2006-157: POLITICAL CONSIDERATIONS FOR FEDERAL FUNDING OF ENGINEERING EDUCATION RESEARCH

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Abstract

Among the principal goals of the National Academy of Engineering's Center for the Advancement of Scholarship on Engineering Education (CASEE) is to promote research on the teaching and learning of engineering among university engineering faculty. Critical to this goal is the availability of a consistent funding source to support those who aspire to conduct engineering education research. This paper attempts to examine the current situation in the U.S. Congress with regards to science, technology, engineering and mathematics (STEM) education reform in general and engineering education research funding in particular. In an examination of current federal funding levels, it is apparent that education research accounts for a small and dwindling portion of the total education expenditure, insufficient for consistent innovation in the teaching of science and engineering. However, this adverse fiscal environment is countered by a growing sense among many members of Congress that the current education system is not producing scientists and engineers in the quantity and quality required to maintain the economic competitiveness and defense capability of the country. Therefore a window may exist to demonstrate that education research may be a means to understand better this country's higher education system and to modify its outputs. Based in large part upon interviews with congressional staff, this paper identifies loci of support among members of Congress, as well as engineering education research funding objectives. The issue of engineering education research has advantages and disadvantages that affect its political viability and which must be considered when undertaking any effort to secure increased funding. The paper provides suggestions on how the academic community can promote funding for engineering education research in the Congress.

Introduction

As with any other field of research, an engineering education researcher possessing only proper training and a strong desire to conduct research is unlikely to make much progress without also having a consistent funding source. Thus, a pool of federal funding becomes a critical element in the pursuit of engineering education research.

This paper seeks to explore the prospects for congressional support of engineering education research funding. The information presented is based in large part on interviews with congressional staff, as well as representatives of several education organizations. The paper begins by briefly examining the current state of funding, focusing mainly on the National Science Foundation (NSF) and the U.S. Department of Education. The current political situation, in terms of support within the Congress, is assessed, and congressional committees and organizations of interest are identified. The final section recommends methods for promoting support for education research among members of Congress. This includes defining appropriate funding and legislative objectives, as well as considerations to be made when encouraging members of Congress to support engineering education research issues.

Many of the specifics of this paper, such as budget numbers and committee assignments, have short "shelf life," and require frequent updates. However, these specifics, in themselves, are not of particular importance. Rather, the model offered of the influences on education research funding should prove useful to those who hope to undertake an effort to build support for their issue of interest, be it engineering education research or otherwise.

Current Federal Funding for Education Research

Research on education in the United States is funded primarily by two federal agencies and two private foundations. The U.S. Department of Education and the National Science Foundation are the primary federal supporters. Though there are several private supporters, the major ones are The Spencer Foundation, with total giving of $15.07 million in fiscal year 2005[1], and The Bill & Melinda Gates Foundation, which contributed an unspecified amount of its "Policy, Research and Evaluation" giving towards education research. Though federal funding far outpaces that from private sources, education research represents a small portion of the total federal education expenditure. In fiscal year 2006, research, development and dissemination accounted for just over two-tenths of one percent (0.2%) of the $88.9 billion budget of the U.S. Department of Education[2]. The National Science Foundation has the largest non-formula driven budget of funding sources. The NSF's Directorate for Education and Human Resources funded $48.06 million in education research in fiscal year 2006 through the Research and Evaluation on Education in Science and Engineering (REESE) program[3]. This funding accounts for 6 percent of the budget for the EHR Directorate. This amount has declined for the last several years, and the Fiscal Year 2007 Budget Request proposes that it continue to decline in fiscal year 2007. Small amounts of education research funding were made available as part of the STEM Talent Expansion Program (STEP); though no education research grants are expected to be awarded in fiscal year 2006, 1 to 3 grants of up to $500,000 each are expected to be granted in fiscal year 2007. The NSF also funded three Science of Learning Centers at a level of $22.7 million in fiscal year 2006.

For postsecondary education research in particular, funding is even more lacking. There is almost universal emphasis on examining issues most prominent in K-12 education. This emphasis is appropriate, given that learning at the K-12 levels provides the foundation for later learning. However, given that almost 70% of high school graduates continue on for postsecondary education, it is clear that college-level education research cannot be ignored.

Plans for a Transforming Engineering Education program, to be focused on engineering education research, were proposed in the fiscal year 2006 budget request but were never implemented. Plans for this program appear to have been abandoned in the fiscal year 2007 budget request. Instead, an unspecified amount of the $44.1 million of the Engineering Education and Centers (EEC) budget devoted to "engineering education and workforce development programs" will be made available for education research.

The overall picture of federal support for engineering education research is one of an already spare and still dwindling source of funds that will be unable to sustain a robust research community in engineering education.

Political Climate for STEM Education

There is a general sense among members of Congress that there are issues that need to be addressed in our nation's STEM education system. This sense has been growing in urgency in the recent months. However, for many members who don't have a particular focus on this issue, their interest may not extend beyond the vague notion that "something needs to be done." Most legislative initiatives have focused on the expansion of current programs addressing science and engineering competitiveness, rather than an exploration of new policy options.

Poor performance in educating science, technology, engineering, and mathematics (STEM) professionals is typically viewed as a problem on two fronts. First, a decreasing number of U.S. citizens with science and engineering degrees reduces the "clearable" workforce able to work in areas related to national defense, intelligence, and homeland security. Second, the deficit in science and engineering graduates when compared with other countries (China in particular), coupled with a decreasing number of international students choosing to pursue advanced degrees in the US due to recent visa restrictions, will hamper the United States' future economic competitiveness. Senators or Representatives may emphasize one or the other of these challenges, depending on their broader policy interests. It will be important to consider this emphasis when approaching a member of Congress on a specific program. Postsecondary education is not, by and large, a top legislative priority right now, so putting engineering education research in the context of one of these higher-profile issues may be critical to building support. This means that engineering education research must be framed as a form of "use-directed" research if it is to find strong congressional support.

As an aside, it is worth briefly examining the case supporting the concern over the United States competitiveness with countries such as India and China in terms of the engineering workforce. Frequently cited statistics include that for the United States' yearly production of approximately 70,000 engineers, India produces 350,000 and China produces 600,000[4]. Statistics such as these, comparing both number and percentage of students graduating with science and engineering degrees, cause valid concern among policymakers. This concern is not unanimous, however, as some authors, such as a group of Duke University researchers, have called such statistics into question[5]. The debate over such statistics may make it important to emphasize the importance of improving the quality of engineering education, rather than solely focusing on increasing the quantity of graduates.

Currently, education reform discussions largely focus on No Child Left Behind activities, and there is a correlated emphasis on K-12 education, rather than postsecondary education. Most efforts at addressing postsecondary STEM education issues are predicated on increasing access and are focused on addressing the financial challenges of students enrolled in STEM majors. These initiatives are usually variations of loan forgiveness (Math and Science Incentive Act) and grants/scholarships (DoD SMART Scholarship, Pell Grant Plus Act). However, as noted by an October 2005 Government Accountability Office (GAO) report, it is unclear how effective these types of programs have been. According to the report, "little is known about how well federal resources have been used in the past," and that, "in an era of limited financial resources and growing federal deficits, information about the effectiveness of these programs can help guide policy makers and program managers."[6]

STEM education discussions have had an increased prominence since the recent release of the National Academies' report, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*[7]. Its slate of high profile committee members (such as Norman Augustine, retired chairman and CEO of the Lockheed Martin Corporation, and Charles Vest, president emeritus of MIT) and action-oriented recommendations have helped garner significant publicity. Many members of Congress have been quick to embrace its recommendations, and several proposals and pieces of legislation have been introduced in the wake of the report. These include bills by Rep. Bart Gordon (D-TN) to establish an Advanced Research Projects Agency-Energy (ARPA-E) and authorize funds for science scholarships to educate mathematics and science teachers. The National Innovation Act, introduced by Senators John Ensign (R-NV) and Joseph Lieberman (D-CT), has several STEM education-related provisions, including increasing funding for existing STEM scholarship and research fellowship programs. The most significant legislation, however, is the three bills introduced in the Senate collectively referred to as the Protecting America's Competitive Edge (PACE) Act. The three bills propose initiatives related to finance, energy, and education, and would implement all twenty recommendations of the *Gathering Storm* report. Support for the PACE Act was bolstered significantly by the President's introduction of the complementary American Competitiveness Initiative (ACI) during his January 2006 State of the Union Address.

Though the *Gathering Storm* report has done much to spotlight STEM education issues, it has brought little interest to education research in particular. The report's education recommendations are mostly in line with the priorities mentioned above; the highest-priority recommendation is to address K-12 science and mathematics education, and higher education recommendations focus on undergraduate scholarships and graduate fellowships for STEM students, as well as visa reform for international students. While these recommendations are laudable and their implementation would constitute a great improvement to the United States' science and engineering enterprise, the report, and subsequent policy discussions, does not tackle the questions that engineering education research seeks to address, in terms of understanding all relevant aspects of systems of engineering education and, based on that understanding, modifying system parameters to increase the quantity and quality of engineering graduates.

The concept of engineering education research, which seeks to understand and correct structural deficiencies in our systems for teaching and learning, is largely unknown to most members of Congress, so a key component to generating support for engineering education research funding is informing the members as well as their staffs. The degree to which this is a challenge will vary member-to-member. Some members may be very engaged on STEM education issues and actively looking for solutions, while others have only a vague understanding of the issue and may need convincing that STEM education reform should be a legislative priority (and once convinced of this point, further convinced that engineering education research is a path to STEM education reform). A member of Congress's position can be viewed as being in one of several stages:

1. Unaware of, or unclear on, issues regarding engineering (or STEM, generally) education reform.
2. Interested in reforming engineering education, and examining possible solutions.
3. Interested in funding engineering education research as part of the solution.

Finding out where a member of Congress fits in on these stages is important, so that the content of meetings with that member or their staff can be focused on information that may move them along to the successive stage.

Relevant Committees and Members of Congress

It will be important, when advocating on behalf of engineering education issues, to locate the key committees and members with influence over relevant legislation, as well as existing support within the Congress. This section examines key members who have shown interest in STEM education and related issues. First, authorizing committees are discussed, followed by appropriations committees, and there is a concluding mention of the STEM Education Caucus. A chart of relevant committees and their current leadership can be seen in Figure 1. As noted previously, this information changes frequently and needs to be consistently monitored. Information can be found largely through the House of Representatives and Senate webpages; committee and subcommittee pages are the most central place to find information on their members, leadership, jurisdiction, and pending legislation.

HOUSE OF REPRESENTATIVES

Appropriations Committee

Subcommittee on Labor, Health and Human Services, Education, and Related Agencies

C: Ralph Regula (OH) RM: David Obey (WI)

Subcommittee on Science, the Departments of State, Justice and Commerce and Related Agencies

C: Frank Wolf (VA) RM: Allan Mollohan (WV)

Committee on Education and the Workforce

C: Buck McKeon (CA) RM: George Miller (CA)

Subcommittee on 21st Century Competitiveness

C: Buck McKeon (CA) RM: Dale Kildee (MI)

Subcommittee on Select Education

C: Patrick Tiberi (OH) RM: Rubén Hinojosa (TX)

Committee on Science

C: Sherwood Boehlert (NY) RM: Bart Gordon (TN)

Subcommittee on Research

C: Bob Inglis (SC) RM: Darlene Hooley (OR)

SENATE

Appropriations Committee

Subcommittee on Labor, Health and Human Services, Education, and Related Agencies

C: Arlen Specter (PA) RM: Tom Harkin (IA)

Subcommittee on Commerce, Justice and Science

C: Richard Shelby (AL) RM: Barbara Mikulski (MD)

Committee on Commerce, Science, and Transportation

C: Ted Stevens (AK) RM: Daniel Inouye (HI)

Subcommittee on Technology, Innovation, and Competitiveness

C: John Ensign (NV) RM: John Kerry (MA)

Committee on Health, Education, Labor, and Pensions

C: Michael Enzi (WY) RM: Edward Kennedy (MA)

Subcommittee on Education and Early Childhood Development

C: Lamar Alexander (TN) RM: Christopher Dodd (CT)

Figure 1: Relevant Committees and Leadership (Chairs and Ranking Members)

In the House, the Education & the Workforce Committee has jurisdiction over the Higher Education Act, as well as educational research and improvement. The House Science Committee has jurisdiction over science agencies, including the National Science Foundation.

There are several Representatives who have traditionally been champions of STEM education issues, and may be receptive to legislation that includes engineering education research. Among them is Sherwood Boehlert (R-NY), chair of the Science Committee, who has been a staunch supporter of the NSF and quoted as saying that, "education, in general, and science and math education, in particular, is the single most important issue before the nation today."[8] Other advocates for STEM education on the Science Committee include Bart Gordon (D-TN), Ranking Member, Vernon Ehlers (R-MI), Bob Inglis (R-SC), Chairman of Science Subcommittee on Research, and Mark Udall (D-CO). Representatives Ehlers and Inglis are also on the Education & the Workforce Committee, along with Ron Kind (D-WI), and Rush Holt (D-NJ), all supporters of STEM education initiatives.

On the Senate side, the authorizations committees have become very active of late due to the introduction of the PACE Act. The subcommittees that have jurisdiction over relevant legislation are the Commerce, Science and Transportation Subcommittee on Technology, Innovation and Competitiveness, as well as the Health, Education, Labor and Pensions Subcommittee on Education and Early Childhood Development. The Commerce, Science and Transportation Committee has jurisdiction over science, engineering, and technology research, development and policy. In the 108th and first session of the 109th Congresses, there was little activity on STEM education legislation. The Health, Education, Labor, and Pensions Committee had held several hearings in the past two years on workforce readiness and Higher Education Act issues, and several pieces of STEM education-related legislation were referred to the committee, but no significant action had been taken. However, in the second session of the 109th Congress, a variety of hearings have been held on aspects of the PACE Act, as well as the President's Fiscal Year 2007 Budget Request as it relates to the American Competitiveness Initiative.

Several Senators in these committees have championed STEM education initiatives. Jay Rockefeller (D-WV) has been focused in recent years largely on K-12 education issues, but he successfully sponsored the Math and Science Partnership (MSP) Act in 2001 and secured $160 million in funding for the program in the NSF. Senator Pete Domenici (R-NM), Chair of the Senate Committee on Energy and Natural Resources, is the sponsor of the PACE Act, which he introduced along with Senators Alexander, Bingaman and Mikulski of the Health, Education, Labor and Pensions Committee.

Several Senators outside the above-mentioned committees have sponsored STEM education legislation. John Warner (R-VA), Chair of the Armed Services Committee, has sponsored the Math and Science Incentive Act, and the 21st Century Pell Grant Plus Act, both of which are currently pending in the Health, Education, Labor, and Pensions Committee. Joseph Lieberman (D-CT) sponsored the Technology Talent Act in 2001, which included postsecondary STEM education research funding as part of its "Type 2" grants. As mentioned previously, members of Congress often associate STEM education with a larger issue. In this case Warner is interested in STEM education as a means of ensuring national security, while Lieberman is generally more concerned with issues relating to outsourcing of jobs and economic competitiveness.

Of course, any attempt to fund a program is useless without support on the Appropriations Committee. In the House, the Appropriations Subcommittee on Science, the Departments of State, Justice, and Commerce and Related Agencies has control over the NSF budget. The corollary in the Senate is the Commerce, Justice, and Science Appropriations Subcommittee. The second relevant subcommittee in both the House and Senate is the Labor, Health and Human Services, Education, and Related Agencies Appropriations Subcommittee, which has jurisdiction over the Department of Education.

The leadership of the House Appropriations Subcommittee on Science, the Departments of State, Justice, and Commerce are advocates of STEM education issues. Chairman Frank Wolf (R-VA) is a sponsor, along with Representatives Boehlert and Ehlers, of the Math and Science Incentive Act of 2005. John Culberson (R-TX), is Assistant Majority Whip, in addition to being a member of the Appropriations Subcommittee on Science, the Departments of State, Justice, and Commerce. He has been an advocate for an increased NSF budget, referring to science and technology spending as a "national insurance policy." In addition, Culberson has said he would work to restore Education and Human Resources funding[9]. Ranking Member Alan Mollohan (D-WV) has been a supporter of the NSF, along with Rep. James Walsh (R-NY), member of the Labor, HHS and Education Subcommittee.

In the Commerce, Justice, and Science Subcommittee on the Senate side, Ranking Member Barbara Mikulski (D-MD) and Christopher Bond (R-MO) have advocated doubling the NSF budget in the past. Richard Durbin (D-IL) in the Labor, HHS and Education Subcommittee has been engaged on STEM education issues as well in his role as co-chair of the STEM Education Caucus.

A group that may be relevant to engineering education research is the STEM Education Caucus. A House Caucus was launched in the summer of 2004, and currently has over 90 members[10]. It is co-chaired by Vernon Ehlers (R-MI) and Mark Udall (D-CO). A Senate STEM Education Caucus was launched more recently, in February 2005, and currently has approximately 15 members. It is co-chaired by Norm Coleman (R-MN) and Richard Durbin (D-IL). Both Caucuses aim to inform the members of Congress and their staff on a variety of issues related to STEM education. The Caucuses do not sponsor specific legislation, in order to promote broader bi-partisan involvement. However, their education efforts do tend to center around legislation that is currently pending. Thus, postsecondary engineering education issues may only be a focus of the Caucus if there is legislation under consideration that addresses this issue. Both Caucuses are relatively new, and it remains to be seen to what extent they are active and/or effective. The House and Senate STEM Education Caucus has a steering committee which serves as a channel for communication between the Congress and the scientific, education and business communities. The best opportunity to interact with the Caucus is likely through the members of the steering committee, most of who are drawn from industry, academia and professional societies.

Building Support for Engineering Education Research

At an October 2005 National Science Board hearing on the creation of a Commission on 21st Century Education in Science, Mathematics and Technology, several Representatives lamented the lack of engagement of the scientific community in public policy matters. In his remarks, Rep. John Culberson (R-TX) placed an emphasis on the need for the scientific community to become more involved. As an example, he mentioned the recent fight to restore the NSF budget cuts proposed in the President's FY 2006 budget request. Culberson's office didn't receive any letters, visits, etc. from interested scientists and engineers. Those policymakers with an interest in the NSF, science and engineering, or any related issue will not likely build much momentum for a cause if they are not supported by a constituency from the science and engineering community.

The process of generating support for engineering education research can be viewed in three general stages. The first is determining a specific goal; how much funding is being requested, and for what program. The second step is to determine an appropriate legislative avenue for that funding. Finally, the appropriate members of Congress must be convinced of this legislation's importance.

Though the general goal of informing the Congress on the importance of engineering education research is a worthy one, it is imperative that there is also a specific funding goal to focus on as well. As the description of the current federal funding situation suggests, this goal most likely will be funding for a NSF or Department of Education program.

The NSF represents the most favorable location for engineering education research funds. Its competitive grant award process is most conducive to producing the highest quality research, maximizing the return on federally appropriated funds. In addition, current education programs, however modest, represent a nucleus of funding that can be expanded upon.

In the Education and Human Resources Directorate (EHR), the Research and Evaluation on Education in Science and Engineering (REESE) program represents the best opportunity for locating funds devoted to engineering education research. However, there are several concerns in seeking money for programs in EHR. There is a possibility of political resistance to favoring one discipline (engineering) over others for funding in EHR. This would possibly argue for either looking for funding broadly directed at education research across all disciplines, or for seeking funding in another directorate, such as the Engineering Directorate (ENG). Another concern is if the current trend of declining funding for EHR continues, and it seems that there is little political support to reverse it. Among certain quarters in Congress, there seems to be more emphasis on the other directorates, who, in their opinion, are doing "real research" in science and technology. It will be important to monitor the stature of EHR among the Congress, even among nominal supporters of the NSF.

However, prospects for engineering education research within ENG are uncertain at best. Plans to create a Transforming Engineering Education (TEE) program, first proposed in the fiscal year 2006 budget request, have been abandoned in the fiscal year 2007 request. Funds available for unsolicited education grants have increased in ENG, but none of that is explicitly devoted to education research. In view of these circumstances, EHR appears to be the more viable alternative for securing funding for education research, at least in the near term.

Equal in importance to determining where funding is needed is determining how it will get there. As mentioned before, engineering education research is a narrow issue that is not on the mind of most legislators. Any attempt at gaining support for a single-issue bill would be most likely be unsuccessful. Education research must be cast as part of the solution to a larger problem, so a place can be found for it on an appropriate bill.

The most typical vehicles for an engineering education funding would be as part of an NSF Authorization Act, such as the STEM Talent Expansion Program (STEP), or as an amendment to the Higher Education Act. However, success on either of these fronts is only half the battle; an appropriation must also be secured.

It is important when choosing the legislative vehicle to consider the support or resistance such legislation may have in the relevant committees. That is, if there is support in the Science Committee for engineering education research, an NSF authorization may be the best course of action. But if a leader in the Education and the Workforce Committee is looking at education research issues, then it may be advisable to push look at the Higher Education Act.

If the goal is increased funding for an existing NSF program, as mentioned in the previous section, the most direct means of securing more funding is through the Appropriations Committees. However, more direct is not necessarily easier, so support among key appropriators must be evaluated.

Most members of Congress (especially those likely to be targeted for support of increased engineering education research funding) recognize a problem generally in STEM education. However, it may be a leap for them to accept that engineering education research should not only be part of the solution, but is an issue worth their support.

The best, most effective case that can be made to a member of Congress is to show them the impact in their home state or district; in the fabled words of former Speaker Tip O'Neill, "all politics is local." It is important to make a specific, *quantitative* case for the importance of this issue to a given member's constituency, whether it's falling numbers of engineering graduates at a local university, or an increasing need for technically-trained employees in an area industry.

Advocacy Coalitions

Lawmakers are more willing to support an initiative with a broad backing, so one possible way to demonstrate the importance and potential impact of an issue, especially one as specific as engineering education research, is to assemble a coalition to support an advocacy effort. The coalition would be made up of groups, organizations, companies and individuals with an interest in the issue. In the case of engineering education research funding, a possible strategy is to form a broader coalition of STEM education research groups. Embedding engineering education research in a larger coalition provides the opportunity to demonstrate to lawmakers the broad appeal of education research across STEM disciplines, affecting every field dealt with by an agency such as the NSF. Caution must be taken in defining the parameters of a coalition such that it is broad enough to generate support, yet specific enough so as not to dilute its goals to the point that the interests of its members are no longer being served.

The role of an organization in such a coalition would be determined by its resources, capabilities and limitations. The organization would be expected to have input on both the legislative goals of the coalition, as well as the strategy for achieving them. The organization would contribute to the overall effort based on its specific abilities, such as its advocacy capabilities, available staff time, and contacts and connections within its field. Certain members of the advocacy coalition would need to be designated to coordinate the effort, as well as supply up-to-date information on budgets, legislation, etc. to the coalition participants.

When petitioning a specific lawmaker, assembling a group of academics and industry leaders from a member of Congress's constituency is an effective way to make this case. The following provides two examples of members, one Senator and one Representative, who have jurisdiction over NSF appropriations. They have not been strong proponents of the NSF or STEM education issues. In these examples, the Congressmen hold positions of leadership in Appropriations Subcommittees, but their natural loyalties lean towards NASA, rather than the NSF. These agencies can be in competition, given that they both fall under the jurisdiction of the same Appropriations Subcommittee. Organizations are mentioned below from which candidates may be drawn from academia and industry to speak with each member of Congress, as examples for the type of group that may be assembled.

Senator Richard Shelby (R-AL) is the chairman of the Commerce, Justice, and Science (CJS) Appropriations Subcommittee. Huntsville's Marshall Space Flight Center gives him a considerable interest in NASA funding, so efforts may be necessary to educate him and his staff on some NSF funding issues. The strongest candidates for this task would come from within the state of Alabama, including representatives of the academic, federal facility, and industrial communities. Besides the NASA facility, Huntsville is also home to many high tech employers in the Cummings Research Park. In addition to a campus of the University of Alabama, the regional headquarters for SAIC and Boeing, which each employ over 3000 people, are located in Huntsville. Auburn University may also have faculty interested in engineering education research.

Representative Dave Weldon (R-FL) is a member of the Labor, Heath & Human Services, and Education Appropriations Subcommittee, as well as the vice-chairman of the Science, State, Justice, and Commerce Appropriations Subcommittee. Having NASA's Kennedy Space Center in his district gives Rep. Weldon a strong interest in NASA appropriations, but there are constituencies in his district that may have an interest in engineering education research funding though NSF. Florida's 15th district is part of the Florida High Tech Corridor (FHTC), which is home to over 5000 technology companies, including Boeing, Lockheed Martin, Northrup Grumman, and the headquarters of the Harris Corporation. Florida's 15th district has the nation's fifth largest high-tech workforce, and is also home to the Florida Institute of Technology, which has shown an interest in innovative engineering education methods.

These two examples show that though a member of Congress may have vested interest in a particular area, it may be possible to find a constituency that would be willing to advocate on behalf of engineering education research. Emphasis on providing information on engineering education research, and showing how it coincides, rather than competes, with the interests of the member and their constituency is imperative.

The Conduct of Meetings with Congressional Members

There are several items to keep in mind when setting up and conducting a meeting with a member of Congress (or one of their staff). It is important to be specific in what action is being requested during a meeting with a member or their staff. For example, have a specific piece of legislation or amendment that should be discussed or looked into by a staff member. Another example of potential action would be to request that the member join the STEM Education Caucus. Bringing a broad issue to a member's attention is not sufficient if future action is expected. There needs to be a specific course of action for them or their staff to follow up on.

It is also of benefit to provide some sort of background materials or introduction to the issue of interest in advance of the meeting. These materials shouldn't be more than a couple of pages in length and should summarize the topics you hope to discuss.

Consistent contact with a member of Congress is also important. In order to increase the opportunity for ongoing support of your issue, it is imperative that the individual advocating for an issue "checks in" periodically. Otherwise, the issue, especially one as specific as engineering education research, will get lost in the swarm of other matters confronting a policymaker and their staff. In the case of a university researcher, it is helpful to become a resource for the member and their staff on a specific issue. An invitation to the member to visit the university while in their home district will help drive home the importance of the funding that the researcher receives.

Political Considerations in Engineering Education Research

When "selling" engineering education research, it is important to keep both its political advantages as well as disadvantages in mind. On the positive side, education research is a relatively cheap and cost-effective method to go about education reform. The monetary size of the programs is small compared to most, on the order of tens of millions of dollars. By comparison, the Pell Grants Plus program or the Math and Science Incentive Act (providing student loan interest forgiveness) could cost orders of magnitude more. Ideally, a small investment in engineering education research would be aimed at eventually improving the educational experience of engineering students across the university system, while grants and incentives have a far more localized effect by giving aid to one student at a time. Another selling point for engineering education research is that it is *different*. Most members of Congress have not looked at education research, and this may possibly prove, in part, an asset. It is a novel solution at a time when most members have identified a problem, but are still exploring policy options.

There are aspects of education research that are politically unattractive. Most notable is the inability to easily quantify a "payoff." With a grant or loan incentive, it can be easily calculated that a given amount of money was appropriated, and distributed to a certain number of students graduating with STEM degrees, for example. Though it may be argued that some of these students may have earned their degrees regardless of this assistance, the fact remains that a direct (if simplified) model of cause-and-effect can be developed. No such obvious equation exists for education research, so this fact needs to be taken into consideration when making a case for funding.

Despite the difficulty, numerical analysis of the inputs and outputs of an education research program should still be attempted. Case studies may be one way of countering this problem. Rather than looking at the macro view, look at the input and output on a smaller scale. Take one example program, and show that its use of methods based on education research have improved a given situation (increased enrollment, decreased attrition, etc.) The objective is to show that a minimal research investment can produce methods that, when properly disseminated, could have a significant and widespread effect on engineering education. Solid case study data is considered very persuasive by many policymakers, and would be an effective tool when making the case for education research.

Summary & Conclusions

Currently, federal funding levels are not sufficient to support the kind of ongoing engineering education research necessary to create continuous innovation in the way engineering is taught. Though many members of Congress would agree that American interests are not adequately served by the current postsecondary STEM education system, this concern is only beginning to be translated into action.

Despite this lack of political momentum, a general interest in STEM education issues and a search for solutions among policymakers may be a sufficient opening to raise the profile of engineering education research. An important component in accomplishing this is the contact between engineering educators and their members of Congress.

Building support is best done by not only identifying the key congressional players, but also determining where existing support lies. The challenges to getting funding for engineering education research are many; it is best to capitalize on current centers of support. Champions of STEM education causes will be the most likely to be receptive to engineering education research. The advocacy efforts should center on these individuals.

The NSF represents the most advantageous location for engineering education research funding. Its structure is conducive to supporting a high-quality array of research projects, and has an existing nucleus of funding for education research that can be expanded upon. The REESE program in the Education and Human Resources Directorate is the most likely candidate for increased funding because it is the only program with and explicit and extensive commitment to education research.

Whether you're working as an individual or as part of a group (e.g., through your professional society), meeting with members of Congress or their staffs is the best way to focus them on an issue that may otherwise be lost in the legislative fog. When making the case for engineering education research funding, specificity and consistency are the keys. Describe why the issue of engineering education reform is important to a member's home state or district. Show how this funding is an effective and efficient solution to the problem, and how this has been demonstrated by past results. Give the member or their staff specific actionable tasks to follow up with, provided they are interested in pursuing the issue farther. Finally, do not make the first meeting the last; it is important to maintain contact every several months, if for no other reason than to keep attention on the issue.

No matter how willing the researcher, the work will only get done with a steady source of funding. Though largely foreign to those in academia, effective and responsive policy on issues such as engineering education research requires them to become informed and engaged politically.

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