Student-led organizations provide robust science policy education

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Scientists and their relationship with policy

'The gap' between scientists and the society at large is often referred to in policy spaces. Statements such as, "We must bridge the gap between scientists and society." are echoed on social media and in academic circles alike. This claim, in which 'society' is sometimes replaced with 'policymakers', 'the people', or even 'the real world,' simultaneously points at a tangible concern around communication barriers and value alignment, while dramatically oversimplifying a complicated set of issues, issues that this very publication is dedicated to addressing [1]. The core of these issues is that the application of scientific advances to societal problems has driven immense improvements in quality of life and the misapplication of these advances has also wrought enormous harm. The capability of science, and the societal need for that capability, has motivated a strengthening of ties between the scientific establishment and the government sector over the past century. This relationship goes both ways, commonly referred to as *policy for science* and *science for policy* [2]. The chief example of the former is the classic *Science The Endless Frontier* that laid out the modern US government system for supporting scientific research [3] and whose legacy the National Academy of Science and other organizations are currently commemorating [4,5]. Meanwhile, *science for policy* is most vividly expressed in increasing need for more individuals with possession of both specialized technical knowledge in some field and an understanding of policymaking, something that has sometimes been called 'the policy sciences' [1]. Such individuals are needed in state and federal environmental regulatory agencies, international trade negotiations, public health agencies, and more. This paper largely focuses on this category and on one way to enable more scientists to lend their expertise directly to the societal application of their work. Specifically we propose that student-run science policy extracurricular organizations are a viable means of addressing the institutional siloing and cultural divide between scientists and policymakers, in particular in the absence of more formal programs.

The need for such 'dual-hat' individuals extends far beyond the need for filling specialized roles at the Environmental Protection Agency or the Army Corps of Engineers. Policy and scientific research are interconnected at all levels. The boundary between a grant proposal and its eventual policy implications can be difficult to distinguish, resulting in many scientists seeing their work used to justify unforseen policy decisions or leading to unintended societal consequences [2, 6].

Roger Pielke proposes at four categories of scientist and their involvement in policy [7]:

1. The Pure Scientist: The archetypical ivory tower figure who seeks knowledge for its own sake and has little interest in the policy implications of their work.
2. The Science Arbiter: The scientific adviser who dispassionately supports a decision-maker by answering clearly defined and cleanly answerable scientific questions.
3. The Issue Advocate: A scientist who is driven by their interest and their expertise

to advocate for a particular policy objective. A historical example of this is the evolution of many nuclear scientists into leading advocates for nuclear disarmament.

4. The Honest Broker: The scientist who uses their technical knowledge to clarify and expand the set of policy options, often working in concert with decision-makers and other stakeholders.

While all of these have some positive role in a diverse and democractic society, many scientists are either implicitly or explicitly taught to aspire to the Pure Scientist role. Worse yet, in all their extensive education, they are rarely given the conceptual framework to consider other roles that they may play in society. In absence of this awareness of the available options, we see disparate and varied cries to "bridge the gap" and just as many attempts to fulfill these cries: opinion pieces in newspapers [8] and in scientific journals [9], large scale political movements [10], science-based advocacy organizations like the Union for Concerned Scientists [11], and university student groups [12]. Many of these initiatives are driven by students and early career professionals, those most capable of recognizing the deficiencies in the educational model created by their forebears.

This paper outlines one such model that has proven successful at numerous institutions and is readily adaptable to yet more: the graduate-student-run science policy club. It will then examine the specific benefits offered, particularly in comparison to formal academic programs, as well as some of its limitations. For concrete examples, the authors will rely primarily on the organization that they are personally familiar with, the Science Policy Initiative of the Massachusetts Institute and Technology (MIT). Numerous other such organizations exist however and references to them will be included throughout.

What is a science policy club?

Fundamentally, a science policy club is just like any other student club: a means for community building, mutual education, and practicing a shared interest. Here the community is largely composed of trainee scientists with an interest in policy without clear avenues for engagement through formal academic venues.

One of the main virtues of such organizations (to be returned to later) is that they can start simple, low to the ground, and with minimal financial resources. When SPI started in 2006, it was primarily a reading club that would meet once a month in the basement of the chemistry building to discuss articles and news. Over time it grew and expanded its programming, identified mentors, and gathered financial support, leading to many of the types of events discussed below. Even as it has grown and expanded, however, SPI has maintained its monthly discussion meetings as the central activity of the organization.

With this in mind, it is worth discussing various types of activities that such a club can engage in. This list is not intended to be exhaustive, but instead to give a sense of options open to a student led organization. After the list, the per-person costs of these events will be presented.

SPI offers three flagship programs during the academic year. During the fall, SPI hosts the Executive Visit Days where participants meet with members of the government science agencies. The Science Policy Bootcamp is held during the winter intersemeter period and offers a short course on science policy and science governance. The last event is held in the spring semester, where participants attend the Congressional Visit Days and advocate for science funding on Capitol Hill. More frequent and cost effective events, such as discussions and lectures, allow for full year engagement and are vital for introducing

new content and opportunities. During the 2020-2021 academic year, all SPI educational and advocacy programming was held virtually. This has proven to be a low cost option for organizations looking to recreate this type of programming.

The effort and financial costs of these events are summarized at the end of this section in Table 1.

EXECUTIVE VISIT DAYS

Executive Visits Days is one of the flagship programs run by SPI. Unlike the Congressional Visit Days, this program is entirely educational with the goal of introducing early career scientists and engineers to many of the nation's science agencies. This experience aims to increase awareness of the opportunities for advanced degree-holding scientists and engineers in the public sector. Agencies visited in the past have included the Department of State, Energy, Defense, and Health and Human services; the Office of Science and Technology Policy; and other executive branch agencies. In recent years, the Executive Visit Days have expanded to include non-governmental organizations such as the Science Technology Policy Institute and the American Association for the Advancement of Science.

BOOTCAMP

The Science Policy Boot camp is a 4-day short course offered during the independent activity period between semesters at MIT. This course began over 10 years ago and is currently led by the director of the MIT Washington Office, David Goldston, who is assisted by the elected SPI bootcamp chair. Graduate students and post-doctoral researchers learn an overview of the origins and structures of federal science and technology policy in the US before working through current issues in science policy and the governance of science. The class uses materials such as congressional hearings, think tank reports, and court decisions to supplement lectures and give students an applied view of science policy. Typically, the course is open to 35-40 students per year, though recently this number has expanded with the inclusion of a version of the course hosted during spring break. The bootcamp has proven to be an excellent introductory class to those interested in the governance of science and how research can inform policy.

SPI has also recently worked with the MIT Office of Digital Learning in order to develop a variant of the course that is freely available online. The ultimate goal of the web based class is for others outside the MIT community to benefit from accessible science policy education. [13]

Congressional Visit Days

Congressional Visit Days act as an opportunity for graduate students and postdoctoral researchers to have face-to-face meetings with their federal elected officials. This program is run through the MIT Washington Office and occurs before the federal budget is submitted. The goal of this programing is to provide advocacy experience to participants, while providing offices with firsthand accounts of the American research climate. Before the trip, participants attend a series of lectures centered around the basics of science funding and how to communicate their research. Many participants come from diverse regional backgrounds and in previous years CVD has facilitated over 70 meetings during the event. Participant's work has been used to advocate for science funding during congressional hearings, develop letters of support for a nuclear energy research bill, and inform the creation of an early career researcher subcommittee in a federal office, among other applications.

INVITED TALKS

In addition to the higher budget cornerstone events, SPI offers a series of talks and discussions for monthly engagement. These smaller scale events widen the breadth of programming SPI is able to offer and allow for more flexibility in topics covered. These events provide timely educational opportunities in response to current events of participant feedback.

The invited talks occur on a monthly basis. These talks underscore the breath of influence science policy has on local university research. In addition to furthering educational goals, these talks offer a way for SPI to reach alternate audiences and experiment with content. In the past, speakers have included local professors, Congressional office staffers, student organization panels, and think tank policy analysts. Invited talks are categorized into the Vannevar Bush lecture series, or in the form of lunch discussions. The lecture series gives a platform for speakers to share their experiences with science governance or their work in policy space, while the informal nature of lunch talks allows for discussion and engagement with the speaker.

MONTHLY DISCUSSIONS

Monthly discussions serve as a major educational and recruiting component. These discussions are largely student led, though they can feature a panel for more expert guidance. Panels serve as a way to involve other student organizations and help set the tone for discussion. These monthly discussions provide a venue for students to engage with current topics at the intersection of science and policy. Source materials are provided beforehand, so as to to supplement discussion and aid in self-directed policy education.

During this period of virtual connection, open discussion via online platforms has continued though increasing moderation and invitation of material experts. In tandem with these online discussions, SPI has begun a bookclub to help those interested in policy stay connected. SPI purchases copies of books for interested members. Through the course of the semester the book is used as a springboard for relevant discussion.

NETWORKING EVENTS

As a student led organization, SPI prioritizes maintaining connections with alumni and science policy student organizations. Robust relationships with alumni and other organizations provide institutional memory in spite of the student turnover. Moreso, many of our educational offerings come from these relationships. Some former SPI members have gone on to engage with policy as a career and provide invaluable career connections and mentorship to current members. Relationships with local and national organizations also allow SPI to provide access to resources that would otherwise be unavailable to a single club. Grants, invited lectures, symposiums, and networking programs give members a chance to engage with science policy enthusiasts outside of MIT.

Table 1. Budget and Effort Estimates for Types of Programming

Cost and Effort	Event	Typical Cost per Person	Ways to Reduce Costs
High Financial Cost and High Effort	Executive Visit Days	$500-900	Instead of traveling to DC, invite alumni with relevant careers to speak remotely or the next time they visit campus.
	Congressional Visit Days	$500-900	Instead of traveling to DC, visit the local offices of your member of Congress. Alternatively, visit the state legislature instead.
Low-Moderate Financial Cost, Moderate-High Effort	Science Policy Bootcamp	$40-70	Participants can always provide their own lunches and you can find an instructor who is willing to donate their time. If you have knowledgeable graduate students, they can even teach it themselves!
Minimal Financial Cost and Low Effort	Faculty Lunch Series	$5-15	Students can bring their own lunches, though providing lunch for the guest faculty member is a nice way of saying thanks.
	Monthly Topical Discussions	$5-15	These are free if no food is provided, though free food is an excellent way to attract graduate students.

How to implement a student led policy club locally

One of the primary virtues of a student club is that it requires minimal resources to start and maintain. That said, many resources exist and are available to support local efforts . National organizations function to connect student groups across the country. The National Science Policy Network (NSPN) [14] and Engaging Scientists & Engineers in Policy (ESEP) [15] are both policy organizations with significant student leadership that help provide resources to schools starting their own science policy organizations

Many of the events listed in the previous section can be scaled based on the level of financial support available. For Congressional Visit Days, members of Congress have local offices in their districts or states that are open to constituent visits. The global pandemic has made Congressional offices more amenable to virtual visits. Professional development trips such as Executive Visit Days can be replaced by inviting alumni in relevant fields to give talks, perhaps situated around reunion events. And for every federal-level type of programming, there is a state-level equivalent. In fact, state and local legislatures commonly have more direct impact on graduate student populations and are thus a good resource for advocacy education and training. State agencies are often closely involved with the application of science to different societal functions and may be amenable to giving talks or providing tours.

Several states even have explicit science policy programs aimed at current graduate students or those who recently completed their degrees. The Connecticut Academy of Science

and Engineering offers two year fellowships with state agencies and hosts a variety of events for current students [16]. Three Idaho universities partnered with government agencies to offer the Idaho Science & Technology Policy Fellowship [17]. New Jersey and Rutgers University support the Eagleton Graduate Fellowship Program in Politics and Government for work with the state legislature and other government agencies [18]. These are just a few examples of such state level resources that students can use as a basis of expertise and support.

Steps outlining the creation of a student science policy club are shown in Figure 1.

The clubs role in developing policy-minded scientists

Any such club plays two roles, that of education and of advocacy, though not necessarily in equal portions. This can be seen in the mission statement of SPI, which reads, “We strive to create better scientists and engineers as well as a better society through rigorous research and authentic engagement with public policy,” [19] and in that of NSPN, which is “to catalyze the engagement of early career scientists and engineers in policy making by fostering community, training the next generation of leaders, and empowering advocates for the role of science in society.” [20]

In its capacity as a venue of science policy education, the club benefits both society as a whole and the individual participants. Society needs more scientists who are productively engaged in policy and aware of the potential consequences of their work. By exposing scientists-in-training to such possibilities, by giving them the terminology to situate themselves, and by providing them with a community of like-minded individuals, we increase the likelihood that they will remain engaged throughout their careers.

Providing such options is key because university professors, by virtue of having self-selected to remain in academia, often are ill equipped to educate trainees on non-academic career opportunities, much less encouraging their students to pursue such opportunities. Large private sector corporations often advertise extensively at career fairs and academic conferences.However, policy-oriented institutions such as government organizations and NGOs lack the resources and support to advertise similarly. This results in many students being presented with a binary choice: industry or academia, even though there is, in fact, a third option available. Science policy clubs can thereby help improve “the sad state of professional development programs for scientists" [21].

Those familiar with the field of technology policy may object to this characterization and point to the presence of such programs as Carnegie Mellon University’s Department of Engineering and Public Policy (EPP), MIT’s Technology and Policy Program (TPP), and Stanford University’s Department of Management Science & Engineering (MS&E), as demonstration that academia is already adequately filling this role. While the cited programs (and others like them) are certainly to be lauded, they are few in number, their existence more tenuous than might be imagined, and they are incapable of satisfying the full societal demand of science policy education.

As Granger Morgan, the former head of CMU’s EPP, wrote, most formal technology policy programs tend to either collapse, as did Harvard’s Program on Technology and Society (1964-1972), or to evolve into a more traditional field, either a social sciences of technology or a systems engineering program. Few are able to sustain both their existence and to shoot the gap of engineering and policy [22].

Starting a Student Led Science Policy Organization

Step 1: Outline the goals for the organization. What do you hope to accomplish, how do you hope to get there?

[We are] an initiative of Ciencia Puerto Rico that seeks to increase the participation of the Puerto Rican scientific community in the deliberation of evidence-based public policies through participatory means. We provide a platform for Puerto Rican scientists, both in Puerto Rico and the U.S., to acquire the tools and resources to get involved in public policy at different governmental scales and to add their diverse perspectives, knowledge, and contexts so that science-based policy decisions have a positive impact on Puerto Rico
--Puerto Rico Science Policy Action Network

[Our] goal is to build up scientists and engineers into leaders in science activism in our community and in policy. We want our members' skills and expertise to be used to advocate for values-driven science and help lawmakers, local community leaders, and other decision makers make fact-based decisions to help Arizona's communities.
--Arizona Science Policy Network

Step 2: What events will further your mission

- Hold journal discussions and meetings
- Begin a science policy course
- Invite subject area experts and career development talks
- Set up summer policy internships
- Organize legislative advocacy trip (local or federal)

Step 3: What support exists at your University?

- Faculty: Many professors are interested and involved in policy within their field. Seek them out as speakers and mentors
- Career Center: They can likely put you in touch with alums in policy-related careers. They also may be willing to help support career development activities!
- Service / Civic Engagement Center: Policy engagement is a form of civic service. Ask them about supporting otherwise unpaid internships with legislative offices or policy think tanks.
- DC Office: Many universities maintain an office in DC that are used for advocacy, information gathering, and educational programs. Ask them about student participation.

Step 4: Connent with existing sceince policy networks

ESEP — The Engaging Scienctists & Engineers in Policy coalition is an alliance of organizations committed to engaging scientitst and engineers in the policy making process at all levels of government

NSPN — National Science Policy Network: This is an entire organization dedicated to sharing resources and building up science policy groups, with a particular focus on student groups.

Even the relatively long-lived and successful such programs, such as MIT's TPP (of which one of the authors is an alum), are quite vulnerable to dramatic changes due to external pressures. Over the past five years, the institutional parent of TPP, the Engineering Systems Division (ESD), was dissolved [23] and replaced with the Institute for Data, Systems, and Society (IDSS), a much more data-science-centric organization [24]. This resulted in significant changes to the TPP curriculum and disrupted the academic pipeline for many masters students intending to pursue doctorates (with the result that several went to CMU's EPP). While TPP has recently stabilized and seems to have retained its identity without turning into a purely data science program (in part due to the timely appointment of a new, invested director), this incident.demonstrates the tendencies that Morgan spoke of. Such academic programs cannot be relied upon to grow substantially in numbers or capacity in the coming years and thus alternative means must be found to advance science policy education.

Student-run clubs are one avenue for providing trainee professional development in the public sector and for making traditional career track scientists more policy aware Though student led programs like SPI lack the institutional support and accreditation, there are distinct merits which arise from the more informal nature of the organization. Student-led programming fulfills a different set of community needs. As such, this type of programming can work in tandem with existing degree granting programs, or as an independent organization.

The lack of formal degree requirements afforded by the student-led model actually removes a barrier to education. Members of the community can choose the level of engagement that best fits their schedules and interests. This allows for a broader membership outside of those who commit to an academic program. In turn, these participants bring area knowledge from sectors outside of the policy space. This intersection of academic interests provides rich grounds for discussion and serves as a venue for cross-disciplinary communication. These skills are vital for anyone interested in a future career in science policy, though the value garnered by broad membership serves a loftier goal. Alan Leshner, the chief executive officer of AAAS, wrote about the importance of "bridging the opinion gap", wherein he discusses the need for bidirectional communication between scientists and the public [25]. Policy engaged scientists with experience in cross disciplinary communication are needed in all sectors. Low barriers to engagement allow SPI to serve more students from different academic backgrounds, expanding the pool of policy and communication minded scientists.

Resource requirements are another area where student led organizations and academic programming differ. Academic programs typically require resource rich environments. Multiple classes taught by experts, as well as administrative support, are needed to facilitate an academic program. These programs are housed under departmental umbrellas and are subjected to funding constraints and resource competition. Student organizations exist outside this structure. SPI has been fortunate to receive financial support from MIT administration and mentorship from the MIT Washington Office. Though these mechanisms are key to the success of SPI today, there are many aspects of the programming that do not require institutional resources.

One downside to a student-run club is that, unlike a formal academic program, it lacks a defined curriculum and an accreditation mechanism. While students, particularly those

who serve in leadership positions, may put their club involvement on their resumes, this does not have the same impact as a formal graduate degree. One way of mitigating this is to establish a certificate program. At MIT, SPI worked with TPP and other faculty members to establish the Science, Technology, and Policy (STP) Certificate [26. It functions as a sort of minor for doctoral students, with a limited and flexible curriculum requirement coupled with a capstone project. This allows science and engineering students to express their interest in science policy and have it formally recognized.

Conclusion

Ultimately, some of the most effective ways to get more scientists involved in policy are to target scientists-in-training and to leverage their own innate interest. This is what science policy student clubs do. They can provide individuals with conceptual frameworks for understanding the scientist's role in the policy environment, tools to productively engage with policymakers, and a network of like-minded scientists to draw support from.

Student-led organizations' effectiveness can be seen in the rapid increase in the number of such organizations across the country, their level of interconnection and collaboration, and in the scale of programs that they are hosting. Solitary groups meeting to discuss a recent paper have evolved into well organized, stable institutions with both established programming and the ability to experiment.

Despite growing demand, the development of formal education curriculums seem unlikely to appear en masse in the near future. Student organizations can flourish even in a limited resource setting. They do not require immense financial resources or institutional support, but are readily adjustable to the interests and resources of their participants. In an absence of a robust formal science policy education and career development pathway, student clubs can and are fulfilling an individual and a societal need.

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