Education as the Weakest Institutional Link in Japan's Nuclear Regulation*

Hiro Saito
Singapore Management University

Abstract

Debates over the Fukushima Daiichi Nuclear Disaster pointed to a set of institutional and organizational failures in Japan's nuclear regulation as a primary cause of the disaster. While the Japanese government has implemented reforms to strengthen nuclear regulation, I argue that these reforms have largely left out the education system as a key institution that produces and distributes expertise necessary for nuclear regulation. First, the Japanese education system has traditionally produced only a small number of experts in the fields related to nuclear regulation, aligned top-ranked experts with the pro-nuclear government, and weakened the civil society's capacity to mobilize counter-experts. Second, the education system has downplayed social-scientific perspectives in energy and environmental education capable of critically examining institutional and organizational dimensions of nuclear regulation. These problems, however, fell outside the purview of post-Fukushima regulatory reforms and, as the result, the education system remains the weakest institutional link in Japan's nuclear regulation.

Keywords: Expertise, Science and Technology, Social Studies, Japanese Education

Between 2011 and 2012, three investigative reports on the cause of the Fukushima Daiichi Nuclear Disaster were published: a nongovernmental report by the Rebuild Japan Initiative Foundation (RJIF), a governmental report by the Investigation Committee (IC) established within the Cabinet Office, and another governmental report—the most comprehensive of the three—by the Fukushima Nuclear Accident Independent Investigation Commission

(NAIIC) of the National Diet of Japan. Although none of these reports was able to pinpoint the direct cause of the nuclear disaster due to a lack of sufficient information on the damaged nuclear reactors, they all agreed that Tokyo Electric Power Company (TEPCO) and the Japanese government had failed to install necessary safety measures against earthquakes and tsunami, which led to the failures of cooling water systems and the eventual meltdown of nuclear fuels. As the NAIIC report stated bluntly, the nuclear disaster was "a profoundly manmade disaster" (NAIIC 2012a: 9).

Indeed, disasters that involve advanced technologies are typically caused by *organizational* failures (Perrow 1984, Vaughan 1996, 1999). Even "natural" disasters, such as earthquakes, hurricanes, and tsunami, are often compounded by organizational failures in emergency management (Kreps 1984, Quarantelli 1978, Tierney, Lindell, and Perry 2001). Similarly, the Fukushima Daiichi Nuclear Disaster was caused primarily by organizational failures. For example, the Nuclear Safety Commission (NSC) and the Nuclear and Industrial Safety Agency (NISA) lacked sufficient authority to enforce safety guidelines on electric power companies operating nuclear reactors. In turn, these organizational failures stemmed from loopholes in the *institutional* framework of Japan's nuclear regulation. As the investigative reports pointed out, nuclear-related laws in Japan created the institutional environment in which operators of nuclear reactors could dominate regulatory agencies to the extent that the former were able to exercise decisive influence on the contents of safety guidelines and to sabotage the installation of countermeasures against earthquakes and tsunami.

In this paper, I propose to extend this institutional perspective on the cause of the Fukushima Daiichi Nuclear Disaster by including the Japanese education system as part and parcel of the institutional framework of nuclear regulation. Although the education system does not directly regulate operators of nuclear reactors, it is a key institution in the production and distribution of *expertise* required of effective enforcement of nuclear regulation. Specifically, I argue that the Japanese education system contributed to the creation of organizational failures responsible for the nuclear disaster in two crucial ways. First, the Japanese education system produces only a small number of experts in the fields relevant to nuclear regulation, such as nuclear engineering and seismology, and aligns top-ranked experts with the pro-nuclear government and electric power companies. As a result, counter-experts who could question the existing system of nuclear regulation were marginalized in Japan, which allowed the pro-nuclear camp to maintain the "safety myth." Second, the Japanese education system emphasizes moral and natural-scientific

perspectives in energy and environmental education while neglecting social-scientific perspectives capable of critically examining economic, social, and political factors shaping Japan's energy and environmental policy. This neglect of social science at the national level likely made Japanese policymakers ill-equipped to effectively diagnose and solve organizational problems in nuclear regulation.

In short, the Japanese education system was structured to marginalize counter-expertise as well as downplay social-scientific expertise, and this allowed organizational failures to persist in the institutional framework of Japan's nuclear regulation and eventually contributed to the Fukushima Daiichi Nuclear Disaster. Thus, to prevent future organizational failures in Japan's nuclear regulation, it will be insufficient to reform only the legal component of the institutional framework to increase authority, autonomy, and transparency of the regulatory agencies. It will be also necessary to reform the educational system as the weakest institutional link in Japan's nuclear regulation.

Problems in Japan's Nuclear Regulation

As the NAIIC report put it, the situation of Japan's nuclear regulation prior to the Fukushima Daiichi Nuclear Disaster was characterized as "regulatory capture, in which the oversight of the industry by regulators effectively ceases" (NAIIC 2012b: 43). Such regulatory capture happened for two related reasons. First, Japan's nuclear-related laws gave two regulatory agencies, NSC and NISA, insufficient authority to enforce safety measures on operators of nuclear reactors. Second, the operators had far more expertise in the fields of science and engineering relevant to nuclear power than did NSC and NISA.

Weak Authority of Regulators over Operators

Japan's nuclear industry began to develop in December 1955, when the Diet passed the Atomic Energy Basic Law and two other laws to authorize the creation of governmental organizations to promote the "peaceful" use of nuclear power. According to these laws, the Japanese government created the Atomic Energy Commission (AEC) within the Prime Minister's Office to oversee nuclear-related policies. Director of the newly created Science and Technology Agency (STC), an agency responsible for research on nuclear power, chaired AEC, while STC staff served as its secretariat. Concurrently, Japanese manufacturing companies began to form associations to import nuclear-related technologies from the United States; for example, Mitsubishi partnered with Westinghouse, and Toshiba and Hitachi with General Electric.

Under the leadership of the first AEC chair Shōriki Matsutarō, Japan began to adopt a two-track approach to nuclear power: manufactures and electric power companies pursued commercial use of nuclear power by importing technologies from the United States, whereas STC focused on scientific research on nuclear power by aiming to innovate nuclear-related technologies (Yoshioka 2011: Ch. 1).

When TEPCO asked AEC for permissions to construct multiple nuclear reactors at Fukushima Daiichi between 1966 and 1971, there was no regulation regarding anti-seismic measures. In fact, no standards of nuclear safety were legally codified at the time. Since the Japanese government was decidedly pro-nuclear, it had no organization dedicated to enforcing nuclear safety and instead left the responsibility to electric power companies. Thus, TEPCO conducted its own survey and estimated 265 Gal as the peak ground acceleration in case of an earthquake in the Fukushima area. AEC then approved TEPCO's estimate and authorized the construction of the Fukushima Daiichi Nuclear Power Plant (NAIIC 2012b: 63-64).

But, after the nuclear vessel Mutsu caused an accident that released radioactivity from its reactor in September 1974, the Japanese government began to establish an institutional framework for nuclear regulation. In September 1978, AEC created the Guideline for Anti-seismic Design Regarding Nuclear Reactor Facilities for Electricity Generation. In October 1978, the Nuclear Safety Commission (NSC), consisting of five specialists (mostly university professors), was newly created within the Prime Minister's Office to define guidelines on nuclear regulation. Separating NSC from AEC, the Japanese government tried to create an independent regulatory agency. Then, in July 1981, NSC revised the Guideline for Anti-seismic Design to specify 370 Gal as the peak ground acceleration that nuclear reactors must withstand in case of an earthquake.

The 1978 reform, however, was hampered by two problems. First, no law existed to enforce "backfit," an act to apply new safety standards to the existing nuclear reactors. All NSC could do was to request operators of the existing nuclear reactors to conduct "anti-seismic backchecks," to examine whether these reactors cleared new safety standards. This meant that Japan's nuclear regulation depended on whether the operators would volunteer to backcheck and backfit their nuclear reactors to meet new safety standards. Moreover, NSC's Common Issue Discussion Panel specifically stated in 1991 that "the accident management... shall be considered and implemented by the operators based on their 'technical competency' and 'expertise', but shall not require the authorities to regulate the specific details of measures" (reprinted

in NAIIC 2012b: 28). Here, NSC legitimated the institutional framework that deprived the regulatory agency of the power to enforce safety standards on the operators.

Second, NSC borrowed its secretariat staff from STA, an agency that conducted research on nuclear technologies (e.g., fast-breeder reactors) rather than on nuclear regulation. While NSC was supposed to function as an independent regulatory agency, it was actually run by government bureaucrats on loan from the pro-nuclear STA. Moreover, in the same year NSC was created, the power to grant permissions for constructing commercial nuclear reactors was transferred from AEC to the Ministry of International Trade and Industry (MITI), a predecessor of the Ministry of Economy, Trade and Industry (METI), that had promoted nuclear power by working closely with electric power companies since the late 1950s. Then, in September 1999, a nuclear accident happened at the Power Reactor and Nuclear Fuel Development Corporation in Tōkaimura, Ibaraki Prefecture, which caused two deaths and exposed more than 600 residents to radioactivity. This accident damaged STA's credibility that had been already tainted by the 1995 fire accident of Monju, a fast-breeder reactor in Fukui Prefecture, and the 1997 explosion accident at a nuclear reprocessing plant in Tōkaimura. As a result, STA was abolished and incorporated into the Ministry of Education, Culture, Sports, Science and Technology (MEXT) in January 2001, when the Japanese government was structurally reformed to increase administrative efficiency. AEC and NSC therefore lost their secretariats, while many of the functions previously performed by AEC and NSC secretariats were transferred, through the same structural reform, to NISA, a regulatory agency newly created within the pro-nuclear METI.

After the 2001 structural reform, the Japanese government tried to strengthen nuclear regulation, including anti-seismic countermeasures. In September 2006, for example, NSC revised the 1981 Guideline for Anti-seismic Design by raising the anti-seismic safety standard from 370 to 600 Gal in light of the 1995 Great Hanshin Earthquake and new findings in earthquake science. NISA then requested operators to conduct anti-seismic backchecks on their nuclear reactors according to the new NSC guideline by setting June 2009 as the deadline for final reports. By June 2009, however, TEPCO submitted to NISA only interim anti-seismic backcheck reports on Units 1 through 6 of Fukushima Daiichi based on limited assessments. TEPCO also decided to postpone the completion of comprehensive assessments until January 2016 by disregarding NISA's original request (NAIIC 2012b: 63-69).

Similarly, TEPCO tried to discount countermeasures against tsunami.

In 1993, the Agency for Natural Resources and Energy requested TEPCO to estimate the maximum height of tsunami that could hit the Fukushima Daiichi. In response, TEPCO estimated the height as 3.5 meters. TEPCO increased the number to 5.7 meters in 2002 in response to the new estimate by the Japan Civil Engineering Association. Then, in 2006, NISA requested the operators to devise concrete countermeasures against tsunami exceeding the estimated maximum height. By 2008, TEPCO recognized the possibility that tsunami could flood cooling water pumps to damage nuclear reactors in light of the 2004 Indian Ocean Earthquake and Tsunami and the 2005 Miyagi Earthquake. Around the same time, TEPCO also estimated that tsunami as high as 15.7 meters might hit Fukushima Daiichi. However, TEPCO did not install countermeasures until November 2009, and all it did was to modify cooling water pumps at Units 5 and 6 to be able to withstand tsunami of 6.1 meters high (NAIIC 2012b: 83-86).

Expertise Asymmetry between Regulators and Operators

The lack of sufficient authority on the part of regulatory agencies was compounded by another crucial organizational failure caused by the institutional framework of Japan's nuclear regulation: regulatory agencies did not possess the amount of expertise necessary for effectively regulating operators of nuclear reactors. All the investigative reports acknowledged that operators had far more expertise than did regulators (IC 2012, NAIIC 2012a, b, RJIF 2011). This expertise asymmetry manifested most clearly in the process through which NSC deliberated on the necessity of installing countermeasures against a station blackout (SBO), a situation where a nuclear power plant loses all power supplies. When NSC was preparing a new version of the Guideline for Anti-seismic Design between 1991 and 1993, NSC staff requested electric power companies to draft a section of the new guideline on behalf of NSC and allowed them to reject the possibility of a SBO. In fact, not only the leader of the NSC sub-committee responsible for examining SBO countermeasures was an employee of an electric power company on loan to STA, but also employees of TEPCO and the Kansai Power Electric Power Company attended every meeting of the sub-committee and assisted NSC staff (NAIIC 2012b, 501). Although the NAIIC report described this situation as "regulatory capture," it may well be called "regulatory capitulation."

The three investigative reports blamed the system of employment of government bureaucrats for the lack of expertise on the regulator's side. In Japan, government bureaucrats consist roughly of two types: elites who rotate positions every 2–3 years, and non-elites who stay in the same positions for

relatively long time. Since elite bureaucrats occupied top positions in NSC's secretariat (STA prior to 2001 and the Cabinet Office thereafter) and in NISA, both NSC and NISA were unable to mobilize sufficient expertise in nuclear regulation. The employment system excluded non-elite bureaucrats in NSC and NISA who accumulated some expertise from the process of decision-making, forcing leaders of the two regulatory organizations to acquire knowledge of nuclear reactors from employees of electric power companies (NAIIC 2012b: 558, RJIF 2012: 299).

This organizational structure of Japan's regulatory agencies prevented the effective use of new nuclear-related knowledge that began to accumulate after the 1986 Chernobyl Nuclear Disaster. In 1996, for example, the International Atomic Energy Agency (IAEA) upgraded its guidelines for countermeasures against a severe accident (SA). Moreover, countries like the United States and France began to expand the definition of SA to include tsunami, earthquakes, and terrorist attacks and updated their SA countermeasures accordingly. But NSC and NISA could not keep up with the changing international standards of nuclear regulation. As NSC chairman Madarame Haruki admitted after the Fukushima Daiichi Nuclear Disaster, "It was a fundamental mistake not to consider a SA... Our safety standard has not kept up with the international standard at all. In a sense, we are conducting safety inspection based only on technical knowledge that was available 30 years ago" (reprinted in NAIIC 2012b: 121).

To be sure, the Japan Nuclear Energy Safety Organization (JNES) was established in 2003 to provide NISA staff with expert knowledge of nuclear safety. Since NISA itself was part of the pro-nuclear METI, however, it did not actively make use of JNES to improve nuclear regulation. In 2008, for example, JNES carried out research on how to improve assessments of countermeasures against earthquakes and concluded that tsunami posed high risks of causing damages to nuclear power plants, but the research result was not adopted by NISA (RJIF 2012: 273). Since elite bureaucrats occupying top positions knew that they would be rotated back to the pro-nuclear METI, they tended to avoid acting against METI's interests while working at NISA. Moreover, JNES outsourced approximately 85 % of its total budget to outside research institutes and manufacturers of nuclear reactors to conduct research on nuclear safety (RJIF 2012: 303). This indicates that JNES failed to provide NISA with independent expertise in nuclear safety.

As a result, NISA was unable to check whether nuclear reactors in Japan actually met the safety standards specified in the NSC guidelines. Instead, NISA checked safety inspection reports submitted by operators simply

to see whether the operators conducted safety inspection according to the guidelines—without independently verifying the validity of the reports. As Hirai Norio, a technician who supervised the construction of nuclear plants for twenty years, testified, "Inspectors who lack skills cannot conduct meaningful inspection. But, in reality, regulatory agencies approve the construction simply by listening to explanations offered by manufacturers and engineers and by looking at required paperwork" (reprinted in Kaido 2011: 129). Thus, the vulnerabilities of the Fukushima Daiichi Nuclear Plant against earthquakes, tsunami, and a SA persisted until March 11, 2011.

Ongoing Reforms of Japan's Nuclear Regulation

In light of these institutional flaws and organizational failures that contributed to the Fukushima Daiichi Nuclear Disaster, the three investigative reports made recommendations on how to reform Japan's nuclear regulation. Roughly speaking, their recommendations revolved around the three keywords: independence, expertise, and transparency. First, the reports recommended that the institutional framework of nuclear regulation should make regulatory agencies independent of both promoters of nuclear power and operators of nuclear reactors. NISA, for example, lacked both kinds of independence: it depended on the pro-nuclear METI in terms of human and financial resources and colluded with electric power companies in sabotaging the installation of adequate safety measures. Second, the reports argued that regulators needed to acquire more expertise than operators, so that the former can effectively conduct safety checks on the latter. Specifically, the reports recommended that the term of employment at regulatory agencies should be lengthened to allow regulators to acquire sufficient expertise in nuclear safety. Finally, the reports recommended that the process of nuclear regulation should be made transparent to the public, so that concerned citizens and NGOs can monitor activities of regulators and operators.

In response to these recommendations, the Japanese government began to reform the institutional framework of nuclear regulation. In September 2012, the Nuclear Regulation Authority (NRA) was established within the Ministry of Environment (MOE) to replace NSC. The new law that authorized the establishment of NRA aimed to strengthen regulators' independence from the pro-nuclear METI and electric power companies; for example, all members of NRA secretariat are banned from rotating to pro-nuclear ministries and agencies as well as from switching to jobs in the nuclear industry. [1]

Although this ban can strengthen autonomy of regulators, it does not correct the existing asymmetry of expertise between regulators and operators,

except by allowing members of NRA secretariat to accumulate expertise on the job. The Japanese government recognized this problem and thereby stipulated in the sixth article of the new law that experts of nuclear safety should be actively recruited from universities and research institutes, while members of the NRA secretariat should be guaranteed the opportunities to interact with people at universities and research institutes, both inside and outside of Japan, to acquire up-to-date knowledge of nuclear safety. Put another way, the Japanese government has begun to increase expertise available to regulatory agencies through cooperation with higher education.

The Education System as a Producer and Distributor of Expertise

Indeed, higher education or, more generally, the education system, is a key societal institution that produces experts by fulfilling two functions. One function is to institutionalize collective representations of the world by inculcating common schemas in schooled populations (McEneaney and Meyer 2000). For example, social studies teach students how society works, and science teaches laws and mechanisms governing the physical world. The education system is a "secular religion" in modern society in the sense that it offers a cosmology based on "scientific rationality" (Meyer 1994). Another function is to institutionalize educational credentials as prerequisites for occupying positions in society (Meyer 1977). The education system does this by defining educational credentials as proxies of competence to perform certain tasks effectively. This is why the education system has become a locus of stratification in the contemporary world (Bourdieu 1983).

These two functions of the education system legitimate the value of expertise. At school, students learn that the world, physical or social, has an order and can be explained by science, and that educational credentials serve as proxies of competence. Consequently, people come to believe that those who have acquired proper scientific knowledge—experts—should play an important role in solving societal problems (Benavot and Braslavsky 2007; Drori, Meyer, and Hwang 2006). Indeed, professionals are authorized to advise ordinary citizens and policymakers because their expertise is institutionalized at societal level (Brint 1994). Especially in politics, natural and social scientists regularly serve on policy commissions and give their input to policymakers who then propose and legitimate particular policies by invoking scientific expertise (Jasanoff 1990). This is why the Japanese government tries to reform the institutional framework of nuclear regulation to provide regulatory agencies with more expertise by strengthening their ties with universities and research institutes, which are central to the production of experts.

However, I argue that the government's reform plan is problematic because the Japanese education system itself fails to produce expertise necessary for strengthening Japan's nuclear regulation. First of all, the Japanese education system has produced a small number of experts in nuclear-related fields. Between 2008 and 2009, for example, a total of 302 students entered nuclear-related graduate programs in Japan, compared with a total of 2,721 students in the United States during the same two-year period (Table 1).[2] This approximately nine-fold difference between Japan and the United States nearly doubles in proportion, when comparing the numbers of nuclear reactors in Japan and the United States at the time of the Fukushima Daiichi Nuclear Disaster, 54 and 104, respectively. Similarly, while the Nuclear Regulatory Commission (NRC) in the United States had nearly 4,000 staff members as of March 2011, NSC and NISA had only about 430. [3]

Table 1. Numbers of students entering nuclear-related fields

	2008		2009	
	Undergraduate	Graduate	Undergraduate	Graduate
Japan	42	141	46	161
USA	2102	1239	2323	1482

Here, the relatively small number of experts in nuclear-related fields in Japan seems to be rooted in the larger problem in Japanese higher education—namely, the underdevelopment of graduate programs. Table 2 shows that Japan's overall Ph.D. graduation rate has been consistently below the OECD average since 1998, and that graduate programs in natural science and engineering in Japan produced significantly fewer Ph.D.s in 2008, compared with some of the OECD member countries that the Japanese government designated as a reference group.[4] These data indicate that Japan has a small amount of expertise at the societal level that can be mobilized for nuclear regulation.

Table 2. Ph.D. graduation rates and numbers of new Ph.D.s

	Ph.D. graduation rate (percentage of graduates to the population at the typical age of graduation)			Number of new Ph.D.s per million	
				Natural science and engineering	Social science
	1998	2003	2009	2008	2008
Japan	0.5	0.8	0.9	42.8	8.3
USA	1.3	1.2	1.2	76.5	25.6
UK	1.2	1.8	1.2	141.9	42.4
Germany	1.8	2	2.2	114.8(2009)	43.1(2009)
OECD average	1	1.3	—	—	—

Moreover, I argue that the small number of experts, especially top-ranked ones, tend to be monopolized by the Japanese government, which has weakened the capacity of Japan's civil society to mobilize counter-expertise to challenge the existing collusion between the regulators and operators of nuclear reactors. In Japan, universities are ordered within a fairly rigid hierarchy based on rankings that large, national cram schools create based on scores of practice entrance exams. According to these rankings, Tokyo University is always considered as the most selective in Japan. Tokyo University was the first national university founded in 1886, and it has produced leaders in politics, industries, law, arts, and science. Since national universities were incorporated in 2004, Tokyo University has continued to receive by far the largest amount of funding from the Japanese government. Within the hierarchy of higher-education institutions, Tokyo University is followed by a pack of six other former national universities (Hokkaido, Tohoku, Nagoya, Kyoto, Osaka, and Kyūshu) and top private universities (e.g., Keiō and Waseda).

This hierarchy is made clear and rigid by the nationwide educational practice, where students decide which universities they will apply for by matching their practice exam scores with university rankings created by the college preparation industry. These rankings are powerful to the extent that high school teachers (and parents) refer to them in advising students. The majority of high school students are also enrolled in cram schools, and high schools depend on the college preparation industry to make practice entrance exams. As a result, students across Japan internalize a hierarchy of universities. That is one of the most important effects of education as an institution: to inculcate common schemas within a population. Such an institutional effect is strong in Japan where school curricula are highly homogeneous because they are centrally regulated by the National Curricular Guidelines and various administrative directives issued by MEXT.

Take, for example, the five NSC members who dealt with the Fukushima Daiichi Nuclear Disaster: Madarame Haruki (chair), Kugita Yutaka, and Oyamada Osamu graduated from Tokyo University, Shirotani Seiji from Kyoto University, and Kuzumi Shizuyo from Hiroshima University.[5] Kugita has a Ph.D. in nuclear engineering, Madarame, Oyamada, and Shirotani have master's degrees in nuclear engineering, Kuzumi has a medical degree. Kugita, Madarame, and Shirotani were professors of nuclear engineering at Nagoya, Tokyo, and Kyoto Universities, respectively, while Oyamada was the head of the Japan Atomic Energy Research Institute, later restructured and renamed as Japan Atomic Energy Agency (JAEA). Similarly, among the newly appointed five NRA members, Shimazaki Kunihiko and Fuketa Toyoshi

graduated from Tokyo University. Tanaka Shun'ichi (chair) graduated from Tohoku University, Nakamura Kayoko from Tokyo Institute of Technology, and Ōshima Kenzō dropped out from Tokyo University.[6] Fuketa and Tanaka have Ph.D.s in engineering and worked at JAEA, Nakamura has a Ph.D. in science and specializes in medical isotopes, and Shimazaki has a master's degree in earthquake science and chaired the Seismological Society of Japan and the Coordinating Committee for Earthquake Prediction in Japan.

In contrast, the social movement against nuclear power in Japan has very little expertise in nuclear-related fields. Take, for example, the Citizens' Nuclear Information Centre (CNIC), the most prominent NGO in the anti-nuclear movement. Founded in 1975 by Takagi Jinzaburō (deceased in 2000), a former professor in nuclear chemistry with a Ph.D. from Tokyo University, CNIC has organized numerous seminars and conferences and made policy recommendations on nuclear regulation. At the time of the Fukushima Daiichi Nuclear Disaster, CNIC had three co-chairs and a few other full-time staff members. Among the three co-chairs, Yamaguchi Yukio has a Ph.D. in nuclear engineering from Tokyo University, Ban Hideyuki has a B.A. in literature from Waseda University, and Nishio Baku is a dropout from Tokyo University of Foreign Studies.[7] In short, the most prominent anti-nuclear NGO has only one expert from a top-ranked university.

To be sure, anti-nuclear NGOs themselves do not have to possess expertise but can cooperate with university professors who are experts in nuclear-related fields. Indeed, since the late 1970s, two associate professors and four lecturers specialized in nuclear reactors at Kyoto University has organized the Nuclear Safety Research Group (NSRG) to publish critical reports on dangers of nuclear reactors based on research on the Three Mile Island Accident and Chernobyl Nuclear Disaster.[8] Especially after the Fukushima Daiichi Nuclear Disaster, two of the NSRG members, Imanaka Tetsuji and Koide Hiroaki, worked closely with anti-nuclear NGOs across Japan to give presentations to disseminate information about dangers of nuclear reactors and problems in Japan's nuclear regulation. However, NSRG is an exception: professors in science and engineering in Japan rarely cooperate with NGOs. Besides, since members of NSRG have been marginalized in their fields of research due to their activism, their credibility is not always recognized by ordinary citizens who do not take active part in the anti-nuclear movement.

In fact, this expertise deficit on the part of anti-nuclear NGOs seems to undermine their credibility in the minds of the Japanese public. The 2012 online survey, the Edelman Trust Barometer, showed that respondents from eighteen countries rated NGOs as significantly trustworthier than mass media,

corporations, and governments, whereas Japanese respondents rated NGOs as the least trustworthy organizations alongside the government.[9] The same survey also showed that university professors and technical experts continued to enjoy higher levels of trust than NGOs, even though trust in all types of organizations and professionals decreased after the nuclear accident. Similarly, an online survey conducted by the Centre for Research on Trust and Safety in Japan in June 2011 showed that respondents trusted experts affiliated with universities and research institutes more than NGOs and government agencies.[10] These surveys suggest that people in Japan retained their trust in experts even after the Fukushima Daiichi Nuclear Disaster. Thus, although public trust in the government decreased after the nuclear disaster, they were not yet willing to trust NGOs, either. This low level of trust in both the government and NGOs therefore seems to help the former retain its relative advantage over the latter: while the Japanese government continues to mobilize top-ranked scientific experts for its policy commissions, NGOs continue to have difficulty in mobilizing a sufficient number of counter-experts who can match their governmental counterparts in terms of credentials and trustworthiness.

Thus, in addition to the asymmetry of expertise between regulatory agencies and operators of nuclear reactors, another asymmetry of expertise exists between the Japanese government and the civil society, for the Japanese education system has produced a small number of experts in nuclear-related fields and aligned top-ranked ones with the pro-nuclear government. I argue that this asymmetry of expertise between the government and the civil society has fundamentally compromised the institutional framework of Japan's nuclear regulation. The absence of "researchers in the wild," experts capable of mobilizing critical counter-expertise against the government, prevents members of a democratic society from having robust scientific debates (Callon, Lascoumes, and Barthe 2009). Contrary to the perception of experts supporting their claims with "scientific truths," it is the norm rather than the exception that experts are divided over a scientific problem under consideration (Latour 1999, 2004). Here, the fact that the quality and quantity of expertise that the Japanese government can mobilize with regard to nuclear regulation far exceeds its nongovernmental counterpart risks allowing the government to dominate public debates by prematurely foreclosing questions and objections from citizens.

But I suggest that the problem with Japan's nuclear regulation runs even deeper: regulatory agencies, not to mention NGOs, seem to lack sufficient expertise not only in the fields of nuclear physics and engineering but also in the fields of social science pertaining to institutional and organizational

problems in nuclear regulation. Table 2 shows that in 2008 the number of new Ph.D.s in social science in Japan is about one fifth of the number in science and engineering. Compared with the other OECD countries that the Japanese government designates as a reference group, the absolute number of new Ph.D.s in social science is smaller in Japan. So is the proportion of new Ph.D.s in social science to those in science and engineering: 1 to 5.2 in Japan, whereas 1 to 3 in the United States, 1 to 3.3 in the United Kingdom, and 1 to 2.7 in Germany.

Here, I argue that organizational failures within the institutional framework of Japan's nuclear regulation are ultimately rooted in the significant weakness of social-scientific expertise. Generally speaking, science and technology are coextensive with society (Jasanoff 2006; Latour 2004). This is also true of the act of operating nuclear reactors, which consists of complex assemblages of scientific knowledge, engineering technologies, and laws and organizations to coordinate actions of operators and regulators, among many other elements. This means that nuclear safety cannot be ensured only by nuclear scientists and engineers. It also requires expertise from people who specialize in studies of institutions, organizations, politics, and the economy, i.e. *social* underpinnings of nuclear power. Put another way, social-scientific expertise is as important as natural-scientific expertise in helping to fix organizational and institutional problems in Japan's nuclear regulation. Yet, prior to the Fukushima Daiichi Nuclear Disaster, the Japanese education system significantly under-produced the former kind of expertise. Indeed, this failure of the Japanese education system is evinced not only by the statistics presented above but also by the contents of school curricula and textbooks in energy and environmental education.

Energy and Environmental Education in Japan

In Japan, social science is marginalized in school curricula, compared with the humanities and natural science (Kusahara 2010). In high schools, for example, Japanese students choose one of the two tracks: arts and science. In the Japanese context, "arts" means the humanities, such as history and literature, whereas "science" means natural science. The same tracking is replicated at the level of higher education. Typically, social science is subsumed under the faculties of arts and considered as part of the humanities. Given that social science is not established as an independent field of research at the university level, social studies in primary and secondary education also remains weak. Indeed, social-studies lessons in Japan's primary and secondary education predominantly focus on memorization of facts about history, the economy, and

the government. In social studies, students have few opportunities to develop the ability to critically examine the working of society by asking what kinds of social problems exist and how these problems come about (Tsuchiya 2011; Uozumi et al. 2010).

The weakness of social science and social studies is coterminous with the second structural problem in Japanese school curricula: their strong emphasis on moral education. MEXT defines moral education as the central pillar of school curricula. MEXT's Curricular Guidelines not only allocate weekly lesson periods to moral education but also require teachers to incorporate elements of moral education in lessons of all the other subjects as well as in every important school event.[11] Even though moral education is indispensable for human development, it demands students obey authorities and cooperate for group-level goals (Sato 2004; Tsuneyoshi 2001). For example, school activities in Japan often aim to inculcate in students respect for their seniors, such as teachers. Activities also try to instill the habits of orienting individual behaviors to groups. As a result, school activities in Japan tend to discourage students from developing the abilities to question the status quo, articulate their own thoughts, and work through disagreements. Given the educational emphasis on respect for authorities, Japanese students are not sufficiently trained in questioning whether orders from the authorities are reasonable or not. Nor are they comfortable with dissenting from other group members because they are taught to give priority to group-level goals over individual interests and needs. Those who question teachers and express their dissenting opinions are often regarded as disrespectful and selfish.

This dominance of moral education vis-à-vis the weakness of social-scientific orientation is reproduced in energy and environmental education in Japan (Table 3).[12] To begin with, lesson plans recommended by both governmental and nongovernmental organizations give priority to moral lessons. Typically, these moral lessons in energy and environmental education take two forms. First, moral lessons promote outdoor activities to increase students' appreciation of and attachment to the natural environment. This type of experiential learning is most common at elementary schools. Second, moral lessons emphasize the importance of energy efficiency. They ask students to find ways to save energy in their daily activities by reminding them of the fact that electricity generation based on fossil fuel harms the natural environment. These lessons are moral in the sense that they try to inculcate in students certain values and dispositions to actively protect the natural environment.

Table 3. Classification of lesson plans in energy and environmental education

	Moral education (affective)	Natural science (congnitive)	Social science (congnitive)	Problem solving (critical)	Total
Govermmental	29	3	2	0	34
Nongovermmental	11	32	32	9	84
Total	40(33.9%)	35(29.7%)	34(28.8%)	9(7.6%)	118(100%)

That governmental lesson plans emphasize moral education is consistent with MEXT's Curricular Guidelines that define the objective of environmental education as "the cultivation of morality as the basis of education of the Japanese who will contribute to the conversation of the natural environment."[13] In turn, lesson plans offered by nongovernmental organizations focus on cognitive aspects of energy and environmental problems from perspectives of both natural and social sciences. These lesson plans focus on how to help students learn ways in which electricity is generated and consumed in society and help them understand existing environmental problems, ranging from local waste disposal to global climate change.

As a result, energy and environmental education in Japan tends to marginalize a critical kind of social-scientific thinking that analyzes existing structures of society in such a way that students can explore ways to act on their knowledge to transform their local environment. Moral education, on the one hand, imposes certain values on students and thereby fails to cultivate the ability to critically analyze existing structures of society that cause various environmental problems. It can also minimize students' internal and external "political efficacy" by confining the scope of their moral actions to their everyday life and by shielding them from critical encounters with the existing structures of society (Kahne and Westheimer 2006). Cognitively oriented lessons in natural and social sciences, on the other hand, tend to provide students only with readily available information to be memorized. Although the intake of new knowledge is no doubt an important part of students' cognitive development, it does not offer them the opportunities to take actions outside the classroom to explore their political efficacy.

To be sure, there are a small number of lesson plans that encourage students to critically debate pros and cons of nuclear power and explore ways to make society more sustainable. However, these lesson plans, if they are action-oriented at all, suggest to students only the promotion of energy efficiency, a kind of action that students can do easily and successfully without calling into question the structural parameters of their everyday life and the mechanisms that cause energy and environmental problems. Missing from these lesson plans is the education of citizens with critical analytical skills and

keen interests in solving social problems confronting their society.

This weakness of civic education is indeed consistent with the fact that Japan's civil society is largely subordinated to the government (Aldrich 2010, Ogawa 2009, Pekkanen 2006, Schwartz and Pharr 2003). A majority of civic associations in Japan have traditionally played a supplemental role to the government by mobilizing local populations to help to implement government policies pertaining to economic development, education, and social welfare. Even though the Nonprofit Activities Promotion Law in 1998 increased the number of nongovernmental organizations in Japan, the majority of Japanese NGOs are chronically short on financial and human resources. Only a handful of NGOs can afford to hire full-time staff to engage in extensive policy analysis and advocacy, and even these NGOs depend heavily on volunteer staff. Thus, in Japanese society at large, civic actors tend to be overpowered by the government. This weakness of Japan's civil society is, I suggest, compounded by the dominance of moral education, whereby many Japanese become adults without cultivating the habits of examining social problems critically and taking collective actions to challenge the status quo.

But this does not mean that the Japanese government, which overpowers the civil society, has sufficient social-scientific expertise. In fact, the Fukushima Daiichi Nuclear Disaster has exposed that Japanese politicians and government bureaucrats, too, lacked social-scientific expertise in critically diagnosing institutional flaws and organizational failures in Japan's nuclear regulation and taking necessary actions to resolve them. Here, the weakness of social-scientific thinking is a society-wide problem. In this respect, the official statement from NAIIC chairman Kurokawa Kiyoshi is suggestive: "What must be admitted—very painfully—is that this was a disaster 'Made in Japan'. Its fundamental causes are to be found in the ingrained conventions of Japanese culture: our reflexive obedience; our reluctance to question authority; our devotion to 'sticking with the program'; our groupism; and our insularity" (NAIIC 2012a: 9). Even though Kurokawa's statement can be faulted for its essentialist stereotypes of the Japanese people and culture, it does contain a grain of truth. Obedience to authority and subordination of individuals to a group has been promoted by moral education, the central pillar of the Japanese education system, at the expense of civic education based on critical and action-oriented social science. The nuclear disaster was indeed "made in Japan," and the Japanese education system was partially responsible for it.

Conclusion and Implications

In this paper, I have argued that the Fukushima Daiichi Nuclear

Disaster revealed the education system as the weakest link in the institutional framework of Japan's nuclear regulation. As the investigative reports pointed out, the nuclear disaster was caused primarily by the organizational failures of Japan's nuclear regulatory agencies, such as NSC and NISA, allowing TEPCO to sabotage the installation of adequate countermeasures against earthquakes and tsunami. These organizational failures in turn stemmed from the flaws in the institutional framework of Japan's nuclear regulation: the regulators lacked both sufficient power to enforce safety standards on the operators and sufficient expertise to effectively conduct safety checks on nuclear reactors. To address these problems, the Japanese government began to reform the institutional framework to give the newly established NRA sufficient power to enforce safety standards on the operators and sufficient organizational independence from pro-nuclear ministries and electric power companies. While the Japanese government is also trying to strengthen expertise available to NRA, I have shown that this effort is insufficient because it does not fully consider the existing state of the Japanese education system as a key producer and distributor of relevant expertise.

Put another way, any attempt to strengthen the regulator's expertise needs to take into account the two existing weaknesses in the Japanese education system. First, the Japanese education system has produced only a small number of experts in nuclear-related fields and aligned top-ranked ones with the pro-nuclear government. Unless the Japanese education system begins to produce a greater number of experts and allow top-ranked ones to work with NGOs critical of nuclear power, Japan's nuclear regulation will continue to risk being compromised by the pro-nuclear METI and electric power companies. Second, and perhaps more important, the Japanese education system has downplayed social science in favor of natural science. Since nuclear safety is located at the intersection of society and science-technology, greater expertise in nuclear-related fields alone will be insufficient to improve Japan's nuclear regulation. In fact, the Fukushima Daiichi Nuclear Disaster was caused mainly by institutional and organizational problems that would fall within the scope of social-science disciplines. It will be therefore crucial for the Japanese government to strengthen the regulator's expertise not only in nuclear-related fields of natural science and engineering but also in social science.

To this end, I suggest that the Japanese government consider two options. One is to expand graduate programs in both natural and social sciences so as to increase the amount of expertise at the societal level-not only NRA will acquire sufficient expertise to effectively regulate the operators of nuclear reactors, but also Japan's civil society will gain sufficient counter-

expertise capable of monitoring both the government and the operators. In fact, the government already began to push Japanese universities to strengthen their graduate programs in response to globalization of higher education in the early 2000s (Ishikawa 2011, Yonezawa 2007). This effort by the Japanese government and universities to pursue prestige at the global level may well facilitate the needed expansion of expertise in nuclear regulation at the societal level. Another option available to the Japanese government is to continue to shift the curricular focus from memorization to problem solving. Since the late 1990s, the Japanese government has revised the Curricular Guidelines to increase the weight of problem solving to educate the Japanese people with the "zest for living (*ikiru chikara*)" or the strength to thrive in a complex, constantly changing global world (Cave 2001, Ministry of Education 1996, Saito 2011). As part of this ongoing curricular reform, energy and environmental education in Japan can be made more problem-solving oriented so as to help students develop critical analytical skills and acquire political efficacy to take actions that will challenge the existing structures of society.

These educational reforms to strengthen social-scientific expertise are urgently needed in post-Fukushima Japan. A variety of important policy problems confronting Japan today are fundamentally political and economic in their nature. To name only but a few: how to promote renewable-energy technologies to decrease Japan's dependency on nuclear power, how to rethink fast-breeder fuel cycles vis-à-vis disposal of spent nuclear fuels. To tackle these problems, moral commitments to sustainability or technological innovations will be insufficient. Needed is the ability to critically analyze and re-envision Japanese society from social-scientific perspectives. The cultivation of this ability will require significant reforms of the Japanese education system.

Notes

* For their helpful comments on earlier versions of the paper, I thank participants in Science, Knowledge and Technology Section Session at the 2012 Annual Meeting of American Sociological Association. This research was partly supported by the Social Science Research Council-Japan Society for the Promotion of Science Fellowship and institutional affiliation with the Institute of Social Science at the University of Tokyo during the 2011–2012 academic year.

1 The Act on the Creation of the Nuclear Regulation Authority, June 27, 2012: HYPERLINK "http://law.e-" http://law.e-gov.go.jp/announce/H24HO047.html (accessed December 10, 2012).

2 The Japanese data come from the presentation by MEXT on May 29, 2012: www.aec.go.jp/jicst/NC/tyoki/sakutei/siryo/sakutei20/siryo2-2.pdf (accessed December 10, 2012).

The American data come from the JAEA newsletter, 2009, volume 3: www.jaea.go.jp/03/senryaku/topics/t09-3.pdf (accessed December 10, 2012).

3 The number of NRC staff members is specified in the NAIIC report (2012b: 570). The number of NSC and NISA employees is specified in the memo circulated at the AEC meeting on February 22, 2011: http://www.aec.go.jp/jicst/NC/iinkai/teirei/siryo2011/siryo07/siryo2.pdf#page=1 (accessed December 20, 2012).

4 Data on Ph.D. graduation rates come from OECD Education at Glance in 2000, 2005, and 2011: http://www.oecd-ilibrary.org/education/education-at-a-glance_19991487 (accessed December 20, 2012). Numbers of new Ph.D.s per million were calculated based on two different data sets. The first data set on numbers of new Ph.D.s comes from the 2012 cross-national comparison by MEXT: www.mext.go.jp/b_menu/toukei/data/kokusai/__icsFiles/afieldfile/2012/07/26/1318687_2_1.pdf (accessed December 20, 2012). The second data set on populations comes from the Statistics Bureau at the Ministry of Internal Affairs and Communications: www.stat.go.jp/data/sekai/zuhyou/0204.xls (accessed December 20, 2012).

5 For profiles of NSC members, see http://www.nsr.go.jp/archive/nsc/annai/iin.htm (accessed December 20, 2012).

6 For profiles of NRA members, see http://www.nsr.go.jp/nra/ (accessed December 20, 2012). Ōshima does not have a B.A. because he dropped out from the university to become a diplomat, which is not unusual in Japan.

7 For profiles of CNIC members, see http://www.cnic.jp/aboutus/staff (accessed December 20, 2012).

8 For details of activities and publications by the Nuclear Safety Research Group, see http://www.rri.kyoto-u.ac.jp/NSRG/index.html (accessed December 20, 2012).

9 "2012 Edelman Trust Barometers Japan Results," Edelman Japan: http://www.slideshare.net/EdelmanJapan (accessed March 10, 2013).

10 *Tokyo Shinbun,* August 27, 2011.

11 Curriculum Guidelines, MEXT: http://www.mext.go.jp/a_menu/shotou/youryou/main4_a2.htm (accessed February 1, 2012).

12 Governmental lesson plans come from MEXT and MOE: *Kankyō kyōiku shidō shiryō, shōgakkou-hen (Materials for Teaching Environmental Education at Elementary School)* by the National Institute for Educational Policy Research, MEXT; and *Jugyō ni ikasu kankyō kyōiku (Lesson Plans for Environmental Education)* by MOE: http://www.env.go.jp/policy/nerai/ (accessed February 1, 2013). Nongovernmental lesson plans come from five teaching materials published by two publishers Meiji Tosho and Kokudosha and two online teaching materials by the Japan Association of Energy and Environmental Education (JAEEE) and the National Council for Energy Education (NCEE): *Mijikani hikiyoseru rnerugī no jugyō (Lessons on Energy in Everyday Life) by Meiji Tosho; Enerugī kankyō kyōiku no gakushūyou Kyōzai, shōgakkou-hen (Materials for Teaching Energy and Environmental Education at Elementary School), Enerugī kankyō kyōiku no gakushūyou kyōzai, chūgakkō kōtougakkou-hen (Materials for Teaching Energy and Environmental Education at Junior High and High Schools), Enerugī kankyō kyōiku no riron to jissen (Theory and Practice in Energy and Environmental Education), and Enerugī kankyō kyōiku no jissen (Practice in Energy and Environmental Education)* by Kokudosha; "Jugyō jissen jirei (Example Lessons)" by JAEEE: http://www.jaeee.jp/ (accessed February 1, 2013); and "Sankō kyōzai (Reference Materials)" by NCEE:

http://www.eneducation.jp/san/index.html (accessed February 1, 2013).

13 "Components of the New Curriculum Guidelines pertaining to Environmental Education," MEXT: http://www.mext.go.jp/b_menu/shingi/chousa/shisetu/013/003/shiryo/attach/1299713.htm (accessed February 1, 2013).

References

Aldrich, D. P. (2010) *Site Fights: Divisive Facilities and Civil Society in Japan and the West* (Ithaca: Cornell University Press).

Benavot, A. and Braslavsky, C. (eds) (2007) *School Knowledge in Comparative and Historical Perspective: Changing Curricula in Primary and Secondary Education* (Dordrecht: Springer).

Bourdieu, P. (1983) The Forms of Capital. In J. G. Richardson (ed), *Handbook of Theory and Research for the Sociology of Education* (New York: Greenwood), 241–258.

Brint, S. (1994) *In an Age of Experts: The Changing Role of Professionals in Politics and Public Life* (Princeton: Princeton University Press).

Broadbent, J. (1998) *Environmental Politics in Japan: Networks of Power and Protest* (Cambridge: Cambridge University Press).

Callon, M., Lascoumes, P. and Barthe, Y. (2009) *Acting in an Uncertain World: An Essay on Technical Democracy* (Cambridge, MA: The MIT Press).

Cave, P. (2001) Educational Reform in Japan in the 1990s: "Individuality" and Other Uncertainties. *Comparative Education,* 37(2), 173–191.

Drori, G. S., Meyer, J. W. and Hwang, H. (eds) (2006) *Globalization and Organization: World Society and Organizational Change* (Oxford: Oxford University Press).

Fischer, F. (2000). *Citizens, Experts, and the Environment: The Politics of Local Knowledge* (Durham, NC: Duke University Press).

Fukushima Project (2012) *Fukushima Report* (Tokyo: Nikkei BP).

Investigation Committee on the Accident at the Fukushima Nuclear Power Station of Tokyo Electric Power Company (2012) *Final Investigation Report.* Available online at http://icanps.go.jp/post-2.html, accessed December 10, 2012.

Ishikawa, M. (2011) Redefining Internationalization in Higher Education: Global 30 and the Making of Global Universities in Japan. In D. B. Willis and J. Rappleye (eds), *Reimagining Japanese Education: Borders, Transfers, Circulations and the Comparative* (Oxford: Symposium Books), 193–223.

Jasanoff, S. (1990) *The Fifth Branch: Science Advisers as Policymakers* (Cambridge, MA: Harvard University Press).

Jasanoff, S. (ed) (2006) *States of Knowledge: The Co-production of Science and Social Order* (London: Routledge).

Kahne, J. and Westheimer, J. (2006) The Limits of Political Efficacy: Educating Citizens for a Democratic Society. *PS: Political Science and Politics,* 39(2), 289–296.

Kreps, G. A. (1984) Sociological inquiry and disaster research. *Annual Review of Sociology,* 10, 309–330.

Kusahara, K. (2010) *Daigaku no kiki: Nihon wa 21-seiki no jinzai wo ikusei shiteiruka* (Tokyo: Koubundō).

Latour, B. (1999) *Pandora's Hope: Essays on the Reality of Science Studies* (Cambridge, MA: Harvard University Press).

Latour, B. (2004) *Politics of Nature: How to Bring the Sciences into Democracy* (Cambridge, MA: Harvard University Press).
McEneaney, E. H. and Meyer, J. W. (2000) The Content of the Curriculum: An Institutionalist Perspective. In M. Hallinan (ed), *Handbook of the Sociology of Education* (New York: Kluwer Academic), 189–211.
Meyer, J. W. (1977) The Effects of Education as an Institution. *American Journal of Sociology,* 83(1), 55–77.
Meyer, J. W. (1994) The Evolution of Modern Stratification Systems. In D. B. Grusky (ed), *Social Stratification: Class, Race, and Gender in Sociological Perspective* (Boulder: Westview Press), 730–737.
Ministry of Education (1996) *21-Seiki o tenbōshita waga kuni no kyōiku no arikata ni tsuite* (Tokyo: Gyōsei).
National Diet of Japan Fukushima Nuclear Accident Independent Investigation Commission (2012a) *Executive Summary Global Edition.* Available online at: http://warp.da.ndl.go.jp/info:ndljp/pid/3856371/naiic.go.jp/en/report/index.html, accessed December 10, 2012.
National Diet of Japan Fukushima Nuclear Accident Independent Investigation
Commission (2012b) *Hōkokusho.* Available online at: http://warp.da.ndl.go.jp/info:ndljp/pid/3856371/naiic.go.jp/index.html,accessed December 10, 2012.
Ogawa, A. (2009) *The Failure of Civil Society? The Third Sector and the State in Contemporary Japan* (Albany: State University of New York Press).
Pekkanen, R. (2006) *Japan's Dual Civil Society: Members Without Advocates* (Stanford: Stanford University Press).
Perrow, Charles. 1984. *Normal Accidents: Living with High-Risk Technologies.* New York: Basic Books.
Quarantelli, E. L. (ed) (1978) *Disasters: Theory and Research.* London: Sage Publications.
Rebuild Japan Initiative Foundation (2011) *Fukushima Genpatsu Jiko Dokuritsu Kenshō Iinkai Chōsa kenshō hōkokusho* (Tokyo: Rebuild Japan Initiative Foundation).
Sato, N. E. (2004) *Inside Japanese Classrooms: The Heart of Education* (New York: RoutledgeFalmer).
Saito, H. (2011) Cosmopolitan Nation-Building: The Institutional Contradiction and Politics of Postwar Japanese Education. *Social Science Japan Journal,* 14(2), 125–144.
Schwartz, F. J. and Pharr, S. J. (eds) (2003) *The State of Civil Society in Japan* (Cambridge: Cambridge University Press).
Tierney, K. J., Lindell, M. K., Perry, R. W. (eds) (2001) *Facing the Unexpected: Disaster Preparedness and Response in the United States* (Washington, D.C.: Joseph Henry Press).
Tsuneyoshi, R. (2001) *The Japanese Model of Schooling: Comparisons with the United States* (New York: RoutledgeFalmer).
Tsuchiya, T. (2011) *Kaishakugata rekishi gakushū no susume: taiwao wo jūshishita shakaika rekishi* (Matsudo: Azusa Shuppansha).
Uozumi, T., Yamane, E., Fukakusa, M., Miyahara, S., and Tsuchiya, T. (2010) *21-seiki shakaika eno shōtai* (Tokyo: Gakujutsutosho Shuppansha).
Vaughan, D. (1996) *The Challenger Launch Decision: Risky Technology, Culture, and Deviance at NASA* (Chicago: University Chicago Press).
Vaughan, D. (1999) The Dark Side of Organizations: Mistake, Misconduct, and Disaster.

Annual Review of Sociology, 25, 271–305
Yonezawa, A. (2007) Japanese Flagship Universities at a Crossroads. *Higher Education,* 54(4), 483–499.
Yoshioka, H. (2011) *Genshiryoku no shakaishi: sono Nihonteki tenkai* (Tokyo: Asahi Shinbun Shuppan).