

## POLICY OPTIONS DEVELOPMENT

*Dr. Judith Ramaley, Assistant Director, NSF Directorate for Education and Human Resources, opened the panel on policy options development by summarizing some of the key issues that had been raised in the workshop so far. She touched on traps that policy makers can fall into, such as failing to realize the assumptions and biases we have from our own experiences, as well as the shifting demographics of the United States and future challenges we have in educating all Americans. Dr. Ramaley highlighted some of the progress policy-makers have made, as a result of asking questions and challenging assumptions, in bringing diversity into the science and engineering workforce.*



What we are talking about today is the kind of problem that requires a great deal of care as we think about our approach to decision making. There are four sets of traps we can get into. The first one is how we frame the question. Although much of our discussion today is about where our next generation of faculty will come from, the environment in which people prepare for various kinds of careers and identifying critical questions that would give rise to policies and investment strategies for institutions and the federal government, we must not forget state policies that interact with all of the above.

The second trap is the question of how honest you are about your current condition. Today we must be open and willing to probe underneath the surface of the language we use, of the assumptions we have, not only about ourselves and what we are trying to achieve, but also the environment in which we are trying to do the work.

The third area that is often riddled with pitfalls is how we assemble our options; how constrained or how broad we are in our interpretation of what is possible and whom we involve in that discussion. The final set of traps occurs largely because nobody thinks about doing certain things as part of the decision making process. Are we in fact asking the kinds of questions that will draw people's attention to what they really need to be taking seriously and attending to? Are we learning from our experience?

When I was preparing for my first presidency, I was walking down the hall one day and a member of the staff stopped me and said, “I have some advice to give you.” The advice he gave me came from the fact he had served as a field commander in Vietnam. His advice to me was, “You are probably heading in the wrong direction.” He was not talking about combat. Rather, he was referring to the fact that as a commander, he learned very quickly the questions he asked of his people determined what they paid attention to and whether they stayed alive. I learned very early and have tried to follow that up as a member of the leadership team here at the National Science Foundation to pay very careful attention to the questions I ask.

So what do we seem to be agreed upon from this morning and this afternoon and how do we connect the dots of what we have heard today? First of all, I think we have some agreement on the challenges we face. But there were a couple of things that were brought up that I had not thought enough about and so I may overemphasize them just because for me they were particularly remarkable.

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The first thing I think we all agree on is that the demography of this country is shifting quite rapidly toward a much more diverse nation, described by some as the underrepresented majority. As I listened further, I realized our institutions are still designed by and for the overrepresented minority. We have very significant gaps in the participation and achievement of men and women who have not traditionally been well represented in the establishment. Even when we do have people to consider, we often do not know where to look for them which gets to the second point which is that it is important to know where the students are and where the candidates are. They are not necessarily where we are accustomed to looking for them.

In the 1999-2000 year based on the National Center for Education Statistics,<sup>59</sup> there were 103 historically black colleges and universities, 215 Hispanic-serving institutions and thirty-four Tribal colleges and universities. The actual number of Hispanic serving institutions, by the way, has continued to increase because it is based not on federal definitions as are the Historically Black Colleges and Universities<sup>60</sup>(HBCUs) and Tribal Colleges and Universities<sup>61</sup> but on enrollment statistics. So the remarkable growth of Hispanics within our K-12 and undergraduate populations are driving more and more institutions and the influence of those institutions toward being Hispanic serving.

What proportion of students who define themselves as Hispanic or black or Native American actually are studying at these institutions? In 1999, only 16.7 percent of African American students were in HBCUs. Only 8 percent of American Indian students were in Tribal colleges. In contrast, almost 58 percent of Hispanic students were in Hispanic-serving institutions.

I mention these figures because I think it demonstrates that at the federal level, we tend to focus on minority-serving institutions. Every federal agency with which I have any contact at all has programming for minority-serving institutions. However, depending on the population we are trying to reach, the institutions may not be in the right place. They may be elsewhere and as a result, be underutilized.

The third point I think we agree on is that too few high school graduates are prepared to pursue careers in science, technology, engineering and math. Although we could improve the attractiveness of careers in academia, we can also improve how we look at candidates for the positions at our colleges and universities. We still will be limited by the fact that although about 94 percent of high school students take biology, less than 30 percent take physics and approximately half take chemistry. When we look at mathematics, the story is considerably worse. Only about 60 percent of the students graduating from high school last year had taken algebra II and far fewer had taken more any more advanced mathematics.

Now when you unpack those numbers to view the experiences of different groups of students within a larger population, the story gets a good bit worse. I just received a report from the Rossier School of Education.<sup>62</sup> They did a similar unpacking of the experiences of students in a number of cross sections of California institutions showing exactly the same thing. Although the total remediation required at the college level in math or in science or in English was about 35-40 percent, when you unpack those numbers, 80 percent of African American students and a very high proportion of Hispanics required remediation. The argument I would make from this and other related numbers is that one piece of advice we must take from what we have heard today is that it is not enough to look at aggregate numbers when we are examining the effects of investments at the federal level or at institutional level. We need to unpack them and examine the experiences of different groups of students coming to us with different levels of preparation and with different career aspirations and having taken different routes to the point where we meet them.

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The next point I want to make is that most of us, I think, still have an image of the student as an individual who studied full time, who completed an undergraduate education in 4.2 years, maybe 4.5, maybe even 5 if we were engineers, who went immediately, or almost immediately, on to graduate study and completed it in a reasonable amount of time, then went immediately on into an illustrious career in academia or industry.

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In fact, only one out of six students today looks like that, acts like that, or takes that kind of route. So we really have to think carefully about what “success” means. We have to think about the relationship of institutions to each other and how they produce educational environments. We need to understand who our students are, what their educational goals are, how they are getting their education and how federal as well as institutional intervention can influence what I have learned to call “pathways” rather than “the pipeline.” The term pipeline works fine if you are a Research One institution serving particularly well-prepared students. It does not work at all if you are anybody else.

You need to use the concept of “pathway” in these other cases because there are so many varieties of experience. When I was at Portland State University almost a decade ago, we tried to map out those pathways. We found approximately 14 different basic patterns and within that, variations that led up to about 72 models by which students were acquiring the credits they needed for an undergraduate degree. Some students were co-enrolled at Portland State and a community college, some started at a community college and transferred, some started at Portland State and retrogressed to a community college and came back again, sometimes several times. Some students dropped out and returned, some completed an undergraduate degree and then went back to a community college for additional credentials and some went on to graduate study and then went back to a community college. We had an enormous range of pathways and we realized that our programs were simply not meeting the needs of the students.

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What else can we agree on? I think we can agree on the fact that a small proportion of the students who are prepared to study at an advanced level in science, technology, engineering and mathematics, actually go on to do so. Many of the reasons why they start and then continue in other fields has to do with both questions about the attractiveness of these fields as careers as well as how they experience with coursework and faculty. I think we may also be able to agree that we really do not know as much

as we need to about why people do choose careers in science, technology, engineering and math and the pathways they take to get there. And finally, I think I heard something that I have been focusing on a lot in recent months and that is that many of our expectations for what we need to do about all this are very much going to require transformational changes in our nation's educational institutions and their relationships to society. We do not know a whole lot about those underlying processes of institutional change, and in particular, for the purpose of this meeting, how federal policy, state policy and institutional policies can aid and abet in the process of making the kinds of changes we want.

What kinds of policies should the federal government as well as institutions consider? So that all of our citizens can acquire a high level of competency in science, technology and mathematics and so that we can ensure a diverse and capable workforce not only for the professorate but more broadly in these fields. The first thing I would like to mention is that we must model our policies on good evidence. My experience in several states and since coming to the Beltway is that most of our policies are based on one story, one anecdote, or one person who is upset about something. We have to base our choices on careful analysis, which is what I believe we have been trying to do here today.

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Secondly, we have to move beyond wishful thinking and toward genuine evidence that we gather from those we support. Whether it is at an institution level or at the federal level, what we ask for defines what we get. Finally, we need to take time to understand the realities of the context we are trying to influence. Most of us have particular experiences in research, often at Research One institutions and have been department chairs or deans or presidents or academic officers. As a result, our assumptions about how the world works, and thus what we include in our thinking, can be quite limited. We have got to look at unexamined assumptions and be willing to examine them.

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Which institutions are we focusing on? Who are our students really? How are they pursuing their education? What are their goals? How are they making their choices? What assumptions do we have about what we are looking for?

Lastly, I think what came out of our discussion today is that we need to think about the impact of our policies and the investment strategies of the federal government and institutions. What sets

these policies and investments in motion and both the intended and the unintended consequences of that. I want to talk about these intended and unintended consequences before I conclude. Consider how the federal government's behavior prolongs graduate study and the time spent as postdoctoral fellows, for example. As one illustration of unintended consequences, it appears quite likely that while trying to support research, what we are doing is supporting an elongation of a credentialing process, which is quite unnecessary.

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One suggestion that was made earlier on this issue is that we limit the number of years we support a student. Suddenly I saw the enormously confusing and complex set of documentation that would be required for that and I thought, no wonder we do not intervene at that level because we would have a great deal of difficulty establishing that person A was in continuous good standing as a student and should not be cut off and person B was not. What we ask for is what we get, as I said earlier, and we do not usually require the same level of documentation of institutional capacity to support our second merit criterion as we require for our first merit criterion. There is similar language used at other agencies. I will just use the ones I have learned here at the NSF because this second criterion is still fairly new in our repertoire. We do not ask tough questions about capacity to broaden participation or to integrate research and education in the same way we ask what research support will be provided to this investigator or group of investigators in the computing environment or information technology environment or technical support. This is something we have to learn to do.

What are we already doing differently to raise issues, revisit assumptions and insist on attention to certain important issues that might get us unstuck? Some of our special requirements for some of our programs are beginning to call attention to institutional capacity and our ability to support and sustain promising work. My favorite example, because it absorbs so much of my life, is our math-science partnership which now has quite rigorous discussions of the capacity of institutions to consider the changes that they would need to adopt in order to work in a K-20 partnership and supportive improvement of science and math in the schools.

Also consider what we talk about when we bring our principal investigators together, what we make them pay attention to, the kind of material we offer them and the questions we ask them. The composition of our review panels is increasingly diverse in a

number of ways as is the composition of our program officer staff and our leadership at the NSF. This is a major commitment of the senior leadership to diversify and strengthen our representation of the overall talent and interests of scientists, technology, engineering and math workforce in this country. The data we ask for and the questions we ask are changing because we have people with different perspectives.

The sense is that we really are making some significant progress. Bear in mind however, that the context of all this requires being extremely honest, learning to talk constructively about things that are very hard to talk about and taking seriously the contributions of people that we would not normally ask to participate in problem solving activity.

To model this, we have assembled a set of panelists, each of whom is going to talk about the gaps and unexamined issues that they heard today and what we can do at the policy level to move forward. Part of the question is, to what extent did our own behavior today illustrate why we have problems? Are we capable of looking at ourselves in that fashion and looking at our own experiences and the things we threw into the discussion? Are there some lessons here?

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<sup>59</sup> U.S. Department of Education. National Center for Education Statistics, <http://nces.ed.gov/>

<sup>60</sup> Educational On-line, Inc. Historically Black Colleges and Universities, [http://www.edonline.com/cq/hbcu/c\\_state.htm](http://www.edonline.com/cq/hbcu/c_state.htm)

<sup>61</sup> Department of Health and Human Services. Office of Minority Health. Tribal Colleges and Universities, <http://www.omhrc.gov/OMH/Tribal%20Colleges/>

<sup>62</sup> University of Southern California. Rossier School of Education, <http://www.usc.edu/dept/education/>



***Dr. Clifton Poodry**, Director, Division of Minority Opportunities in Research, National Institute of General Medical Sciences, National Institutes of Health, stressed the importance of defining success for initiatives. In doing so, Dr. Poodry believes that diversity among the definers, and inclusion of all stakeholders in the conversation is essential. One proposed suggestion is to provide mentors to minority students to equip them with the skills for communicating their vision and goals at the highest level.*



In the realm of policy, I would like to focus my attention on the large centers that the NSF and the NIH support, as well as the training grant activities and the institutional programs for training. Any consideration of these activities needs to start with a definition of success. In formulating that definition, we really must have an inclusive authorship. It cannot be left up to just the program directors to dictate what should be accomplished. On the other hand, the program directors cannot sit back and let the grantees dictate what the definition of success is nor should we just all sit back and let the National Science Board or our advisory councils tell us what the definition of success should be.

One of the reasons that I am quite focused on the definition at the outset of a program is that we are struggling with the evaluation of programs that have been going on for some time at the NIH, at the NSF and at other agencies. It is always difficult to evaluate after the fact when defining success has not been part of the planning up front. You rewrite history as you go along. I think that the definition of success of major centers is really important and it is paramount that we have an inclusive authorship because within the definition of success, diversity, inclusiveness and providing value for all Americans would certainly be part of the criteria.

Once we have a definition of success and we know what we are looking for, then we have to be sure that the data is collected. With regards to the data, we need to go about actually looking at it and doing an assessment of it. Unfortunately, we often start with the question of assessment, then we ask what the data is on which to assess, and then we examine the data to find that we cannot ask or answer the questions we want to. We basically do things backwards.

I am concerned with the progression of students through middle

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school, high school and college. Problems with this progress have led to us to not having competitively trained underrepresented minority students who will be able to challenge for faculty positions. Our programs have actually done fairly well at increasing the number of potential candidates. The numbers of Ph.D.s produced each year is substantial but if you ask how many Ph.D.s were produced in biology and chemistry in the 1990s and over that time, how many faculty were hired by major universities the University of California's entire system, to take one example, you will be distraught.

How can it be for all those Ph.D.s that so few are competitive? We have to face the challenge that we need competitively trained Ph.D.s and postdoctoral fellows of all ethnicities. For me, that would be part of the definition of success of major centers and training grants. I would want to know for the various training programs that we have, what are the products, how have they done, and is there any disparity in the outcomes between the various men, women and ethnic groups?

I would like to change my focus now to leadership training for high achieving minorities. I think that this is very important for people of all ages, whether they be precollege students, college students, graduate students, young faculty, old faculty, senior government administrators, whoever. One of the things that we examine when hiring new faculty is not just their research papers or their graduate work. When we are trying to make a judgment of what they are going to be and what they are going to do, one of the things that is often cited as a failing of women and minority candidates is that we did not see their vision. They tell us very well where they have been and give a terrific seminar of their work but their vision of what is important and how they are going to have an impact on the world is not apparent. How much does individual affect and presentation style influence whether interviewers see an applicant as highly skilled and having a vision?

Mannerisms and presentation style may influence how one is perceived. If any of you know molecular biologists, you will know that 40 percent of the time, a molecular biologist starts out a conversation with "so." It is just part of the way they talk. "So" is the first word that begins a seminar. Well, if you do not talk this way, you are not quite as warm and fuzzy and you are not quite as much like us. I think that affect is quite important in those subtle judgments that are made in faculty hiring and I think some of those behaviors are teachable and coachable.

I have always longed for a mentor but I have not had that kind of good fortune. I once had a really good supervisor. She not only told me what was positive, she also told me what some limitations were. Furthermore, that supervisor told me what qualified for an “excellent” evaluation, and she went further to articulate what I would need to do if I really wanted to be “outstanding.” That kind of honest direction is empowering, but in my experience is seldom given. Perhaps some of us can provide it for each other. Mentoring is not just a word that involves teachers and students.

Let me close with a hypothetical situation. If you gave me a bunch of money and asked me what I would do to foster diversity in the scientific workforce, I think that I would provide flexible funds to institutions that are above average in their sending minority students on. For every minority student who went on to get a Ph.D., I would provide a little grant to the institution that would be a pat on the back showing that they have done well and that they are supported in their mission. How much would that cost? Maybe \$10 million to \$20 million per year. It’s not a large sum but I think it would substantially encourage institutions’ efforts.

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*Dr. Willie Pearson, Jr., Chair, School of History, Technology and Society, Georgia Institute of Technology, challenged the audience and all Americans to get involved in the issue of diversity. He stressed that this is not a problem that has come about overnight and in order to solve it, all Americans and American institutions must make a concerted effort to open doors for minority students in the science and engineering workforce. Dr. Pearson expanded the panel's focus on the lack of diversity to include minority serving institutions as well as Research One institutions. Dr. Pearson's analysis highlighted the pervasiveness of this important issue and noted that its resolution necessitates the participation of all universities and all Americans.*



I will begin by discussing some of the deliberations of the Committee on Equal Opportunities in Science and Engineering,<sup>45</sup> CEOSE. CEOSE has been given very strong encouragement by Dr. Bordogna and Dr. Colwell to make policy recommendations and provide advice on a process for implementing the policies.

CEOSE has held several discussions regarding Dr. Wu's earlier comments about holding proposers accountable for accomplishing the goals of the two NSF evaluative criteria. The Committee has also focused on the issue of the representativeness of reviewers because program officers have considerable influence in the selection process. To date, CEOSE has recommended to NSF over 100 names of a diverse population of potential reviewers and panelists.

This brings me to my next point. I want to make it very clear that the sciences are inclusive of the social, behavioral and economic sciences. You have seen graphics of the percentages of underrepresented minorities receiving Ph.D.s in some sciences and engineering that hover around 2 percent. Do not assume that there is adequate minority representation in the social, behavioral, and economic sciences. While the overall representation of underrepresented minorities is higher in the social, behavioral and economic sciences than in other sciences and engineering, the level is far from being representative of the general or college-age populations. The fact of the matter is that there needs to be a greater production of degrees across all STEM disciplines for all underrepresented minority groups.

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Some of the previous speakers have mentioned the underrepresentation of women and underrepresented minorities on the faculties of Research I institutions. This remains a serious problem. However, some minority serving institutions are facing problems recruiting U.S. citizens to their science and engineering faculties. For example, some HBCUs have few U.S. born science and engineering faculty members. Let us not overlook the schools between the community college and the Research One university levels. There is a place in higher education for everyone in this country. There are institutions that meet the specific needs of various student populations and we should not minimize those institutions. The larger issue is how the nation can attract talented individuals to the professorate so that there will be a diverse faculty in every institutional category.

It is very clear that some minority serving institutions lack the fundamental funding to develop an infrastructure in science, mathematics, engineering and technology. Yet, some minority serving institutions are very productive in developing human resources for science and engineering. For example, Spelman College, with a population of fewer than 2000 students, consistently ranks among the top baccalaureate producers of African American Ph.D. scientists and engineers.

We have not heard much discussion about the budgets of federal programs for broadening participation. Some of these programs receive very small allocations; yet there are high expectations that they contribute to the production of large numbers of underrepresented talent. Look at some of the programs like Alliances for Graduate Education and the Professorate.<sup>63</sup> Given its funding levels, it is unreasonable for it to meet all of the challenges in increasing graduate degree production among underrepresented groups in science and engineering. There has been no discussion of funding levels for programs to broaden participation in STEM fields today. In some ways, the Education and Human Resources Directorate is expected to bear the responsibility for programs related to the talent development of women, minorities and persons with disabilities. What are the responsibilities of the research directorates? They also have a major role to play in talent development.

The other issue that I would like to discuss is historical in nature. We have much to learn concerning the incredible jobs that both minority and majority men and women have done in producing human resources in STEM fields. For example, in the 1930s and

1940s, a White male at McGill University produced at least three Ph. D. chemists of African American descent. There was some overlap among the three. What can be learned from this? While on the faculty of Morehouse College, chemist Henry McBay is credited with producing over 20 undergraduates students who earned Ph.D.s from some of the country's most distinguished universities. What can be learned from the legacy of Henry McBay? Undoubtedly, there are other highly productive mentors lost in history. Where is the recognition for them?

Another issue that we constantly hear about is what can be done? About 20 years ago, Alexander Astin's (1982) *Minorities in American Higher Education* listed flagship institutions with severe underrepresentation of racial/ethnic minorities among their undergraduate student bodies. Some institutions, embarrassed by their ranking, implemented recruiting programs to begin to rectify the situation. At the time of the book's publication, some states with very large populations of Mexican Americans or African Americans had few among the undergraduate students at their flagship universities. Now, we are beginning to hear anecdotes about young underrepresented men and women doctoral graduates of some the most selective research institutions completing their degree with no predoctoral publications or access to significant postdoctoral fellowships. If true, how do we explain this? Some scholars refer to this situation as a "bare bones degree"—where students have the pedigree but lack critical pre-professional experiences. This can have a tremendously deleterious career impact.

Another issue that we have not discussed is tenure denials. We have talked about the hiring process, but what about people who actually get hired but do not make it through the tenure process? In a study conducted several years ago, my colleagues and I found that when some of the minority and women students witnessed their young minority and women professors experiencing difficulty with tenure, many responded that if their professors had no chance of getting tenure, then neither did they. Consequently, many did not plan to pursue academic careers.

Another challenge we have in this country, particularly those of us who are concerned about assessment, is the availability of data disaggregated by race, gender and ethnicity. This is a very serious problem. If one cannot get access to the appropriate data then how can one ascertain whether there is progress? If data are disaggregated, then we are able to have better informed policies and therefore, better practices.

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Finally, I believe that the NSF and the NIH alone are unable to solve the challenge of a diverse scientific and technical workforce. Solving this problem is going to take the effort of the private and public sectors, and the commitment of citizens. It is not a simple problem, nor did it develop overnight. This country has demonstrated that it has the will to solve very difficult problems. The challenge is to move beyond talk to actually making things happen.

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<sup>63</sup> National Science Foundation. Alliances for Graduate Education and the Professoriate, <http://www.ehr.nsf.gov/hrd/agep.asp>

## DISCUSSION

*The brief discussion consisted of two points made by a panel member. We must recognize and minimize the elitism within science and also minimize the media portrayal of science to foster supportive environments for young scientists. By offering encouragement we can bring new students into the science and engineering field.*

### ***Dr. George Langford***

I would like to bring up two issues that I believe that we need to confront. One is that we have a certain level of elitism in operation in many of the scientific communities. We have to figure out in addition to the pedigree problem, how we deal with this issue of who can come in and who is expected to achieve what. This is what we need in order to enjoy a healthy and wholesome environment to do science in. The other issue is that perhaps the National Science Foundation, the National Institutes of Health and others can find a way to work with the media to dispel or to minimize some of the discouraging language that our young minorities and all students hear every day about careers in science and engineering. I think that would do a tremendous thing to uplift young people to want to pull each other up and to network and move ahead.

