

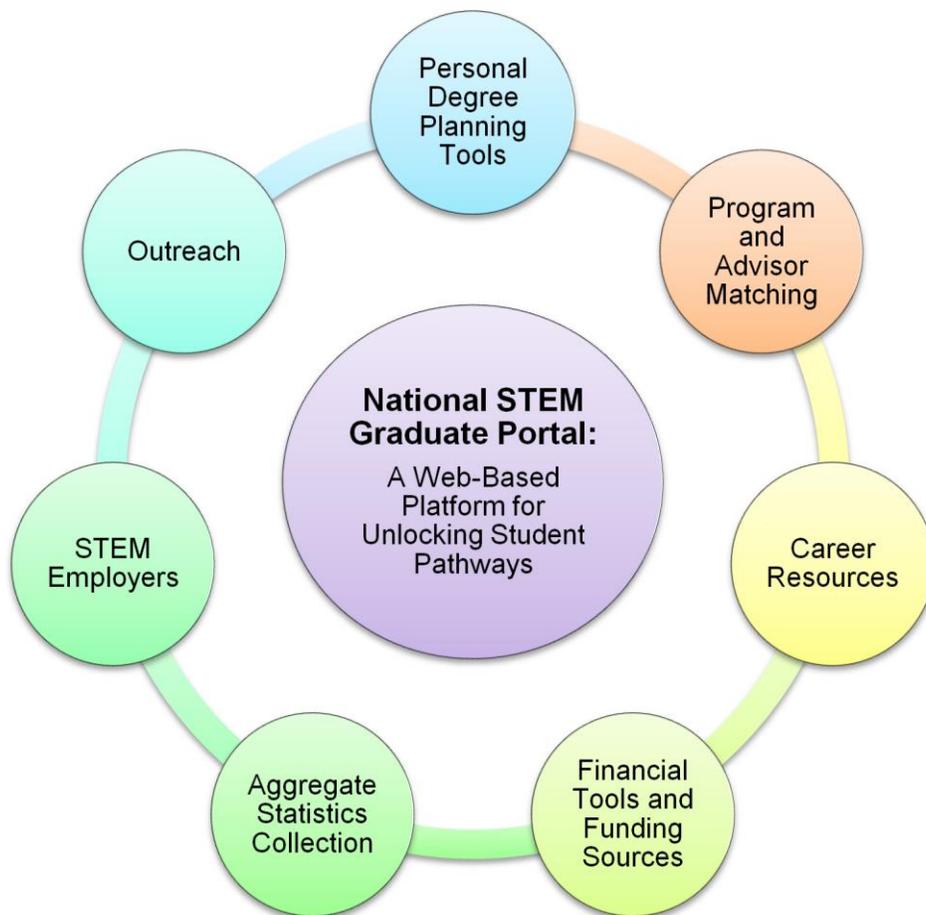
# **Opening the Doors of STEM Graduate Education: A Collaborative, Web-Based Approach to Unlocking Student Pathways**

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As a key scientific advisor to President Franklin Roosevelt, Dr. Vannevar Bush emphasized national coordination of basic scientific research needs among government, universities, and industry [1]: “Science can be effective in the national welfare only as a member of a team, whether the conditions be peace or war.” Following the establishment of the National Science Foundation and the first national science policy, the federal government continues to serve a primary role in the funding of academic research in science, technology, engineering, and mathematics (STEM) and the associated training of graduate research assistants who largely perform this research before entering the workforce. Thus, graduate education is justified as a public good and a strategic national asset. Since adopting the early nineteenth century model of graduate education introduced in Germany [2], there have been lauded efforts to increase the supply of this good through combined B.S./M.S. programs that shorten the total time to an advanced degree; but while the traditional apprenticeship model continues to emphasize technical specialization, employers in the evolving knowledge-based economy have indicated that a broader range of skills is desired in advanced degree holders to spur commercial innovation. This disconnect between academic institutions and employers has been recognized for decades as a key focus for improving the outcomes of graduate education [3], yet the fact that recent commissioned reports [4, 5] continue to identify the same issue highlights the level of inertia present in the graduate system. One can point to the large degree of compartmentalization as a source of inertia: individual academic departments, each with their own unique compositions and resources, continue to serve as the basic unit of administration for their graduates. Due to this patchwork nature, it becomes difficult to enact a coordinated response to the shortage of qualified advanced STEM degree holders in the United States. The revolving door of graduate education must be replaced with open pathways charted by students who are supported with clear access to information on graduate school and careers; a common medium

which brings together students, faculty, academic departments, industry, and government in support of this end is a crucial link that will optimize the outcomes of graduate education.

A low-cost, high-impact tool with national scope is proposed to facilitate coordination among these stakeholders by establishing a web-based gateway to the STEM graduate system that will function as an educational “passport” for graduate students – helping them plan their degree journeys while benefiting from the assistance of a broad support network. The logistics of operating such a system would be similar to the social media platforms pervading society today, such as Facebook, Google+, and LinkedIn. However, the portal would be tailored to the STEM graduate community and comprise several dimensions: a searchable database for advisor matching, personal degree management tools, access to career resources from employers, networking and job search functions with the cooperation of STEM employers, and a forum for sharing their work with a public audience. These dimensions are illustrated in Figure 1.



**Figure 1: Dimensions of the proposed web-based STEM graduate portal.**

Students, faculty, departments, companies, and government entities would manage their presence on the dedicated system by creating customizable profiles. As a national asset, establishment and operation of the online graduate portal should have national oversight; the National Science Foundation would be a natural fit through its charter.

Such a platform does not currently exist, and available means of accessing information about graduate school lack broad national participation from faculty, businesses, and government agencies to effect a coordinated movement in organizing the national supply of advanced STEM degrees. Students are largely left on their own to gather information from fragmented sources on graduate programs, research advisors, degree financing, and career options. A recent survey by the Council of Graduate Schools [5] reported that 35% of current or recent graduate students regarded the information they initially received about graduate school to be “extremely accurate,” while only 19% indicated that they had received accurate information initially about career pathways. Once in graduate school, 73% of students speak with their faculty advisors about careers more than any single resource [5]. Depending on the particular background of the faculty advisor, students may be provided career information which narrowly defines the spectrum of post-graduation opportunities. Students must not only have easy access to mentors in the private or public sectors who share their aspirations, but also a listening ear from the faculty advisor to help support their goals. Embracing the integrated role of faculty, students, and the workforce in shaping the outcomes of a graduate education is central to optimizing student pathways, and a versatile web-based portal is ideal for accomplishing this.

The Council of Graduate Schools Ph.D. Completion Project recently reported that an average of 50-60% of initial doctoral students in the U.S. complete their degrees [4]. In some cases, irregular funding of graduate students between projects prolongs time-to-degree with a concomitant rise in frustration and financial burden on the part of the student. These situations illustrate the need for clear pathways through graduate school with accountability shared between the faculty advisor and student. With the proposed web portal, students would be able to create digital roadmaps for their graduate journey that can be readily shared with the faculty advisor or other mentors for input and progress monitoring; these items would include curriculum planning, a timeline of targeted milestones agreed upon by the advisor and advisee, a description of career interests, and a list of desired skills that should be developed during graduate studies to support individual career aspirations. Statistics such as typical time-to-degree

and employment accepted by former advisees could be compiled and displayed for each advisor. These personalized tools are aimed at promoting meaningful student-faculty conversations on the outcomes of a student-focused graduate education. Such discussions inevitably lead to strategies for financing an advanced degree, and a database of national funding opportunities should be centrally maintained on the system. For example, businesses and government agencies have greatly increased the number of internship positions, grants, joint research opportunities, and fellowships [5]; the full spectrum of these opportunities should be made available on a single platform.

By establishing a national STEM graduate portal, the doors of graduate education will be opened to all for a more transparent look into the system. This web portal would be especially impactful for students without a history of graduate education in their families and those who may not have an accurate perception of graduate school. With a common platform for students to access during their studies and also after exiting the academy, more direct collection of data on STEM graduate education can be achieved. For example, surveys and polls sent to user profiles would be highly valuable to the National Center for Science and Engineering Statistics as part of their monitoring mission, allowing graduate education to dynamically adapt to emerging trends. Graduate research projects can also be widely disseminated to the public through guest access to the system. For example, to address the desire for graduate students to present complex ideas in simple contexts to broad audiences, a growing concept involves students submitting 60-second “snapshot videos” of their research [6]. These videos could be uploaded to student profiles and viewed by multidisciplinary researchers, prospective students, employers, and the public. A one-stop access point to graduate education would provide a medium for facilitating STEM outreach opportunities and exchanges with K-12 teachers for curriculum development. Moreover, the proposed national portal is a robust approach that can be implemented for undergraduate STEM degrees as well, offering the opportunity for seamless integration from the beginning of secondary education.

The responsiveness of faculty and employers to improving graduate outcomes will be readily demonstrated by the level to which they embrace a national interface for interacting with graduate education. The proposed web portal does not undermine the intellectual rigors on which an advanced degree is based, but seeks to optimize student pathways through graduate

studies and into careers. A one-stop web portal will enable U.S. graduate education to become a more transparent, versatile system which reflects its importance as a strategic national asset.

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[3] National Academy of Sciences (1995). *Reshaping the Graduate Education of Scientists and Engineers*. Washington, D.C.: National Academy Press.

[4] Council of Graduate Schools (2007). *Graduate Education: The Backbone of American Competitiveness and Innovation*. <[http://www.cgsnet.org/portals/0/pdf/GR\\_GradEdAmComp\\_0407.pdf](http://www.cgsnet.org/portals/0/pdf/GR_GradEdAmComp_0407.pdf)>.

[5] Wendler, C., Bridgeman, B., Markle, R., Cline, F., Bell, N., McAllister, P., and Kent, J. (2012). *Pathways Through Graduate School and Into Careers*. Princeton, NJ: Educational Testing Service. <<http://pathwaysreport.org/>>.

[6] Flaherty, C. (2013). "Duke proposes a mandatory, short video pitch to accompany dissertations." *Inside Higher Ed*, February 22. <<http://www.insidehighered.com/news/2013/02/22/duke-proposes-mandatory-short-video-pitch-accompany-dissertations>>.