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Abstract

Efforts aimed at democratizing science continue to emerge, but these many efforts remain isolated from each other. This article argues that the full impact of democratization efforts will not be felt until they are integrated with each other. Two strategies for integration are proposed: a typology approach and a generative strategy. Uses of such strategies in other areas have been successful and offer pathways for coordinating science efforts. The article ends with recommendations for how such strategies could be pursued to integrate promising but dispersed democratization of science efforts such as citizen science, community based participatory research, participatory action research, and public participation in scientific research.

Keywords: democratization of science, citizen science, community based participatory research, participatory action research, public participation in scientific research, boundary spanning, wicked problems

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"Compartimentos" en la Democratización de la Ciencia

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Resumen

Esfuerzos para democratizar la ciencia continúan emergiendo, pero a veces de manera aislada. Este artículo argumenta que el impacto de estos procesos democratizadores no será significativo si no son integrados entre sí. Para ello se proponen dos estrategias principales de integración: un acercamiento tipológico y una estrategia generativa. Los usos de esas estrategias en otras áreas han sido exitosos y ofrecen vías para conseguir esa integración. El artículo acaba con unas recomendaciones sobre cómo esas estrategias deberían ser llevadas a cabo y así poder integrar los prometedores pero dispersos intentos para democratizar la ciencia ejemplarizados con propuestas como ciudadano/a científico, participación de la comunidad en la investigación, investigación-acción participativa, y la participación pública en la ciencia en general.

Palabras clave: democratización de la ciencia, ciudadano/a científico, participación de la comunidad en la investigación, investigación-acción participativa, participación pública en la ciencia, superando fronteras, problemas complejos

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The democratization of science has become a major preoccupation of our time (Ezrahi, 1990). Efforts aimed at reforming science are occurring on multiple fronts under such names as public participation in scientific research, citizen science, science for the people, science shops, community-based participatory research, actionable science, knowledge co-production, and participatory action research. These separate efforts share a common concern with the need for science to become more democratic, less controlled by elites, and less aimed at research that perpetuates the status quo.

It is no accident, however, that these efforts are occurring under different names. The various efforts at the democratization of science remain siloed, and the varying names reflect the specific preoccupations of particular movements. The science shop movement, for example, has focused on the problem of science too often failing to serve the needs of ordinary people as opposed to large corporations. Actionable research is focused on the problem that the actions and policy implications of research are frequently unclear. Citizen science is focused on science democratizing the data collection process so that citizens play a more central role. Participatory action research is concerned with opening up science so that it is not just scientists who are driving the research agendas. And community-based participatory research is focused on reframing research approaches so that communities become the architects of rather than merely the objects of study.

Silos are also very much in evidence, as well, in the conceptual analyses that have startlingly reframed and moved forward individual science democratization efforts. For example, researchers working in policy arenas have tapped a novel "wicked problem" reconceptualization (Kreuter, DeRosa, Howze, & Baldwin, 2004) to challenge the fundamental research assumption that additional data will inevitably make clearer how to solve a problem. Yet, despite these productive conceptual reframings within individual movements, these paradigmatic shifts remain largely isolated within their particular science democratization efforts.

Future progress in the democratization of science will depend on these separate efforts coming together to overcome their siloes with all

of the attendant fragmentation and duplication. What might help with this integration? In looking for guidance on methods for cross-fertilization, one discovers strategies in other areas that have fostered cross-learning and integration. In the remainder of this paper, an examination of two such cross-learning strategies--a typology approach and a generative strategy--will be used to suggest how disparate efforts within the democratization of science might be brought together.

Typology Approaches to Integration

In the face of siloed efforts, the first step frequently has been to collate and systematize information. As a part of this step, matrices, tables, typologies, taxonomies, rubrics and the like are created to capture the similarities and differences among efforts. There has been a long and grand tradition of turning to such taxonomic approaches. The value of such an approach can be seen, for example, in efforts to make sense of the jumble of activities that proliferated under the umbrella term of university engagement (Brukardt, Holland, Percy, & Zimpher, 2006). Over the last several decades, university engagement activities have burgeoned, yet frequently there has been little cross conversation among these efforts and it has been increasingly unclear how the proliferating efforts relate to one another. Foundations such as Kellogg Foundation, organizations such as Campus Compact, and the Carnegie Classification systems leaders have all stepped into the fray to call for a clearer understanding of the heterogeneous engagement efforts. Holland (Brukardt, Holland, Percy & Zimpher, 2006; Holland, 2009) and others have pioneered efforts to develop typologies that categorize the engagement efforts in instructive ways.

Many positives have resulted. Organizing previously chaotic information has helped move toward greater clarity (e.g., clearer definitions of what is and is not engagement). This matrix approach has been a means of making similarities and differences across activities more evident and more easily grasped (e.g., how engagement practices vary inside and outside of the classroom). Matrices have helped to create the “yardsticks” for comparison and thus allow for integration of what otherwise might be deemed incommensurate activities (e.g.,

diverse faculty activities in very different disciplines). And the matrix analysis approach has been instrumental in identifying gaps: by submitting the different approaches to the same matrix analysis, it becomes more evident what is missing among extant efforts (e.g., the absence of community engagement in some majors).

Yet valuable as this matrix approach has been, it is not without its shortfalls. While creating taxonomies has been helpful in highlighting dimensions that are particularly salient or noticeable, such an approach may downplay less obvious features. Metafeatures such as causal variables are often not well represented. Contextual factors may be neglected. Nor does the matrix approach lend itself to highlighting "why" questions such that particular strategies were undertaken. Strategies are made visible but the reasons for their success remain a mystery. Perhaps even more problematic is that the matrix approach frequently edges from the merely descriptive into the prescriptive. A grid summarizing what exists can lead to conclusions about what should be. Thus, in engagement efforts, the taxonomic can edge toward prescriptions that "x" way of doing engagement is better than "y" way. Orthodoxies that are not suitable for all contexts are sometimes the result.

Finally, there is a problem if efforts at integration stop with the matrix approach. The matrix approach does not lend itself to providing guidance in how to move beyond what currently exists. The approach is not focused on generativity. Creative problem solving is not a core feature of this approach. As Gardner (2009) might note, the matrix approach focuses on the synthesis part of the problem but not the creative part. The matrix approach alone does not encourage the kind of inventiveness that will be needed if the disparate efforts at democratizing science are to be brought together.

The Possibility of Adding a Generative Strategy

A second strategy, what might be called the generative approach, has been gaining currency in many circles as a complement to a taxonomic focus. This generative approach has been found to be highly productive in moving fields forward when extant analyses have become ossified and a matrix focus has gone as far as it can. Under this generative

strategy, two bodies of literature articulating different perspectives might be brought together to reframe a problem. Consider the phrases 'environmental justice,' 'social capital,' 'built environment,' 'social cognition,' 'boundary spanning,' and 'violence as a public health issue.' Each of these phrases captures the productive bringing together of two previously disparate bodies of literature (e.g., environmental issues and justice issues), resulting in the generation of 'game changing' new insights and approaches. Under the social capital framing, communities are understood in new ways by reconceiving of the social connections as a form of unrecognized capital. In the built environment framing, urban areas are understood to be physical spaces that affect residents in ways that could be compared to natural environments. To illustrate why this generativity approach holds promise, we will consider two examples: reframing environmental problems as a justice issue and reframing violence as a public health issue.

Environmental Justice

For decades, environmental problems were examined largely from the science and policy perspective: what are the factors that are leading to the degradation of the environment and how can they be addressed? Thus, previous efforts looked at the problems wholly from within the framework of the environmental literature. A study by the United Church of Christ's Commission for Racial Justice changed this and brought a civil rights and justice perspective into the discussion (Bullard, 2000; Chavis, Goldman, & Lee, 1987). Rather than simply documenting a litany of environmental problems, these researchers made note of the fact that environmental problems were unevenly distributed. They were more common in poor communities and communities of colors than in white upscale communities; thus, these environmental issues were justice issues. This insight reframed the discussions of environmental problems to ones of justice. This helped reinterpret environmental issues: they were not merely about how to improve water quality and the like but about whose water quality was impaired and whether some people's access to a clean environment was particularly compromised. The reframing led to an outpouring of new ways of thinking about what needs to be done about environmental

problems. This approach drew on different perspectives, led to different questions, and brought together different partners. The reframing suggested different solutions to these problems. The policy analysis was shifted and new questions were raised about what regulatory agencies should do. By bringing justice framings to bear on environmental issues, the results were both integrative and generative.

Violence as a Public Health Issue

The same generative effects of reframing have been seen when public health analyses were brought into discussions of how to address violence in urban areas (Gellert, 2010). Until this reframing occurred, most attempts to understand urban violence drew just from the criminal justice perspective. Researchers and policy makers considered what the criminal justice literature has shown about propensities for violence and how these could be addressed. Bringing in the framing of public health introduced new perspectives. Public health analyses are particularly strong at focusing on systemic causes, which helped frame issues of urban violence in very different terms than had previously been the case. The focus moved from being on the perpetrators and the need to control their behavior to a concern with systemic causes that could be addressed in ways that would reduce the epidemic of violence. Causes, treatments, and solutions were all examined in a new light. As is typical of public health analysis, population factors were brought to the forefront. Consideration was given to what might be gained by understanding that violence might share properties with other health epidemics. By bringing in analogies from the public health perspective, new tools could be brought to the task, such as those used to measure impact of various interventions. And this approach has been successful in reshaping discussions of urban violence by bringing in analogies.

How Can These Two Approaches Be Used to Reduce "Silos" and the Fragmentation in the Democratization of Science?

These two approaches—the typology approach and the generative strategy—offer promise as we look for ways to "desilo" the democratization of science efforts. The challenge will be to tailor the approaches to science democratization's particular problems. A few

small starts have been made in this direction and in this final section we consider these fledgling efforts and how they might be built upon and advanced.

Typology Approaches as an Aid to Desiloing

Consider, first, the typology approach and some initial efforts within individual democratization movements to formulate categorization systems. Working within citizen science, for example, Shirk (et al., 2012) have developed a continuum to capture how citizen science initiatives vary in the steps at which citizens are brought into research. This continuum shows that citizens are sometimes asked to volunteer as data gatherers (e.g., carrying out bird counts or contributing to online data collection where the need is simply for many person hours) and other times to be involved in a much more substantial range of activities such as deciding which issues are to be studied and how they are to be investigated (e.g., Karubian (2012) work in ecology in Ecuador or Nichol's (2012) work with sea turtle hunters in the Baja Peninsula of Mexico). Shirk's et al continuum has stimulated discussions within citizen science circles about the value of various activities that fall at different points on the continuum. Working in actionable science, Hutchins et al. (2011) have used a typology or matrix approach in a different way to assess preferences among policy leaders for different types of involvement in actionable science. Building on previous literature, Hutchins et al. (2011) created a selection matrix through which stakeholders could express their preferences for levels of involvement (from stakeholders entirely directing the research and its use to researchers entirely controlling the agenda) that range along a democratization continuum. These findings are being used to design more democratic, less researcher-centric approaches to creating policy-informing science. Within community based participatory research, Silka and Renault-Caragianes (2007) developed a Research Cycle Framework that places different stages in community-based participatory research on a time-course continuum capturing when particular science democratization tasks emerge in the research process. The framework is designed to be a tool used jointly by researchers and community members for confronting the challenges of ensuring

democratic, collaborative processes at each of those stages.

Efforts at systematization have begun within individual movements (e.g., citizen science, actionable science, and community based participatory research), but an inclusive typology or matrix that brings together the different movements now needs to be created. A master matrix would make apparent what the similarities and differences are among various democratic science efforts such as actionable science, community based participatory research. But such a matrix or typology, to be productive, also needs to move beyond merely laying out the obvious differences to making apparent how those differences reflect history and context (such as CBPR emerging out of the ethical problems of poor community members being repeatedly the objects of investigation and having little choice over this, or PPSR originating in part out of the problem that more data needs to be collected than there are researchers to collect it). These different origins have colored the emphasis in the individual approaches and decoupling the foci from their histories reduces their prescriptive thrust and opens up considerations of how they can be brought together across the array of situations where science needs to be more democratic. And, the typology should not simply be created: it should be used as a guide much like the Silka and Renault-Caragianes's (2007) Research Cycle Approach has been used.

Generative Approaches as an Aid to Desiloing

To integrate the independent democratization of science efforts, it will be important to add the tools of the generative approach. Here, too, there have been initial starts. Consider the phrases 'citizen science' and 'actionable science' as examples of generative efforts that combine literatures that reframe the discussion. Both place emphasis on bringing ideas together. By combining 'citizen' and 'science' one naturally starts to think about how citizens have ownership claims over science, that science is not owned by scientists, and that the link between science and democracy is strong. By combining 'actionable' and 'science', the steps to creating science that is useful doesn't seem separate from the science itself. Action becomes integral to good science.

At the heart of these generative and integrative approaches is the

effective use of metaphors and analogies. Consider Cash, Borck, and Patt's (2006) loading dock analogy. This analogy is being widely used to help scientists see why it does not work to create science in ways that simply assume that someone will find a use for it. In the case of loading docks in factories, widgets are produced and then trundled out of the factory and on to the loading dock so that they can be picked up and taken away for use. Scientists implicitly assume that they are operating in a similar context: that there is someone at the loading dock who will pick up the results from studies and use them. In the case of widgets, we know that it is important to make certain beforehand that they are useful and that they been designed so that a market exists for them. By analogy, we need to ask whether our research is designed in ways that speak to problems as they are conceived of by key stakeholders and that garner solutions that as taken to be viable by those who would use the information.

Boundary Spanning

The generativity that could result from bringing different bodies of work together will be possible only when there are those adept at bridging the gap. The boundary spanning literature provides helpful guidance on what is needed to strengthen such cross conversations (Kimble, Grenier, & Goglio-Primard, 2010; Wenger, 1998). This literature, found within the sociology of science, tackles the recurrent problem of people from different backgrounds (researchers and the policy makers, for example) failing to achieve a common understanding because they are unable to span the boundaries separating their perspectives. Use of this concept of boundary spanning has turned out to be productive way to frame a problem that is plaguing many areas. And what makes it possible to span boundaries? One answer has been to understand the importance of boundary objects and their creation and use within and across groupings (Lee, 2005, 2007). Boundary objects have been described as physical objects or even activities that by their nature can be used within each territory but also can be used in both to bridge differences. Something as simple as a map has served as a boundary object (helping to span boundaries) in some science democratization projects. Marine researchers and the fishing community might come together to study

local fish depletion patterns. The researchers and stakeholders might experience trouble in communicating across their different ways of framing the problem but both rely on maps as a part of their work. Effective boundary spanners understand how both groups use maps and can envision ways to use maps as boundary objects so that they are helpful within the community but also across communities.

Boundary spanning has the potential to be helpful in reducing the silos in the democratization of science. What will be needed is individuals conversant with the different movements in science democratization who are also able to use that knowledge to innovatively create and use boundary objects. And part of what they need to ensure is that they carry out their facilitation of combinatory activities in ways that avoid making prescriptive recommendations but at the same time move things forward.

How will we know if we have succeeded in reducing the silos? There will be some important markers. Cross-learning will be evident in the integration, typologies, and generative analyses. Citations will regularly occur to each others' work and publishing within the same journals will be commonplace. Perhaps most importantly, our colleagues outside of academia will have a sense that the various democratization approaches are deeply linked: if stakeholders start with one kind of science democratization effort (getting involved in community based participatory research, for example), they will end up not at a dead end but will find a pathway to another (starting with community based participatory research can be directly tied to actionable science and vice versa). All of the efforts of doing science that matters will be understood to be related.

Conclusion

Current science democratization efforts differ. Some have been directed at looking at how the research is done while others on how the research is used. Some have focused on creating processes by which knowledge is jointly produced whereas others have focused on how knowledge, created by whatever means, can be made more widely available. Some are concerned with who decides on the focus for the research whereas others have focused on ensuring that the research, whatever the

emphasis, is done in ethical ways. The next step is to bring these various approaches together.

In all of the efforts to integrate the approaches, it will be important not to forget the extent to which calls for the democratization of science of any sort deeply challenge what is believed to set science apart and makes it special: rigor, reliability of data, objectivity, truth, and the like (Gieryn, 1999). The pushback among scientists to the democratization of science is not merely about inviting nonscientists into participation in various aspects of the science. Democratization efforts will continue to be seen as under mining the very underpinnings of what is believed to make science better than, stand apart from, and stand above other activities. The hybrid approach being recommended throughout this paper could provide the kind of united front that will help create robust democratization efforts that can move forward in the face of continued skepticism on the part of science traditionalists.

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