfried.

DR. GEARY: Yes. Maybe I can just touch base with Doug afterwards, or I can just say now that on 491, calculator use does not inhibit proficiency with computational algorithms.

The outcome measures, or as I understand it, are accuracy and not speed and accuracy. And so, it does not inhibit accuracy, but it hasn't really assessed fluency. And that's an additional issue that is a very important issue.

DR. CLEMENTS: Based on your comments and other people's comments, it's been changed. And like I say, that's why I'm frustrated that it's not up on the screen.

DR. FAULKNER: Well, I think this has been a very complicated issue, and I do want to acknowledge Doug's leadership and willingness to try to get this as right as we can possibly get it in the time that's available to us. And we do appreciate your leading that effort, Doug. Wilfried.

DR. SCHMID: Well, this sentence, "calculator use does not inhibit proficiency" also caught my attention, but for an additional reason.

I mean, what the basis for the sentence is that, you know, if you look at the literature, you do

not show an overall negative effect, but this is a very sweeping statement. I mean, it could be read as, no matter how much calculator use we permit in the classroom, this will not inhibit proficiency with computation algorithms, and this is surely nonsense.

So I mean, I think this issue of calculator use is a minefield. And more than many of the other minefields we go through.

And so here this -- the language has to be examined on many grounds. It has to also be examined on how it comes across.

I think that this statement, obviously, this is not going to stay, but I'm giving you this as an example. A sentence like this will be immediately misinterpreted, and we have to be super-careful.

The other issue is that whatever literature review you do, I think the report -- the comment by Bert, which in the printed version is a side comment, is very much to the point.

That many of these studies are dated, and calculator use, what exists out there in the marketplace, how it is used by teachers, this is moving far more rapidly than anything else that we are talking about. And that if you are -- if you quote studies using calculators that existed six years ago, this may be an entirely invalid study because what

calculator use means at the moment may be entirely different.

So I'm not saying that it is not worth reviewing the literature, but this comment of Bert's needs to be kept in mind.

DR. FAULKNER: Wu?

DR. WU: Just two small comments. One is actually the general point brought out by Sandra, that any statement of this nature about when it's good or when it's not good, it makes a difference if you specify exactly for which class of students.

For example, the fact that it has low impact on calculational skills, or you see someone like me using calculator, has low impact on my calculational skills, it says nothing. In fact it has a lot of help -- I mean, does me a lot of good. But to say that for K to 3 students, to use calculators has no impact on this, which would be an explosive statement.

So I just in general just in future about such things, we just have to be very grade-specific.

DR. CLEMENTS: Yes, and we do it as well as we can.

DR. WU: Yes, I understand.

DR. CLEMENTS: And it's just an argument to Larry that maybe more details need to be in the --

DR. WU: Yes. And the other -- the point is something that we have talked about before, meaning that obviously, I mean, we have to be very careful about how we state this. And in view of the existing uncertainly of the literature and in view of the amount of anecdotal evidence, including the things that we talked about in our e-mail, I think we have to convey the impression of proceeding with caution.

I mean clearly, I mean at the moment -- I mean, I don't mean that this is what you're going to say, but I'm just saying, even with a statement like this, this is basically saying everything is a-okay, and that's very bad.

DR. FAULKNER: Well, I fully realize that this is a part of this report that will have the status of scripture and that we are going to end up scrutinizing every sentence carefully.

So I think at this stage, these sentences are not worth spending time about because we are going to get additional information. Valerie and then Tom.

DR. REYNA: I offered a possible resolution for this by saying that to the extent that calculator use supplants the opportunity to practice the retrieval of arithmetic facts, that would in fact be a negative -- and we know that the retrieval of arithmetic facts has a demonstrated influence on

mathematics achievement and performance.

So we could add that caveat, that phrase, I think we could make the connection here.

DR. FAULKNER: Dan, you're on the phone, I meant to acknowledge you earlier. Dan Berch is on the phone, and he has a question. Dan?

DR. BERCH: Just a comment following up on Valerie's statement that there has been wording like that in some of the previous versions in the -- I think in the instructional materials, a paragraph, so they're -- I agree with Valerie, and I think we can look back to some of those sentences as a guideline, should we decide to include statements -- a caveat like that.

D. LOVELESS: And if I could piggyback.

DR. FAULKNER: Dan, have you been able to hear okay?

DR. BERCH: Unfortunately, yes. No, just kidding.

DR. LOVELESS: If I could piggyback on the last point. Doug also has responded to some of my concerns within the task group about the fact that these studies are predominantly, and I mean predominantly, all but one by my memory, done with students. And I'm talking about good, solid experimental research with students after grade 3. So

we have very little evidence of what happens.

And of course it's -- grades 1 through 3, and this touches upon Wu's point, it's grades 1 through 3 where kids acquire basic facts in arithmetic.

So the use of calculators in those grades, we have to -- that's where we can really throw up some cautionary flags, and we need to do that.

DR. FAULKNER: Okay. More on technology? We're actually past our time -- allotted time. So if there's any major point that needs to be made, make it. But we're grateful to Doug.

Also, I might add thanks to Abt for putting some additional time into this. And we look forward to seeing the product, and then it will be fashioned into scripture. And will it come down on stone tablets, Doug?

All right. That's it until 10:30. We're going to break here for about ten minutes and come back and we'll pick up with Assessment, and then we go into the recommendations.

(Whereupon the above-entitled matter went off the record at 10:19 a.m., returning to the record at 10:40 a.m.)

DR. FAULKNER: Okay let me ask everybody to come back to their locations. Okay. Again, let me

ask people to take their places. We have lost some members.

Bert actually reminded me that we didn't pick up real world problems and the gifted students. So let me -- it's under the technology header, which it shouldn't be, but let me open the discussion on that. Yes.

DR. BENBOW: I think the description under real world problems doesn't reflect very well the conclusions from our report.

So again, I think this is one where I know what the conclusions are from our report. They just need to be better reflected in here, because this is quite inaccurate.

DR. FAULKNER: Bert?

DR. FRISTEDT: This is one of the places where I am most concerned about terminology.

On Assessment now we've reached an agreement. Word problems means everything that involves words, and there have to be at least some nonmathematical words; nouns from some other area, not just words that connect geometry with algebra, I'm saying. Okay? And I think that was Skip's suggestion. And I think I interpreted it correctly?

DR. FENNELL: Yes, you're doing great.

DR. FRISTEDT: Okay. Now, there's some

things about -- is that the same as real world problems?

Well, as Joan actually mentions in her piece in Instructional Practices, there's a floating definition of real world. It means some things at one place, some things at another.

So when you're making assertions about it, you know, which version is it that you have in mind?

And finally, I want to mention one other thing on the Survey of Algebra Teachers. There was one thing that was listed as even more critical than fractions, namely, word problems. Well, which word problems are we talking about? Those that Skip has now defined for assessment? Well, some of those probably, but not -- it's not clear they were talking about, say, what might be called real world projects, that are sometimes used as a classroom technique. That's something different. And I think this whole area has to be just dealt with real carefully, because the same word can mean opposite things to different people.

In fact, if you interpreted word problems the way that Skip has done for assessment, there's no one who's against them. There is no one who is against them in this room, but if you take certain portions of that topic, and then we can have a little

fight about it.

And that's the end of that. But just some extreme care is needed.

DR. FAULKNER: Well, I think what we will do is, again, use the language that's in the working paper or in the report, and we'll see how that flies.

DR. FRISTEDT: Yes, it won't mesh very well with the assessment use of word problems, but you can sort that out.

DR. FAULKNER: Well, you and Skip will sort that out and other people, I expect.

DR. FRISTEDT: Skip and I are in close harmony.

DR. LOVELESS: If I could make a comment, and I'd like to hear from Joan on this too.

But Joan looked at what was a meta-analysis of the research on real world problems, that's the basis of the statement and of the section of our report. So one key question there is how that meshes with this notion of word problems as well.

DR. FERRINI-MUNDY: And most -- I think actually all of these studies are based around a particular kind of an intervention where it has its own particular kind of definition of real world problems, so that can be added. And it's real world problems used as the main carrier of the mathematics,

in a sense, in the instruction; so we could be more clear about that too. It's not a use of real world problems to sort of test out how well students can apply something, but it's rather to teach the mathematics through the real world problems.

And then the testing -- there's more subtlety also that needs to be included according -- I think the right point is what the outcome measures are and where there's an effect and where there isn't.

So we can clean that up.

DR. BENBOW: Val?

DR. REYNA: It may be too late to deal with this. But I was just surprised that there wasn't more material that passed our standards here.

And you know, it may be the case that you reviewed, for example, the work of Walter and Kinch and colleagues on what was called word problems, but many situations could be viewed as real world problems, and work on transfer that might have, you know, tapped some of this work.

Is there anything -- I mean, it seems at least we can -- there appears to be at least some work out there that might be rigorous, but that we haven't been able to tap it somehow.

MS. FERRINI-MUNDY: I'd need to go back and talk to Abt and look at their original searches.

I'm sure we used word problems as a search term, but we may have excluded those for different reasons. We'll go back and look, I just don't know, Valerie.

DR. BENBOW: Skip?

DR. FENNELL: I don't know that it's worthwhile or not to draw this distinction, and I'm frankly not sure where we do it. But the issue of the importance of children solving problems as they learn mathematics, that's what Bert alluded to earlier, probably everybody in the room would be fine with that, and the use of words as context to get to that place, whether it's an assessment or instruction, is probably similarly valued.

Where Vern Williams and I had a discussion, I think it was in St. Louis, is the distinction between what I just said and some elaborate display of length about a problem situation. And if there's a way to draw that distinction and/or if there's a need to, that's, I think, the issue.

Vern, would you respond to that, please?

MR. WILLIAMS: Yes, there's definitely a need to, because I believe one leads to focused learning, and the other leads to confusion.

DR. BENBOW: Are there any more issues on real world problems? We obviously are going to be rewriting this part. Anything else? Because this is

not -- what you see up here about real world problems is highly inaccurate, so do not take that with you as a take-home message. Wilfried.

DR. SCHMID: Well, I must say I was astounded by the sentence. I mean, it seems to say that the use of A in instruction appears to have a significant impact on student's ability to do A.

DR. BENBOW: That's what it says.

DR. SCHMID: So if we have sentences like this in our report, we'll become a laughing stock.

DR. BENBOW: Yes, absolutely. No, this with not be there.

All right. Given that, can we move on to gifted? Any comments? Okay.

DR. FRISTEDT: I think one thing, sort of a general theme should appear somewhere, which is that math teachers are confronted with a problem that is deeper in mathematics, probably, than in other areas.

At the top end, the students can do so much more than would be in a typical class. And at the bottom end, they can struggle forever to get a certain prerequisite nailed down so they can move on. And the breadth between them is very large.

That's my -- that's of course a judgment issue of mine, but I think we've confronted that

several ways, the gifted here, the concern about equity, and the concern in Instructional Practices about the low achieving students. And some of the testimonies we've heard at other of the public sessions were either about one extreme or the other, as if they're not being served well, and they might be accurate that they're not served well, because the extremes are really hard to deal with for an individual teacher.

DR. BENBOW: Any other comments? Val?

DR. REYNA: I've been concerned about a theme that cross cuts this issue and others about at-risk kids needing more help, which of course they do, and this particular issue. And this also ties into the issue we mentioned before, about kids having the opportunity to take courses so that they can ultimately take calculus, and so that they can ultimately have certain careers.

The theme that cuts across all of this is these trade offs that are not inherent, but that seem to pop up regardless. So I would avoid making these tradeoffs.

I think it's important to help the gifted and it's important to help those with learning disabilities, as it's important to help the broad swath of students that are underperforming as well and

that we need not make these choices among which group of students we're going to help.

I think we need to make a strong statement that we have to step up and help all of these students.

DR. BENBOW: Anything else? Going, going, gone.

All right, next page. All right, we're now on to assessment of math learning. Susan?

DR. EMBRETSON: Yes. Well, you know, this is just a little more than a half a page, compared to the other reports, so it obviously does not have enough material in it. Material should be taken from the working paper that is not in here.

My particular concern is with how to represent what has not been really elaborated at all here in this concept paper. It gets into one of the major findings we had, which is the validity study and the rather large proportion of marginal and flawed items. But then it goes to guidelines that are needed for assessing mathematics.

Well, okay, test developers, item writers, they have guidelines, but they're not going to get at the features that we have been concerned about. What we need is knowledge to generate better guidelines. And that is what we do not have. Now that should be

based sometimes on logical analysis, but other times on scientific evidence.

One review that was undertaken that should be mentioned in the Panel was with respect to a popular design feature, namely, whether the item was constructed response or multiple choice. Now it's commonly believed that the constructed response items measure different kinds of mathematical processes, different kinds of knowledge skills and abilities than do the multiple choice. Literature does not show that.

The literature shows that when you have tight comparisons available between constructed response and multiple choice, that is, they have the same stem, in one case you have to select an answer, and the other case you have to provide it. The studies are from different perspectives, but they don't find much difference. They measure the same common dimension.

When it's done experimentally, looking at problem solving strategies, even kids apply the same problem solving strategies to the constructed response that they do to the multiple choice.

You might wonder, well, how is that possible? Well, one strategy that is associated specifically with multiple choice is taking the

answers and plugging them in the problem, rather than actually working out the problem and finding the answer.

Well kids, it turns out, can do that too with constructed response items. They can generate candidates for the right answer and plug them in. And that I think is a rather interesting thing.

Now you might say, okay, well maybe we don't want the short answer constructed response; we're more interested in the long ones where they have to show work or provide explanations and so forth. Well, there's very little literature available to compare the processes involved there on any basis to what's involved in the multiple choice items.

The designs you need for that, you can't really compare tightly the two item types, you have to look at the best of multiple choice and the best of constructed response probably. And you've got to compare them to outside knowledge, abilities, and skills. You know, like verbal abilities and so on like that. But there's, you know, just very few studies like that, just a couple.

So in other words, to say that guidelines are needed for assessing mathematics isn't going to make much sense, unless we say that we need some more solid knowledge to provide the basis for those

guidelines. So that's really what needs to come in there. And there are candidates from that in the working paper. Basically, the numbered responses are 1 through 6, I believe, where we list some things.

DR. BENBOW: Point well taken. I think also for the Panel, I guess to inform them, we spent several hours -- well actually, we've been working on the assessment paper, because you know, we had a very late start. We've been working very hard to get it finished. I think that we got very close to closure on our assessment paper on Monday, so there is new language, new stuff.

I mean it's not dramatically new that we're having different conclusions, but a much better paper. So we will be picking up from that. I just wanted to let people know that we have advanced significantly since the first working paper was drawn.

Tom, did you have a comment?

DR. LOVELESS: Yes, just a couple things.

First of all, the first paragraph, I think, needs to be moved down here. So the discussion of fractions doesn't belong first in this, and that needs to be clear. It's a discussion of National Assessment of Educational Progress (NAEP) and state frameworks, and fractions are one of the things that we then discuss in regards to National Association of

Educational Progress (NAEP) and state framework. So that's just an ordering issue.

The other thing is, there's just a slight technical problem in the first paragraph. Descriptive studies of the framework have revealed -- those were not studies of framework, those were studies of item pools that revealed the lack of fraction items among items.

DR. BENBOW: Yes. Russ?

DR. WHITEHURST: There's a statement that begins on line 550 that I would prefer to have deleted, because I think it's not well founded.

It calls for better communication essentially between NAGB, the National Assessment Governing Board, and the National Center for Educational Statistics, NCES. I don't know what empirical work has demonstrated poor communication. There's a lot of communication back and forth between those two staff.

And I think unrecognized here is that the governing board approves every cognitive item, item by item. So not only do they specify the design characteristics of those items, but they approve the actual items that appear in the test.

DR. BENBOW: Susan, do you want to address that issue? Because that's something that you -- yes.

DR. EMBRETSON: Well, it is -- I think it's primarily a problem not only of communication, but a mismatch in the level of expertise on people who have the statistical results on items, versus those who look at the item content.

This is especially true with state assessments where the psychometricians of course are all PhDs and have a very sophisticated statistical language, which the people who are involved in item-writing and development can't understand and basically tune out. They don't get together in a lot of cases. The statistics are handed to someone else, which are then handed to item writers and developers who -- mostly have a bachelor's degree at most, maybe not even subject matter experts, and they decide which items should stay on the test or not. Now this is a problem.

And you know, the first statement I think is the more important one, that is, the one about having a range of experts representing the item content analysis and better communication. But I wouldn't -- I don't know about the National Assessment Governing Board (NAGB) and the National Center for Educational Statistics (NCES) myself, to put that part in.

DR. BENBOW: So we can take out those

specific references. Yes, National Assessment Governing Board (NAGB) and National Center for Educational Statistics (NCES). Valerie?

DR. REYNA: Are you saying that there would be -- it would be better to have better ongoing communication between those people who are experts? Could we add that, and those people involved in the policy?

DR. BENBOW: We have actually much better language about this issue in our revised paper. This was something that has developed and is being explicated in our -- that wasn't there in previous versions.

So you might -- Russ, maybe we'll send it to you and you can comment on that because yes, we've moved way down the road.

DR. LOVELESS: Yes, we need to strike the National Center for Educational Statistics (NCES) and the National Assessment Governing Board (NAGB)-.

DR. BENBOW: Yes, I struck it.

DR. LOVELESS: And then the second thing is, if there is any empirical evidence to support the general assertion of the lack of communication, even among state people, it would be good to cite that.

DR. BENBOW: Anything else? Russ?

DR. WHITEHURST: One other point, and

that's the final statement on -- starts on line 554. It seems to be redundant with what's already been covered under the heading of formative assessment. So I don't know that it needs to be covered twice.

DR. BENBOW: Yes. Does everybody agree there? Yes. Okay, thank you. Bert?

DR. FRISTEDT: Three things are somewhat interrelated.

One is that we've noticed that on at least via the released items from National Assessment of Educational Progress (NAEP) and the six states that there's a real lack of actual problems asking for calculational facility at grade 4 with whole numbers and at grade 8 with fractions. That's one of the things that we've noticed that there's just not many of.

Thus the calculator issue has been somewhat moot, because those are the problems where it makes a big difference whether you have a calculator or not. And they also -- that lack is also related to the multiple choice versus what might be -- I don't know if I like the word constructive response -- but give your answer one way or another. Because there, if you give the multiple choice, it does enable one to work backwards more easily than if it's -- you have to supply the answer. Although I've seen some good

multiple choice of this type.

For instance, adding three numbers up. The multiple choice items were very carefully chosen so that the whole issue was did they remember to carry in both places as they moved over, and that gives four possible answers, and they're all sitting there and that's a perfectly nice multiple choice then.

So any way, these three things are somewhat related, but they come out in our report that these calculational facility items are noted by their absence.

DR. BENBOW: Yes, absolutely. Bob?

DR. SIEGLER: I'd like to reiterate Russ's point and suggest that the language be struck on the point about better communication.

There's an implicit criticism there, which as far as I can tell, there's no data to support it. And by the very nature, policy makers aren't going to have the statistical expertise to communicate with the people who are designing the items. And unless there's evidence to say that communication, per se, is both low and it would be better if there were more, I don't see the basis for this recommendation.

DR. BENBOW: Well, Susan?

DR. EMBRETSON: Well, it's common knowledge, is the basis here.

I think anyone who has been involved with test development outfits, whether they're commercial, whether they're large or small, whether it's even the military, knows that the psychometricians and the item developers do not fit together.

So I don't know how we're going to put that in, but I think it's an important point because you know, it's not a new gap at all, but it's pretty important. Because I think there are kinds of statistics, which are not necessarily reported, which will help the item writers to revise their items in such a way that they can be better.

But right now, you know, they're like in one room this unit and another room that unit. And one of our external reviewers said they kind of threw the items over --

DR. BENBOW: Well, actually this is kind of interesting, because we didn't have a discussion of communication much in our report that was sent out for review, and this was the very comment that came back from the person who was a test developer, that this is a well-known problem about the lack of communication.

So I think we can couch it in the sense of not making it scientific evidence, but it's fairly common knowledge. So I think we can address it that, you know, we can couch it in such a way that we can be

protected and our integrity can be protected.

And I think it's Wilfried, then Tom.

DR. SCHMID: Well, if I understood Susan earlier correctly, then of course the point is really not a statement about NGAB and NCES.

DR. BENBOW: No, that's being scratched.

DR. SCHMID: It is really a statement about, let's say, the degree of cooperation among various groups in test development.

And I think that -- I mean, I completely agree that there is really absolutely common knowledge and common agreement among people who have been involved in the review of various tests that there are these separate worlds. The psychometric world and the world of those who construct test items and invent them; and this has absurd consequences.

So I think that if it's properly said, it's really an incontrovertible statement.

DR. BENBOW: Tom?

DR. LOVELESS: Well, maybe. I actually want to support Bob's point.

And I think Bob's point is that it's nice to say that there needs to be more communication or better communication, but do we know that actually better communication is going to lead to any positive outcomes? And it would be nice if we did. Maybe,

probably? But if we could cite some ways in which better communication would actually produce positive outcomes, that would be great. And if we could also think about how did this system evolve with these two different rooms? Maybe there's a reason. And maybe there are other -- maybe there are benefits from having policy makers separate from item developers as well.

Maybe you don't want -- maybe to preserve, for instance, the technical integrity of the test, that you don't want people who don't know much about testing directing the show.

DR. BENBOW: Susan?

DR. EMBRETSON: Well, I think rather than communication, the more important point has to do with the basis of the review and analysis.

And so one thing we suggest is we need to hire a level of expertise, people who know the mathematics content, but also cognitive scientists. How do people approach this kind of problem? Developmental experts and so on, so that the level of expertise is, you know, moved up.

Now, in a practical sense, you can't have all those people look at every item because that's very expensive. So what you also need then is better research on design features, which will, you know,

lead to certain opinions by this higher level of expertise. But right now we don't have it.

I mean, to me, the notion that item writers don't even necessarily have a bachelor's degree on the subject matter, I think that that's troublesome.

DR. BENBOW: Valerie, and I think Wilfried, and then if there's a burning question on this topic, I think we need to cover something else. But yes.

DR. REYNA: Yes, I can just give you some very quick examples.

For example, you can look at an item and think as a layperson that ah, that's obvious what that item measures. And this is an issue of validity, which is a fundamental psychometric property. You can say that's clearly a computational fluency item, but it's not mathematically, and it's known that it's not.

So you have to bring that -- you can't maximize psychometric properties that you're unaware of and don't understand.

DR. BENBOW: Yes, yes. Wilfried?

DR. SCHMID: Yes. Well, I would also like to give, you know, a couple of examples.

I mean, so I was involved in the National Assessment of Educational Progress (NAEP) Validity

Study Review of Mathematical Accuracy. And one of the outcomes was that when the same group of mathematicians was asked to look at the next, you know, a new collection of items that were constructed afterwards, there was an obvious difference. I mean our concerns had been taken into account, and what came out looks much better.

The other is the statement that there has to be better communication between policy makers who specify item content and those who construct the actual test items.

Well, I think this also speaks to the gap between frameworks and actual tests. I think there's a huge gap. If you look at various frameworks and then look at the state tests, those are separate worlds as well.

And again, I would say that better communication, better integration of these two sides of policy and implementation, how can you argue against that?

DR. BENBOW: Burning issue? Because I think we'd like to have some time on the policy recommendations. Okay. I'm going to wrap that up.

I have heard we're going to try fixing that language so that everybody can be happy.

And let's move on to recommendations then.

I'll turn it over to our chairman.

DR. FAULKNER: Okay. We need to go down the list of recommendations and have time to talk about them. These will, I think, evolve as we go. But we need to have a sense of your reactions to them at this point.

Let me kind of group them, rather than just taking everything from in the first category policy and preference, let me suggest that we consider one through five. We'll just take them in groups of five. Okay? And that'll be reasonable I think.

Let me ask you to look at 1 through 5 and see if you can make comments on them. Russ?

DR. WHITEHURST: On question 2, the last line, line 563, could we strike the word "reliable"? I don't know that we've done any research on the reliability of teachers. I'm not even sure what it means. So we're interested in skillful teachers, not --

DR. FAULKNER: Number 2?

DR. WHITEHURST: Yes, number 2, line 563.

DR. FAULKNER: Skillful teachers and just leave reliable out.

DR. WHITEHURST: Yes. Thank you.

DR. FAULKNER: You mean that whether reliable refers to whether they come to work?

DR. WHITEHURST: Or whether they're dressed appropriately, I just don't know what that means.

DR. FAULKNER: Okay. Skip?

DR. FENNELL: I'm looking for a phrase clarification. The phrase, "at risk for later failure." Are they at risk for success? Or help me understand that. That seems more negative than maybe it should.

DR. FAULKNER: Dave?

DR. GEARY: Yes, kids who enter kindergarten behind tend to stay behind throughout their entire career, and the gap may well -- it may very likely increase. So they're certainly at risk for -- and that results in later risk. But they're certainly at risk for staying well below what we want them to be at, throughout their entire school career.

DR. WHITEHURST: Maybe this change of phrase to "at risk for low achievement" would -- take some of the sting out of it. Risk for failure, that's a pretty categorical -- yes.

DR. FAULKNER: At risk for? What do you say, low achievement?

DR. WHITEHURST: Yes, persistent low achievement, something like that.

DR. FAULKNER: Yes. So it turns this into

a personal recommendation, rather than an institutional one, right? We're not talking about the failure of the school; we're talking about the individual failure within the educational process. Okay. Bert?

DR. FRISTEDT: I'm looking for ways of combining it, because 19 is a rather long list. I'm thinking that 1 and 2 could be combined, and that four and five could be combined. But in the combining of four and five, I'd like the word calculational facility -- or is it computational facility that we use often to appear, and I don't think it does.

DR. FAULKNER: Let me -- you've made several points, let's pick them up one at a time. You suggest combining one and two?

DR. FRISTEDT: Yes. They're slightly different.

DR. FAULKNER: Well actually, number one is not a -- or number 2 is not even a recommendation, sort of. But do you want -- is it the sense of the group that combining one and two makes sense? Valerie said yes.

DR. FAULKNER: Yes? Okay.

DR. REYNA: Yes, for the record.

DR. FAULKNER: All right, everybody seems to agree that one and two looks like a combination.

All right, now what was your next point?

DR. FRISTEDT: That four and five should be combined and the word "computational facility" should appear somewhere. And I'm going to get some objections to that.

DR. FAULKNER: All right, what's the reaction to four and five?

DR. SCHMID: Well, let me first say something else, although it is related.

What is glaringly missing in four is the automaticity with number facts, and also algorithms. And when they are included, then probably four and five become unwieldy.

So I think if you look at the package of four and five, I agree that maybe it has to be repackaged. But we absolutely need to include in these recommendations a strong recommendation that recall of number facts needs to be automatic, and we also need a strong statement about the importance of algorithms.

DR. FAULKNER: Don't we have language from Conceptual Knowledge and Skills that basically deals with this?

DR. SCHMID: Yes, but it didn't make it to this. That's the problem.

DR. FAULKNER: Okay.

DR. SIEGLER: Yes, I think that it's critically important to keep fractions as its own item, actually. Because it's so fundamental to learning algebra, it's so clear that kids are terrible at it. And it's one of the biggest findings of the whole panel process.

So that a way of addressing Wilfried's point and that, is to have four rewritten so it's primarily about whole numbers, and five rewritten so that it incorporates the material from four about fractions that isn't there now.

DR. FENNELL: Larry?

DR. FAULKNER: Yes, go ahead.

DR. FENNELL: I would just suggest, it goes back to what Wilfried said earlier, that I'll take the "original language" relative to whole numbers that includes his statements with regard to facts and algorithms and patch that in, and similar original language with regard to fractions. That is more encompassing than what you see here. But these would be two items. I agree with Bob's suggestion.

DR. SCHMID: In the Siegler group, certainly we had in fact two such recommendations; one focusing on whole number arithmetic and the other on fractions. They addressed the concerns that have been mentioned here now.

So maybe the way we should put this is look again at the two corresponding recommendations by the Siegler group.

DR. FENNELL: Can I amend your statement, in that Wilfried when we did that, we packaged that under number sense. The piece that we're just talking about.

DR. FAULKNER: Okay. Other items on one to five? Bert?

DR. FRISTEDT: I'd just like to make one comment on automaticity if I can learn to say that word in my old age.

We don't want to give the impression that it's only basic number facts. For instance, when they go to fractions, often one of the denominators might be 54 and the other one 36, and you'd want them to see the factor of six sitting there -- the common factor of six. So, there are more than just the basic facts.

And I wouldn't mention that, except in the state standards I've seen, basic facts about the numbers, that's highlighted. But sort of carrying it on to being able to do more is not.

DR. FENNELL: You're not going to get any problem on that one from me, but I'm going to lean on Dave Geary, because they're work in learning pretty much solely deals will fact acquisition. Am I right,

with regard to automaticity?

DR. GEARY: Yes. I mean the effect of practice on automaticity is there in all areas that have been studied.

And I agree, I think we should have automaticity in all basic skills which kids need to carry forward in order to be successful in algebra, and that includes arithmetical facts, algorithms, as well as fractions, knowing prime numbers, factoring. I'm sure there's a host of things.

DR. SCHMID: Well, when I pointed to Skip, what I really wanted him to say is that the two corresponding recommendations from the Siegler Group in fact addresses exactly your point.

DR. FENNELL: Right. Yes, yes, yes. Thanks, Wilfried.

MR. FAULKNER: Valerie?

MS. REYNA: I notice that we're missing a couple of items we have in the other common concept about the pervasive -- difficulty with fractions is pervasive as in an obstacle to further progress in mathematics and other academy domains has been linked to negative outcomes in adulthood; that's not here.

And in the teacher survey, this was among the worst preparation items. Is that in here?

DR. FAULKNER: Well, I don't think it

belongs in --

DR. REYNA: Okay. There it is, there it is.

DR. FAULKNER: But I don't think it belongs in the recommendation --

DR. REYNA: Okay.

DR. FAULKNER: -- I think it does belong in the text discussion.

DR. REYNA: Okay.

DR. FAULKNER: Okay, let me suggest we move to recommendations six to ten, these five.

Let me suggest that you give the audience a chance to look at ten also. Russ?

DR. WHITEHURST: On item eight, I'm not quite sure what the initial phrase is trying to say. "Research base supported application and local evaluation of certain practices can be recommended." My gosh, that's hedged, you know.

DR. FAULKNER: You need to be a little more forthcoming there.

DR. WHITEHURST: Right. What I would suggest is that we just list the practices that -- out of the Instructional Practices and other reports that we've already endorsed as having sufficient evidence to demonstrate effectiveness. And I don't know that -- I think that's probably not quite the list here, but

that's what -- certain practices can be recommended, based on the existing research, and then list them. That would be the way I'd do it.

While I have the floor, I think that nine and ten could be combined. I don't know in nine what the middle -- the middle sentence seems to be out of place.

The rest of nine and ten are about the accuracy and focus and coherence of textbooks, and then there's a statement there "that a large amount of research has been conducted on instructional materials," but it doesn't meet methodological standards. This is -- these aren't statements about instructional materials, they're statements about textbooks. And so I just think that needs to be --

DR. FAULKNER: Hold it, you're covering two --

DR. WHITEHURST: Well, I'm sorry, unlike the National Math Panel.

DR. FAULKNER: All right Russ.

DR. WHITEHURST: Let me try it again. There is in statement nine, the second sentence, "a large amount of research has been conducted on instructional materials, but most of it does not meet even moderately stringent methodological criteria."

I'm not sure why that sentence is there,

because the rest of nine and ten talk about the length and mathematical adequacy of textbooks. And so it just seems to me -- it's perhaps an important statement, but it seems to be misplaced.

DR. FAULKNER: It comes out of the Instructional Materials report, which dealt with more than textbooks.

Your recommendation is to strike the list? Or strike that sentence?

DR. WHITEHURST: Strike the sentence or combine nine and ten and create a new sentence that talks about how little research exists on the effectiveness of instructional materials, that demonstrates the effectiveness of instructional materials. That's it for me.

DR. FAULKNER: Okay. Again, you want to combine nine and ten on textbooks.

DR. WHITEHURST: Yes.

DR. FAULKNER: And create a stand-alone point on other matters?

DR. WHITEHURST: The paucity of --

DR. FAULKNER: Right.

DR. WHITEHURST: -- high quality research on the effectiveness of instructional materials.

DR. FAULKNER: Okay, all right. All right. Bob?

DR. SIEGLER: I would favor striking the last clause in number 8, because our synthesis group talked a lot about this, and there doesn't seem to be any evidence for it. I don't even quite know what it means. So I don't think it should be there. And the use -- or the use of a combination of grouping strategies.

MS. FLAWN: That's fine.

DR. FAULKNER: Well, I think this is a reference to -- what was it -- the cooperative item that Tom validated. I mean, this is meant to be a list of things that were validated. Okay? It's not well expressed, but that's what it was meant to be.

DR. SIEGLER: Well I know that, but I don't know what combination of grouping strategies means.

DR. FAULKNER: No, that's not the right language.

DR. SIEGLER: Yes.

DR. FAULKNER: Okay.

DR. REYNA: In that connection, if we're adding things and trying to integrate it across the task groups, there were a number of things that we identified in the learning processes group that were -- that you know, fell out as effective practices, including the board game intervention, demarcating

names for fractions as parts in wholes was shown to be effective. We may want to enumerate those here as well, in number eight.

DR. FAULKNER: These are pretty big scale topics, and they're on a different scale than the ones you just named, it seems to me.

DR. REYNA: The ones I just named are probably specific and operationally defined. I would vote for that on all of them. I think being more specific and clear about what's actually been shown to be effective would probably be good, but that's just my opinion.

DR. FAULKNER: Okay. Well, we can work on that list. Vern?

DR. WILLIAMS: I have a question about seven and eight. In eight, you said "explicit instruction for students with mathematical difficulties," et cetera, that it's better for students with mathematical difficulties.

Would you consider explicit instruction to be more teacher centered? And if you do, then when you look at eight, would you not be able to say that teacher-centered instruction is actually better for students with mathematical difficulties?

DR. FAULKNER: I think that we did say earlier in this document that that conclusion that for

low achievers that explicit instruction was better.

MR. WILLIAMS: But is teacher centered -- is explicit instruction, teacher centered or more student centered?

DR. FAULKNER: Oh yes, we're going to have to deal with those terms. That term has been -- that term battle has been going on continuously.

MR. WILLIAMS: Yes, because if you say explicit instruction is great for kids who are having difficulties, and if it's actually a part of teacher centered instruction, then you can also say the same thing for teacher centered instruction for that particular group of students.

MR. FAULKNER: Yes. I think -- yes.

DR. FERINI-MUUNDY: Vern, I think in our synthesis group yesterday, Russ was talking about this, and explicit instruction gets used here as a kind of truncated description of the actual intervention that worked. And he had -- there were other words that had -- I forget what they were -- but feedback and individualization and so forth.

So we need to go back and look at what the research actually said and what explicit instruction was in those particular cases where it was supportive of well achieving students.

And the other thing I just wanted to flag

is that on 7, as we go through this sort of last look of the Instructional Practices report, we may recommend some adjustments in that one.

DR. FAULKNER: Okay. I will indicate that this Panel as a whole is going to have to come to terms as to what terms it uses in this area. The Instructional Practices's task group has discussed that. The Panel has not discussed what terms it wants to use for spectral limits. And that's something I think we'll have to come to.

Other points on item six to ten? Bert?

DR. FRISTEDT: As to items nine and ten, they seem weaker than the statement that we got earlier on length of textbooks. And I think length and coherency of textbooks can be in a clear statement there.

And one other thing that should be added, and that is sort of here, that schools and teachers, when they choose textbooks, that's a major task. It's not easy to do. You've got to spend a lot of time doing it. So that's one comment.

My second comment is formative assessment seems to be definitely a plus for learning. And I can't help but wonder if teachers in the schools don't use -- don't avoid it, because they're required to keep records of everything. And if you're using

assessment to guide students, you'd like to look at one problem very carefully and diagnose it and tell the child what's been done, say on the homework or even he's done it in class or she has done it in class, and you don't have a score to report that the principal wants you to keep records of, but you have information to give back to the student.

And I'm just wondering what school policies are, and whether they sort of force teachers to keep track of everything, and thus not to use formative assessment of their own making.

DR. FAULKNER: Are you posing a question for the Panel?

DR. FRISTEDT: To the Panel or maybe for Vern, since he has the --

MR. WILLIAMS: I was just thinking about answering that.

Because in the school system where I teach, you do need to keep records of the benchmarks that are passed by each student and what you've done to remedy the hindrance of any progress. And teachers do complain vehemently about the paperwork involved.

DR. FAULKNER: Okay, we're going to need to move, because we only have, you know, a limited amount of time. We've still got a lot of recommendations.

So let me go ahead and move this to 11 to 15. 11 to 15. Yes, Skip?

DR. FENNELL: Number 11, I would suggest we take the language that we used earlier, which was something along the lines of evidence from research and so forth and so on, supports the value of preparing larger number of students to complete an Algebra one course or its equivalent, rather than this --

DR. FAULKNER: Than the incentives language?

DR. FENNELL: Yes.

DR. FAULKNER: Yes. Okay.

DR. FENNELL: That's earlier in the document.

DR. FAULKNER: Yes.

DR. WHITEHURST: I will point out though, that that's not a recommendation, and this is the recommendation --

DR. FAULKNER: Right, we probably need to turn this into a -- something else. Or we need to make them concordant.

Okay. And Tom made his case I thought pretty explicitly about trying to get away from using incentives or putting -- recommending an incentive program.

Anything else on 11 to 15?

DR. FENNELL: Yes. The particular recommendation from the teacher group was that mathematics teacher specialists not -- I mean, there's a long list of definitions of mathematic specialists that include coaches and so forth.

And Russ, I'm looking at you. I believe your recommendation was a teacher specialist that is a dedicated teacher teaching mathematics. So that language ought to be consistent.

DR. FAULKNER: Yes, we have to be very clear about what we mean when we use the word specialists.

DR. FENNELL: Right.

DR. WHITEHURST: I have a comment on number 14. Bob's synthesis group reworded that. And it would be good if that wording could be passed to you --

DR. FAULKNER: Okay.

DR. WHITEHURST: -- regarding this stuff, because I think it was better than what's --

DR. FAULKNER: Will you send it to me?

DR. SIEGLER: Yes. You should have it. Jim gave you the -- I believe, the file with that.

DR. FAULKNER: Okay.

DR. SIEGLER: If not, Jim has it for sure.

DR. FAULKNER: Okay. Joan?

DR. FERRINI-MUNDY: Just quickly. I just add that 13 and 15 aren't yet really phrased as recommendations.

DR. FAULKNER: Right. I think that's an endemic problem. We are going to have to decide what's a recommendation and what's a finding.

DR. WHITEHURST: And on 15, it should be made clear that we're talking about the salary differential between teachers with training in mathematics and other technical fields.

DR. FAULKNER: Okay. Other points?

DR. FENNELL: 18, the recommendation relative to the NAEP.

DR. FAULKNER: Wait, you're on 18 now?

DR. FENNELL: I'm sorry.

DR. FAULKNER: Okay. We're done with 15. Okay, now we can go to 16 to 19. And Skip is in order.

DR. FENNELL: The recommendation that was made relative to the National Assessment of Educational Progress (NAEP) content frameworks was more extensive than what's here talking about the areas. And we can provide that.

DR. FAULKNER: Okay.

DR. FENNELL: Camilla knows exactly what

I'm talking about.

DR. FAULKNER: Okay. Okay, anything else in 16 to 19? Susan?

DR. EMBRETSON: Yes, 19. As stated, it isn't going to do anything at all, because as I stated, they already have quality control in oversight procedures.

So we need to add a phrase after "oversight procedures" like this, "that are based on scientific evidence and logical analysis at high levels of expertise."

DR. FAULKNER: Is that in the language that's actually in the task group report or working paper?

DR. EMBRETSON: Not currently as such, as a single statement, no.

DR. FAULKNER: Well, will you send me an e-mail that has that language in it?

DR. EMBRETSON: Okay.

DR. FAULKNER: Okay. Yes. Valerie?

DR. REYNA: May I add a friendly amendment to that. High levels of expertise also can be construed in very loose ways. How about "doctoral level of expertise"? You know, the more specific you can be about high levels of expertise, the more effective this recommendation would be.

DR. EMBRETSON: I guess. I'm not sure about that. But I guess. The best I have seen anywhere --

DR. REYNA: I'm arguing for necessity, not sufficiency.

DR. FAULKNER: Okay. Well any way, using whatever consultation you deem appropriate, you'll generate language that you'll send to me.

DR. EMBRETSON: Okay. At this point could I make another suggestion? Because I know that these other recommendations that are coming up are going to receive a lot of scrutiny as well.

And that is, because Assessment was not really done, we didn't get a research recommendation in either. And the one I have is related to this business of quality control and oversight procedures and their basis. And that --

(Distant loud music)

DR. FAULKNER: You're just going to have to plod on, Susan.

DR. EMBRETSON: Well, here's a statement that I had in mind here under research. That -- and as follows: "Research is needed on the design features that impact the knowledge, skills, and abilities that students apply to solving items."

DR. FAULKNER: And you're proposing to add

that in as a research recommendation?

DR. EMBRETSON: Right.

DR. FAULKNER: That's fine, send it. Okay. Bob?

DR. SIEGLER: Yes. Another friendly amendment to Susan's point about 19, is that before you specify the kinds of expertise that you thought were critical for better item design and selection, and I think doing that here again, you had some very nice choices there. And I think at present it leaves the question of high expertise in what open. And I think specifying the kind of expertise that we want is critical.

DR. FAULKNER: Yes. I think we need to be quite explicit about what we're suggesting. Okay. Then I'm sensing the recommendations dealing with policy and practice we've already covered.

Now we can go to those dealing with research capabilities and agenda. That is -- that's research capabilities and research agenda, is what's meant there. 20 to 25. Let me ask you to react to 20 to 25.

Let me point out -- well, let me just let you talk about 20 to 25. But I want to point out that 21 is a recommendation that I phrased. My -- and you can do with it as you wish.

However, I believe that this Panel does need to consider whether the shape of the federal research establishment is getting the research that we need.

We have in effect gone through reviews of something like 18,000 studies. We have found that a relatively small proportion, let's say a quite small proportion, actually reaches the stage of generalizability, which is what we're being asked to address with respect to practice and policy.

And I -- my impression is that the shape of the funding structure isn't quite adequate to generating the kinds of studies that we've found useful. And that may or may not be true, that's my impression, as we've gone through this process.

And I think it's certainly reasonable for this group to consider whether to make recommendations that bear on that question. I think it's within the scope of what the President asked us to do. Whether this set of things is what we should say is certainly up for debate. I put it in here to create an opportunity for a discussion.

Okay. But we can talk about anything in the 20 to 25 range here. Bob?

DR. SIEGLER: One thing that actually isn't explicitly here, but came up in the synthesis

group discussion yesterday, is the need for greater overall funding in education. And it's related to point number 21, because we don't want this, which it seems to me at least to be a very good idea, to be something that yanks away all the other education funding.

A statistic was cited in the discussion yesterday that was really pretty shocking that in a comparison, in the education funding, less than one-half of one percent of discretionary spending is spent on research. In health spending, the number I believe was 42 percent of discretionary spending is spent on research. That's quite a ratio.

DR. FAULKNER: Yes.

DR. SIEGLER: And I don't think -- you know, it could be viewed as feathering our own nest to recommend greater funding of research, but not to do so I think would be irresponsible. It's really -- the total amount of money is a very large problem.

DR. FAULKNER: Okay. Yes, also Valerie I think wanted to say something. So let me talk to -- get to Valerie then to Russ.

DR. REYNA: I wanted to direct your attention to the document you may not remember, but is tab 16 for more details on this. I think that these are good concrete examples of some of the points in

that item 16.

I would add however, that these emphasize the importance of large trials, and certainly those are important.

I also mention in that document experiments that get at causal mechanisms. We really don't even have basic knowledge about, you know, what are the problems with fractions? Why are they so hard? And therefore, how would you fix it? We don't know about learning disabilities. The nature of the problem. So we just teach everything a little slower, because we don't even understand the mechanism.

So there was a lot of -- there was some attention paid in that document to causal mechanisms that test hypotheses as well as these recommendations.

My suggestion might be that it's a fairly short document that we might think about putting, you know, maybe 50 lines from it into our recommendations, so it will take up very little space.

DR. FAULKNER: I think over all our report needs to discuss the overall capability, and whether we're getting at the problems that we need evidence on, and whether we have the right apparatus to do it. That's really what I'm saying here. Russ?

DR. WHITEHURST: Well, you know, I appreciate the motive behind point 21, but I don't

think it's sufficiently informed by what the federal government has already done.

My office was established in late 2002 to do this work. We are doing it. We're beginning to get yield from it. Grants take four or five years.

So if you go down the list here, "distinct federal funding program that can support a small number of rigorously designed and executed trials." We have through our national center for education and evaluation 22 such trials in the field, some of which have already generated results like the technology study that has been reported to the panel.

Within our research center, that funds individually initiated projects at the university level, we have established goals. This is entirely about taking projects that have been shown effective at smaller scale and moving them to larger scale. We have about 40 projects under way there.

With regard to point (C), we've established ten interdisciplinary pre-doctoral training programs that are scattered across America, and have currently 190 doctoral students in training who have produced to date about 200 publications; all directed to the pipeline issue.

So I think this work is under way. Certainly the National Science Foundation (NSF) has

similar work.

And so I'm leery, and I won't want to be unduly defensive, but I'm certainly leery about a recommendation for this panel to create some kind of new bureaucracy that is intended to address matters that are already being addressed, but have a delayed yield curve because of the necessary time it takes to fund research and get products from --

DR. FAULKNER: These comments were made on the basis of what our experience has been with the research that has been available to us. And that's a relatively new initiative.

DR. WHITEHURST: Right. So I applaud, you know, the motive behind it I applaud. I'm just trying to indicate that I think a lot of this is already under way. And new entities and new boards kind of interfere. I think there is some high risk associated with them for vitality and continuity existing --

DR. FAULKNER: Right. And in putting this forward, I don't want to argue for the language.

What I really want to do is create a place marker for us to address the question of whether we have the right apparatus to get at the questions that we're after. I'm not the person to even formulate those questions or that apparatus. I just want to be sure we don't miss that opportunity. And that is not

a task group item. It's something that the task groups individually did not do. It's going to have to be done at the Panel level, so. Joan?

DR. FERRINI-MUNDY: I would underscore what Russ has said and just add a couple of points.

I mean, looking inside it more closely from the National Science Foundation (NSF) angle, part of what we are not seeing enough of are the efficacy studies that get things set up and ready, where the large scale studies then can happen.

So there would be more subtlety perhaps if something like this still goes forward about the particular kinds of places where there is a need -- a continuing need for more investment. But the other --

DR. FAULKNER: I wonder if a group could actually work on some language that we could deal with in the report, and maybe a little section for the report, and a suitable recommendation probably needs to involve Valerie and the two of you and maybe anybody else who wants to get in.

DR. FERRINI-MUNDY: Could I just make one additional point on this, which is, that the discussion of capacity around the federal funding and so forth is interesting and good. But another place where we might choose to make some recommendations and push the capacity issue is toward higher education.

I mean, the federal agencies have programs, but we will only be able to fund what comes in that is strong. And so these research communities that would be positioned to take up some of these questions, probably could be encouraged to do more of the kind of work that we're calling for that we're not seeing.

DR. FAULKNER: That's entirely appropriate.

DR. FERRINI-MUNDY: So maybe that could come into it too.

DR. REYNA: That's really a good point. And of course this is a chicken and egg issue. You know without a prospect of funding, it's hard to encourage people to dedicate their careers to something. But so I think you're right, there's a supply issue as well.

I would say if we do this right, it should encourage and provide support for the kinds of successful things that have been done at Institution of Education Sciences (IES) and at the National Science Foundation (NSF).

I think one might still make an argument that there's plenty left to do, but I think if we frame this correctly, it should recognize the positive accomplishments that have occurred, and maybe have

some small effort in sustaining them.

DR. FAULKNER: Dan's voice came out of the blue, and I think we should let him say something.

DR. BERCH: Thank you. First, I wanted to second what Russ said, be concerned about creating yet another layer of bureaucracy and coming up with a recommendation about this program.

It's interesting that at this moment we are recommending that, the National Institute of Child Health and Human Development (NICHD) have an Rehabilitation Services Administration (RSA) out on the street about mathematical learning difficulties with disabilities.

So we all have ways in which we're working separately, just in some cases together too -- not that we couldn't do more.

The second piece is that in a way, I think I would feel a little uncomfortable being a part of this group, and I don't know if Russ would or others who are currently or Joan, because it would be almost as though we're making recommendations to ourselves. And it's somewhat akin to the instructional materials group not having anyone but their own specific end of their curriculum, if you will.

So I think there is certainly a model for this sort of thing that comes of some of the national

academy reports, and I concur that it would be important to make this kind of recommendation. But I'm a little worried about the specificity of the -- and again, don't feel that I should be directly a part of any group like that, although I could make some comments as Russ just did a moment ago and Valerie is doing, if needed.

DR. FAULKNER: Okay. Well, I think you all are going to have to settle that among yourselves. But I think we should not miss the opportunity to comment on this general topic.

DR. FENNELL: It just seems to me that however this is crafted, these are general avenues for -- potential avenues, suggested avenues for research. And then underneath that we have a lot of very specific things that we might want to delve into deeper. So I think they're related, but different.

DR. FAULKNER: Bob?

DR. SIEGLER: On item number 25, I think we should strike the four or five words on the last line and just say, "research is needed to identify key features of teacher education that have effects on students' achievement."

Because otherwise, it opens the door to saying well we taught them Finn's theory of pedagogy and now they know Finn's theory of pedagogy, and that

doesn't do anyone any particular good.

I think we really want to keep the emphasis on student achievement and the effects of teacher training on that.

DR. FAULKNER: Okay. Bert then Russ.

DR. FRISTEDT: Going back to 21.

One thing I noticed in just looking at the few research articles is that in some studies a particular person has an idea and carries it through and compares it with a more conventional idea. But of course he's -- that person has quite a vested interest in how it comes out. And no one seems to pick up on that idea and replicate it. So one person's idea for this might be better. They test it, okay. But then it should be replicated by someone who has no particular interest in showing that that's good or bad. But my experience in this research area is somewhat minimal to say the least. Somehow I've taught 45 years without it, but anyway, I just -- I don't see this attempt to replicate.

DR. FAULKNER: Other comments on 20 through 25? Wilfried? Oh yes, Russ, I'm sorry. No, no, Russ. You're in line here, Wilfried.

DR. WHITEHURST: I have first a small issue and then a larger one.

On 24 we cite the cognitive tutor as an

example. And I think it's probably inappropriate to cite a commercial product as an example of what we're about. I think that could simply be struck.

On 23, I may be reading more into this than was intended. But it really seems to me to be talking about a particular program at Institute for Education Sciences (IES), cognition and student learning, where we require grantees, who are in every case cognitive scientists, to spend a majority of their grants doing work in authentic education settings. And the recommendation here is not to impose that requirement on the research community.

I think that would be ill advised for a couple of reasons.

One is that there are many sources of funding for cognitive science. One can go to the National Science Foundation, for example, in the divisions having to do with learning and obtain research to do laboratory type work that exposes the basic mechanisms of learning and memory. All of that work is important, and much of it is important as a foundation for what happens in education.

But what we don't have, and I think it's relevant to the comments you made earlier, Larry. What we have not had is translational work that takes the findings from cognitive science, and we have a

report in this Panel that has hundreds of references, that takes those findings and moves them into classrooms and other learning situations under conditions of extended learning, with the complexity of what's going on in a classroom, and generates yields that have a relatively small gap between the findings and what educators might use. And that's what the particular program at the Institute of Education Sciences (IES) tries to do. And it's done it with a great deal of success.

So I would -- I just think it's not a wise idea to say that there can be no federal program in which cognitive scientists are required as a condition of a grant to do work in the classroom.

DR. FAULKNER: Your recommendation is to strike 23?

DR. WHITEHURST: Yes.

DR. FAULKNER: Dave?

DR. GEARY: I agree to a point. But however, I want to mention that a lot of cognitive scientists do work that is potentially relevant and usable, and if they go to National Science Foundation (NSF) or to the National Institute of Health (NIH), they're really not thinking about educational types of issues. If there was additional funding that was say with IES or some focus on educational issues, then

they could think about the studies they're doing with respect to learning of A, B, and C in a school setting. And that basic kind of mechanism type of research could be done in a more lab setting. And work like it is being done in lab settings, but without really any thought about it. Because if you go to the National Science Foundation (NSF) or you go to the National Institute of Health (NIH), in many cases you don't have to think about that. What they're thinking is reduction. How do we understand this process a little more -- in a little more refined way, rather than the other direction?

And I think if we left it at the National Science Foundation (NSF) and the National Institute of Health (NIH), I think we're just going to continue to get more of that.

DR. FAULKNER: Let me suggest that recommendations 21, 23, and 24 all be taken into this group that we're talking about here, that would be Valerie and Dave and Joan and Russ, and you all can kind of think about what the over all package of recommendation texts that we might want to put with it would be. Does that seem reasonable?

DR. REYNA: Seems very reasonable. And again, I should say, no particular program here was intended. We want to remove barriers that would allow

this kind of translation that we all agree is really important to occur.

DR. FAULKNER: Okay.

DR. REYNA: And we will take this up in further study.

D. FAULKNER: And Valerie, you can coordinate this.

DR. REYNA: Okay.

DR. FAULKNER: All right, thank you. All right, let me suggest we move on past 25 to 26 through 30. 26 to 30. It's almost noon and the music is getting louder. 26 to 30. All right, Skip?

DR. FENNELL: Number 28, I would suggest that that item be amended to something like, "longitudinal research is needed to specify the skills and knowledge and their sequence and level of emphasis, which lead to algebra."

In other words, it's not just the identification of the skills, but how they might be ordered and the amount of time that should be spent at various levels.

DR. FAULKNER: Okay. Bob?

DR. SIEGLER: Yes. Continuing Skip's focus on number 28, I think it actually needs even more expansion than that, because there should be classes here.

There's one, skills that kids attain several years before they enter algebra courses that are important. And then there are skills that they obtain, as they exist right before; right at the beginning of the algebra courses. And those are somewhat different issues.

And whether you need to remedy things years in advance, or whether you just need to do it at the beginning of the algebra course, is a very important instructional issue, and one that just the data today don't exist.

DR. FAULKNER: So who's going to do that?

DR. SIEGLER: Skip and I.

DR. FAULKNER: Okay. Send me the material. Bert?

DR. FRISTEDT: It seems to me that in general, we have not discussed much in the Panel until we got to this recommendation. And also -- yes, this one right here, about what are the most important prerequisites for learning fractions.

We say fractions are important for algebra, but my own suspicion is that whole number arithmetic fluency is very important for learning how to do fractions, just so you can get that out of the way in your mind and concentrate on common denominators and that type of thing.

But anyway, that has not gotten much attention until right here.

DR. FAULKNER: Bob?

DR. SIEGLER: Yes. Actually, empirically, this problem is somewhat understood. And while whole number fluency is predictive, it's not the most predictive factor.

The most predictive factor is conceptual understanding of fractions. There are a huge number of kids who just don't understand what a fraction is. And that turns out to be easily the most predictive factor.

The fellow who did this research, Steve Hecht, used a variety of measures of conceptual understanding. I believe one of them was the number line. Val actually reviewed that --

DR. REYNA: This is reviewed in detail in the task group report. Step by step exactly what constitutes conceptual understanding, and Bob is exactly right. There were a variety of operational definitions. He looked at word problems, computational facility, and a variety of other kinds of things like relative magnitude judgments of fractions and so on, but that's detailed in the report.

DR. FRISTEDT: If we know all this, and

I'm taking your word that we do, it seems that some recommendations for publishers are in order here.

And for example, Wu mentioned to me a fact that I hadn't been aware of. He says that when they talk about addition and subtraction of fractions in textbooks, they don't mention the number line again and moving to the right or the left on the number line. Well, I didn't know that that -- I thought that was in vogue 50 years ago, but apparently it's been out of vogue. Well no, that certainly is -- it should be mentioned in the textbook.

So I think there's some recommendation for publishers that can come out of the research -- more for the publishers than for the Panel, more for the publishers than for the teachers.

DR. FAULKNER: Russ -- or Joan then Russ.

DR. WHITEHURST: Larry, I'm sorry, what number are we allowed to go down to at this point?

DR. FAULKNER: We're down to -- we're in the 30, range of 30.

DR. WHITEHURST: Okay. I would just -- I want to point out that 30, 31, and 32 are not research recommendations at all, and so they either need to be struck or put in a different place.

DR. FAULKNER: Yes, that's true.

DR. WHITEHURST: There is missing here

something that the Siegler synthesis group came up with as a very important research recommendation. And that is, and help me out Bob if I miss the wording, but this is how I remember it, "Research to identify and inculcate the characteristics of persistently effective teachers."

DR. FENNELL: Yes, that's exactly the wording; you nailed it.

DR. FAULKNER: You're adding that line?

DR. WHITEHURST: Well, you know, put it in as a new number.

DR. FAULKNER: Okay.

DR. WHITEHURST: You've got three to work with now. 30, 31, and 32.

DR. FAULKNER: Well, we still need to comment on these recommendations, even if they're in the wrong place. Give me that language again, Russ.

DR. WHITEHURST: "Research to identify and inculcate the characteristics of persistently effective teachers."

In other words, we know that there are some teachers who do a good job one year and they do a good job the next year and the year after that, and we are clueless as to what the characteristics are that represent -- that generate those gains in student achievement.

DR. FAULKNER: Okay, anything else in the recommendations up to 30? We've got to go also to 31 to 33. Wilfried -- Joan. Joan's been standing in line for a long time.

DR. FERRINI-MUNDY: I have. I'm back to 28. I think we want to be a little careful for consistency sake when we call for longitudinal research needed to specify the skills and knowledge leading to success in algebra, when earlier we've quite clearly stated what we believe the critical foundations for algebra are. So I think we want to reconcile that.

DR. FAULKNER: Well, and I think we're explicit that the critical foundations are determined on the basis of judgment.

DR. SIEGLER: Just to address that point. There are a number of critical foundations on logical grounds. Empirically, some of them are going to be more important than others, due to greater variability in the population or lower absolute levels in the population, and that's what I think the key contribution of 28 will be.

DR. FAULKNER: Okay. Wilfried?

DR. SCHMID: I would just like to second and amplify what Bert said. So I must say I wasn't aware either that there was such detailed

understanding of the predictive value of conceptual understanding of fractions. And if the evidence is really that strong, then we have to say more as a recommendation to textbook writers.

I mean, that should just not be forgotten. I mean, that is really a serious issue. I mean, if we know that much, then we need to make that clear.

DR. FAULKNER: Would the two of you consult with Bob and try to -- and Val and see if you can develop --

DR. REYNA: I offered the fractional report.

DR. FAULKNER: Just a recommendation. She already has a job. She can be part of the team.

DR. REYNA: Don't worry, I already did all this reviewing, so it's not much additional work.

DR. FAULKNER: Okay. Liping?

DR. MA: Is there any research available talking about whole number division as the prerequisite for --

DR. REYNA: Yes. And I can give you the line numbers.

DR. FAULKNER: Okay. I'm going to suggest we go to 31 to 33 now. Which means that anything is fair game.

DR. FENNELL: So those are all teacher

salary issues. And as Russ pointed out, they're not in the area of research. You'll just put those somewhere else relative to policy, right?

DR. FAULKNER: Yes, but the question is, do you want to keep them?

DR. FENNELL: I know.

DR. FAULKNER: Val?

DR. REYNA: Well, with regard to 33 and the rest of the items, Wade, before he left, reminded me to say that we had a number of recommendations on learning principles and content areas in learning, that we listed teacher things here which are clearly things we should mention, but there may be others that we want to include that we mentioned before. Things like, for example, links between intuitive knowledge and formal knowledge as an area for focused research. Because in domain after domain, fractions in geometry, in particular, that link was not -- is not well understood and is the foundation for progress and formal mathematics.

So there are a series of recommendations that were in the other common concept that we might want to import here and that parallel the learning principles bullets that are findings and that we can turn, you know, that have corresponding recommendations.

DR. FAULKNER: Which ones? They were -- where'd they come from? Which synthesis team? Do you know?

DR. REYNA: They were included I know in the Clements' synthesis team as principles, but I'm not sure all of them made it into recommendations.

MS. FLAWN: You mean the working paper?

DR. REYNA: Yes, yes.

MS. FLAWN: So working paper for Learning Processes?

DR. REYNA: Yes. They're in the working paper for Learning Processes for sure. And in this annotated document we prepared for the Clements group as well, which I can send you if you need.

DR. FAULKNER: Okay. Go ahead and do that if you can.

DR. REYNA: Okay.

DR. FAULKNER: Yes, Bob?

DR. SIEGLER: Point number 33, a number of comments. Points (A) and (B) are almost identical, and both of them are essentially identical with point number 25 from previously. Even the language is virtually identical.

So 25 says "research is needed to identify key features of teacher education, duration, structure, quality, and teacher capacity with student

achievement." And here it's just phrased as a question.

DR. FAULKNER: So you're saying we can just chop them out here?

DR. SIEGLER: Well yes, (A) and (B) can be deleted. And (C), I don't know what -- this sounds so open ended and amorphous as to be virtually meaningless.

DR. FAULKNER: Yes.

DR. BENBOW: That might be true, but didn't we want something on professional development? And do we have a question on research on professional development? Because this is a big issue that we don't think -- that our current practices are not all that effective? So we need to have something on professional development.

DR. FRISTEDT: Yes, that needs to go instead of (A) through (C).

DR. FAULKNER: Yes.

DR. WHITEHURST: What if question 25, and one just inserted after teacher education and professional development? I think all of the questions there are relevant both to the pre-service and to professional development of teachers.

DR. FENNELL: And Russ, teacher education -- the phrase "teacher education" would pick up varied

levels of certification, be that alternative or not, right? Okay.

DR. WHITEHURST: I think so, yes.

DR. FENNELL: Because that came out earlier.

DR. WHITEHURST: Sure.

DR. FAULKNER: And what about (D)? Well, Joan and then Susan.

DS. FERRINI-MUNDY: Yes, just really quickly. The working paper from the IP group didn't really consolidate any recommendations for research. Which means that they're missed in anything we might have had to say -- got missed in these concepts. So maybe we could make a placeholder that there'll probably be one coming from that group.

DR. FAULKNER: Okay. All right. And then Susan and then Wilfried.

DR. EMBRETSON: Yes, back to 32. I'm kind of troubled by it, because the way it's stated, it says "raising student achievement." And I worry how that's going to be measured.

The thing about the measurement of change is it depends on the match of the test to the student. And so if you're students are already at a pretty high level, you can't get them much higher. So you're going to have to have some language about, you know,

persistently high achieving students or something like that, because if you've already done a very good job you're not going to be able to raise them. And that is a comment I've heard.

DR. FAULKNER: And you'll get that comment, for sure. Wilfried?

DR. SCHMID: You said before that since now we are through 33, then anything is fair game. So what I'm going to say now is not really about these questions. It is the larger issue that has come up before.

Mainly, when this document is written, where will you go back to? The working papers or the reports?

Now, obviously going back to the reports is going to take more effort. However, the reports were very carefully written. A lot of effort went into them. The working papers were coupled together rather in a rush. And I think that certainly the Conceptual Knowledge and Skills report that I was involved in, it is very clear to me that the report itself is far more nuanced, is a far better source than the working paper.

And while obviously it will be time consuming to go back to the working paper -- or to the reports, and I don't know what I can suggest here,

except to say that reliance on the working papers is going to be a problem.

DR. FAULKNER: Bob?

DR. SIEGLER: Continuing in Wilfried's spirit of looking over the whole set of issues. With this large number of recommendations, I worry that the ones that are especially high priority will get lost. And I think we need --

DR. FAULKNER: Well, we have attempted to identify those.

DR. SIEGLER: Right. So my synthesis group submitted one list of nominations, and maybe the other synthesis groups should undertake similar exercises, and we'll see how much agreement there is, and maybe there will be a lot of consensus, if we're lucky.

DR. FAULKNER: Okay. I think we have demonstrated once again that a work of a committee expands to fit the time available. And we are out of time. I'm sure there are additional comments, but frankly, we have done quite a bit here in Phoenix. And I think we can feel pretty good about how we've come out.

There is a basis here for trying to start to put this document together, and it will be -- there'll be a need for further discussion, quite a bit

of further discussion. And we'll gradually try to get the best language from the best sources.

We are going to end up having to condense, of course, this final report can't carry all that is in the past group reports, and we are going to have to end up with condensed representations, and we'll have to make those valid and effective.

I think Tyrrell just received a message earlier today that Secretary Spellings will join us for lunch at the Baltimore- Washington International (BWI) Airport meeting on November 28th. And that is our next meeting. We will have no proceedings before the 28th. People can get to Baltimore- Washington in that time. I think Tyrrell is planning to make -- to have an available dinner, but there's not any work that will go on the 27th. Our whole meeting will be on the 28th, and we will be finished by roughly three o'clock in the afternoon. And it'll be focused on the language in the draft report.

My hope is actually to get the draft report to you by the 12th of November, and to be able to enable some reactions by e-mail. And we actually may put the synthesis teams back together in order to be -- provide for discussion forums. It's not practical I think for us to convene a phone call of the whole Panel, but we could do it in segments

through the synthesis teams and use that as a feedback mechanism, and we may try to do that. We may even work on the arrangements here in the next couple of days.

But anyway, I think that's all we can do right now. The bus is ready to take us to the airport, and some of us need to get there.

(Meeting Concluded at 12:19 p.m.)

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Change Number: 2
Last Saved On: 1/9/2008 4:37 PM
Last Saved By: jennifer.graban
Total Editing Time: 2 Minutes
Last Printed On: 1/10/2008 8:22 AM
As of Last Complete Printing
Number of Pages: 162
Number of Words: 26,947 (approx.)
Number of Characters: 153,601 (approx.)