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3.3.3. Nine steps toward policy-makers' science literacy: including examples from nursing attrition research

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Abstract

Administrators and researchers addressing social issues need wide-ranging skills to translate scientific research into practical problem-solving. Besides specialized knowledge of particular fields, they need scientific literacy—the ability to think scientifically—and their need for scientific literacy is becoming increasingly important. Historically speaking, Japan has not conducted sufficient education in research methodology: examining issues through a scientific lens and applying conclusions to policy-making or social contributions. Japan urgently needs administrators and researchers who can bridge science and society in promoting "science for policy." This paper presents a framework for "science literacy for policy," that is, the ability to bridge science and society, using research in nursing attrition, among others, to illustrate the nine steps involved in this process.

Keywords

Scientific literacy, human resource development, research methodology

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Main text

In recent decades, most OECD countries have actively promoted science for policy. Representative examples include the dashboard[2] of the NSF in the US, SRP[3] in Australia, and SGMAP[4] in France. Well-known university programs include the University of Michigan's Science, Technology, and Public Policy Program[5] and the Science Policy Internship Program offered by the University of California, San Diego.[6] The Science Policy Research Unit at the University of Sussex the U.K. has made significant achievements in the fields of energy, industrial management and economics, and is noted for its joint research with Harvard University Science and Technology for Defense Policy.[7] In Europe, institutions such as the United Nations University Maastricht Economic and Social Research Institute on Innovation and Technology,[8] and the University of Oslo[9] in Norway, have actively promoted research on science-based policies and scientific policies to develop technology, producing numerous publications. According to one CRDS survey of domestic and international education and research programs (2017), at least forty-three university research institutions in Japan are engaged in science, technology and innovation policy[10].

More than two decades into the twenty-first century, it is no longer acceptable to enact policies without adequate scientific grounding, yet Japanese university education on scientific thinking remains rare if not old-fashioned. In Europe and the United States, courses on "scientific thinking" are offered in the faculties of college-preparatory high schools as well as research universities.[11] More importantly, North American university entrance examinations (Scholastic Aptitude Tests, SATs) focus on assessing students' abilities to draw conclusions based on evidence and logic, rather than their rote memorization. Conversely, in Japan, entrance exam scores depend almost entirely on rote memory, and even major Japanese research universities offer few classes on "scientific thinking," "the scientific method," or "scientific literacy." Moreover, the overwhelming majority of research on this subject has been conducted with secondary science education in mind, with precious little in the context of higher education. This is why SciREX is so important today.

Science literacy is not limited to science in the narrow sense; science literacy is not mere knowledge and understanding of the concepts and methods of science, deriving generalizations and principles through methods such as natural observation and experimentation (cf. Omi, 1996). On the contrary, it includes society in its purview of study, including the formulation of policies based on scientific evidence. In other words, "science for policy" presupposes and depends on science literacy, and requires scientific research

2 https://labs.data.gov/dashboard/offices
3 http://www.science.gov.au/scienceGov/ScienceAndResearchPriorities/Pages/default.aspx
4 http://www.modernisation.gouv.fr/en/our-activities/evaluating-public-policy
5 http://fordschool.umich.edu/stpp; cf. http://ihpi.umich.edu/csp
6 http://aip.ucsd.edu/programs/ucdc/spip.html
7 http://www.sussex.ac.uk/Units/spru/hsp/Harvard; https://sites.fas.harvard.edu/~hsp/about.html
8 https://www.merit.unu.edu/about-us
9 https://www.sv.uio.no/english/research/phd/structure/TIK.html
10 https://www.jst.go.jp/crds/report/report04/CRDS-FY2017-RR-03.html
11 Jurecki and Wander (2012)

methodologies that can lead to social contributions. In the United States, this research methodology has been deliberately incorporated into educational curricula for children as young as three to six years.[12] Indeed, even in the US, which actively teaches "science for policy," not all policies are based on scientific evidence; indeed, appallingly many politicians and citizens remain anti-science. Yet compared to Japan, where there is little education in science literacy, much less "science for policy," most OECD administrators and public officials share a common understanding of "evidence-based policies."

In the following sections, we briefly introduce science literacy, understanding that it is not "memorizing facts about science" but rather "scientific thinking applied to policy." We use studies on nurse turnover (Fumiko Nakajima et al., 2015) to illustrate this process, which can be divided into nine steps.

1. Topics: Defining terms and delimiting objectives

Many Japanese scholars conduct studies that appear vague or unclear in scope, as often seen in titles with the structure "A and B." Rather than "A and B," an actual research question should be more clearly defined, such as "How does A affect B" or "What can improve B in A?" For instance, if we were to conduct a study of the reasons for and solutions to nurse burnout, the title "Nurses and burnout" would provide readers no clear idea of our aims or methodology. "How burnout affects nursing attrition" or "Factors (or interventions) that can improve burnout in nursing" would constitute far more attractive and descriptive titles. When multiple factors are involved, the process of narrowing them down is crucial. For example, while considering multiple solutions, measures, areas, or target groups, researchers should narrow their focus to those specific factors in which interventions appear practicable and effective.

2. Benefits: Why will who pay for whom?

If we had unlimited wealth and human resources, we might solve all kinds of problems. However, because we have limited wealth and human resources, we must think about how to use them most wisely and properly. In emergency medicine, we practice "triage," prioritizing patients who will benefit most from medical intervention over those who do not require it or will not substantially benefit from it. Similarly, in public policy, when it is impossible to pay for everything at the same time, we must prioritize projects that offer the highest return on investment, leaving aside those that will be resolved naturally with time, and those that will not be resolved regardless of the efforts or attention they receive. Thinking of policies to reduce nursing attrition, for example, the idea of "doubling nursing salaries" seems attractive at first glance, but without patients and hospitals willing and able to paying double for nursing, such a proposal would be impossible under our current national budget. Neither patients, nor hospitals, nor the state want nurses to leave their jobs, but they cannot afford to double their pay just to retain them. So to address the nursing

12 https://www.scholastic.com/teachers/articles/teaching-content/scientific-thinking-step-step/

shortages caused by attrition, we must seek other policies where public investments are more than recovered by the outcomes.

Counselling for the bereaved is another example; it is surely desirable to comfort bereaved families, but states and hospitals find "comfort" alone to be insufficient grounds to continue paying counsellors. Rather, if we can show that investment in counselling improves the health of the bereaved, enabling them to return to work and thus pay more taxes, or reduces the healthcare deficit because the bereaved receiving counselling grow less dependent on medical treatment, then some of the funding saved thereby could be spent on bereavement counselling. Conversely, without clear proof of its costs and benefits—showing who or how we will pay for what benefits—a good idea alone does not make for scientifically grounded policy.

3. Root causes: Are they remediable?

Japan in particular pays tremendous time and effort to identifying "causes" of crime, accidents, and social issues—yet there are many cases where they cannot be identified or corrected. For instance, knowing what causes an earthquake or tsunami does not mean we can prevent it from happening. Knowing that capitalism or urbanization cause many social problems does not enable us to discontinue capitalism or urbanization. In the case of nursing attrition, even if the causal factors are known to be overwork on night shifts, weekends and holidays, or stress resulting from too many tasks and responsibilities, still reducing care for patients at night and weekends, or reducing nurses' tasks and responsibilities are not immediately viable solutions.

Suicide, as another example, involves a huge range of factors that cannot be narrowed down to a single "root cause." Even if poverty, psychological and social disorders are identified as triggering factors, we cannot predict which poor or psychologically/socially disordered people are most likely to suicide, nor do we have sufficient funds to eliminate poverty, psychological and social disorders altogether. In other words, while investigating the root causes of problems may provide insights, it is often not the best way to identify corrective policies.

4. Alternative solutions (if root causes cannot be solved)

If we cannot solve the causes of a problem, how can we prevent it from recurring? If earthquakes and tsunamis are unavoidable, governments should at least prohibit nuclear power plants from operating directly above active faults and on coastlines vulnerable to earthquakes and tsunamis. If capitalism and urbanization are inevitable, governments can at least use progressive taxation to redistribute wealth, and green zones to encourage interaction with neighbors and nature. In the case of nursing attrition, even if working conditions cannot be changed, we may reduce nurse burnout by increasing work satisfaction and supporting nurses' mental wellbeing. Even without a single root cause of suicide, we may reduce suicide rates by restricting the means of committing suicide (like handguns in America, charcoal in Hong Kong, jumping from train platforms in Japan).

5 Finding successful precedents (qualitative research)

Researching precedents and previous successes may enable us to adopt and adapt creative solutions not solely based on "root causes." For instance, countries in Scandinavia have successfully reduced electricity consumption by introducing daylight saving time.[13] However, the opposite was reported in areas with higher air-conditioning usage.[14] Governments such as Hong Kong's have reduced their high suicide rate by restricting the sale of guns and charcoal, and by making apartment balconies more difficult to jump off. Japan's hospitals have highly variable attrition rates, but exploring why some retain staff better than others, even with the same pay and working conditions, leads to insights into hospital environments and work culture. The more precedents we find, the better we can scientifically explain our policy proposals—and people in authority are more likely to adapt policies which have previously been proven useful, than to creatively adopt utterly innovative but untested plans.

6. Finding previous data (quantitative research)

As policy science is based on data, we must carefully gather all necessary supporting data in advance, evaluating its relevance and validity. Before looking for our own new data, we should consider what data previous studies have already collected, and whether we can meta-analyze multiple case studies. Even if we must carry out our own new research, rather than create new criteria, we should preferably borrow criteria for evaluation from extant credible sources. Rather than inventing yet another measurement scale, it were far preferable to use an existing scale, which also enables comparison of our new data with previous studies. In the case of nurse burnout, for example, Pines, Maslach, and Zarit have already developed three highly validated scales to measure burnout, which are now used worldwide;[15] we must understand their respective strengths and weaknesses to choose the most appropriate measurement tools. The logical connections between problems and policies should be established before conducting any investigation, in order to avoid belatedly wishing that we had included yet other variables in our purview.

7. Finding new data (quantitative research)

When initiating independent research, we should target groups likely to be representative and cooperative, and conservatively estimate their rate of potential response to our questionnaires. Explaining to potential respondents how data will be used and obtaining their permission beforehand reduces the likelihood of respondents withdrawing their consent later. But it is all too common to get a response rate of 10-20%, whereafter we must again compare sample data with the overall target population to check how representative it is. The representativeness of the target group and its relevance to problem-solving are

13 https://doi.org/10/1016/j.enpol.2011.03.057

14 https://www.wsj.com/articles/SB120406767043794825

15 See all http://www.acqol.com.au/instruments/instrument.php

important, because measuring an unrepresentative group of subjects will not be convincing in policy proposals.

Our analysis of relationships between two or more factors will differ depending on whether we can prove a one-way causal relationship between them, or mere correlations but not causality. For example, if we hypothesize that nurse exhaustion is connected to the level of nurses' concern for their patients, it is hard to believe that an increase in exhaustion would lead to an increase in nurses' concern for their patients, so the logic that nurses' concern for their patients increases exhaustion is probably valid. On the other hand, if the two variables we are considering are nurse exhaustion and relations with colleagues, deteriorating relationships between colleagues could constitute either a cause or a consequence of exhaustion, so finding mere statistical correlation does not demonstrate causality.

8. Evaluation of pilot measures

After data analysis, we plan interventions to address the problems studied. Prior to implementing nationwide policies, however, small pilot initiatives enable review and evaluation of effectiveness. For instance, Nakajima et al. found that nurses' lack of work satisfaction and of sense of accomplishment were major causes of burnout. Their next step endeavored to increase nurses' work satisfaction and sense of accomplishment through periodic nurse training sessions at nearby hospitals. After introducing training and informal check-ups to raise the nurses' work satisfaction and sense of accomplishment, they conducted follow-up questionnaires using well-established measures of satisfaction, accomplishment, and burnout. Before-after analyses showed improvement of work satisfaction and accomplishment, as well as reduction of burnout, demonstrating the effectiveness of their interventions.

However, the training and informal check-ups to enhance sense of accomplishment were conducted by colleagues familiar with the research on work satisfaction. Even if their intervention were to prove beneficial, this small group of colleagues could not be replicated immediately on a nationwide scale. Therefore, development of nationally usable training materials, training a larger cohort of facilitators to enhance work satisfaction/sense of accomplishment, and expansion from pilot models to national policies remain issues to be addressed.

9. Identifying the policymakers with authority to approve and implement

In point 3 above, we noted that knowing the root cause of a problem does not necessarily illuminate its solution. Similarly, experimental and statistical proof of effectiveness does not necessarily inspire governments or businesses to innovate their policies. It takes more than experiments and statistical proofs to get people to change real world behaviors. In order to persuade people to do something they haven't done yet, we must communicate exactly how this will benefit them and persuade them to believe it. Of course, the task of persuading governments and companies is outside the scope of academic research. However, policy research itself becomes meaningless if none of it is ever implemented. This means we need to consider in advance how our research will appeal to responsible departments and people in authority.

In the future, if academia, industry, and government can learn to collaborate, we may gain further opportunities to convey the results of scholarly research to the real world (industry and government). Yet even as such collaborations increase, it is unlikely that industry and government will immediately adopt policies demonstrated by scholars. To that end, the selling points of any research need to be clearly considered from the earliest stages of applying science for policy. Based on good data, we need to be prepared to answer questions like “If we invest X amount of money and people in this policy, how much money will it save in the long run, and how many more people will be able to work?” to make a clear case to policymakers. Although this may not be sufficient on its own, we will not succeed in science for policy without persuasive explanations of costs and benefits.

10. Conclusion

As shown above, scientific literacy does not involve memorizing mathematical formulae or elements from the periodic table. Rather, it is a way of thinking about things scientifically from the ground up. Researchers and administrators need to define and delimit issues, collect and analyze data, using logic and persuasion to connect them to solutions. As John Dewey suggested,[16] this kind of scientific literacy should not be confined to postgraduate education, but taught to all citizens. Perhaps scientific policy-making is beyond the purview of Japanese grade schools, but for Japanese graduate students and professional administrators, education about and grounding of policy upon scientific methods—such as the ways of thinking discussed above—is long overdue.

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16 Wickman et al. (2011); cf. John Dewey, The supreme intellectual obligation. *Science Education*. 1934;18(1):1–4; and https://www.ncbi.nlm.nih.gov/books/NBK396086/

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Sites about policy briefs and literacy

- Johns Hopkins University
  https://www.jhsph.edu/research/centers-and-institutes/womens-and-childrens-health-policy-center/de/policy_brief/ index.html
- University of North Carolina
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- https://www.gapminder.org/data/
- https://ropercenter.cornell.edu/polls/dataset-collections/

- http://wiki.dbpedia.org/projects/sparklis
- http://www.visualdataweb.org/relfinder.php

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