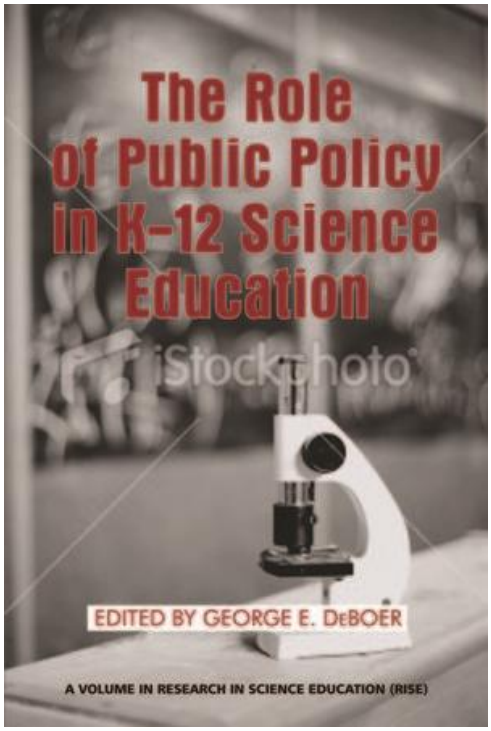
International Journal of Environmental & Science Education
Vol. 7, No. 4, October 2012, 651-657

Book Review

Paul Webb, *Section Editor*

The Role of Public Policy in K-12 Science Education



by

DeBoer, G. E. (Editor)

452 pages

Publication Date: 3 January, 2011

Publisher: Charlotte, NC: Information Age Publishing

ISBN 978-1-61735-224-9 (paperback)
ISBN 978-1-61735-225-6 (hard back)
ISBN 978-1-61735-226-3 (e-book)

"The goal of this [book] is to examine the relationship between science education policy and practice and the special role that science education researchers play in influencing policy." (back cover)

This book partially addresses the pressing international problems related to policies for change and changing policies in science education and to implementing reforms and influencing powerful people and public policy. DeBoer has assembled an interesting and informed panel of scholars, critical informants, and activists and has attempted to represent the international breadth of the problems. We found this volume informative but it mainly focused on the USA, which left us desiring an expanded and elaborated international perspective; its primary audience will be educational administrators, researchers, advocates, and lobbyists in the USA. Based on our interpretation of several international science education handbooks, recent special issues on international

ISSN 1306-3065

http://www.ijese.com/

assessments, and other internationally authored books and conference presentations that consider policy issues, we find them common to other jurisdictions; however, policy influence, formation, and implementation vary across centralized and decentralized national/federal, state/provincial, and local educational organizations. We have crafted this book review to generalize important ideas to the readership of the *International Journal of Environmental and Science Education*.

Summary

The book is organized into an introduction and three parts. DeBoer's introduction describes the political landscape underlying the science educational policy terrain in the USA from federal mandates, state benchmarks/testing, and local course offerings. He notes that (a) the dominant research strategy attempts to 'back fill' the evidence voids on enacted policies made by well-intended politicians, bureaucrats, and other powerful actors; (b) more research is needed on how science education research affects policy; and (c) more effort is needed to make high-quality research findings available to policymakers. "There are also opportunities for science education researchers to become actual policy researchers, that is, individuals who study the very interesting and complex process involved in policy formation and implementation." (p. 8).

Part I, by far the largest and most diverse, addresses the multiple influences on policy development and enactment—science education researchers, scientists, foundations, funding agencies, state departments, and science teacher associations. Chapters 2 and 6 provide overviews of the intersection between policy and practice and how some European Union member countries designed and implemented science education change. Osborne (Chapter 2) examined how the declining rate of interest in science-oriented careers (pipeline issue) and the general democratic need for science literacy amongst citizens (mainstream issue) influenced the English national science curriculum, which reframed secondary science courses to meet the needs of students seeking advanced study and of all students to critically assess events in techno-scientific societies. He pointed out that the "Failure by researchers to recognize the specific policy agenda of policy-makers [and the classroom realities of teachers] leads to a situation where the ideas and thinking of science education researchers are ignored." (p. 18). Sarmant, Saltiel, and Léna (Chapter 6) examined an inquiry-based science program entitled *La main* à *la pâte* (LAMAP) that was initiated by the French Academy of Sciences and three physicists. This case illustrated the influence scientific leaders can have on policy within the highly centralized educational system. The developers of LAMAP recognized and embodied the well-established context and traditions of French primary schools' emphasis on "fundamental skills of speaking, reading, writing and counting" and in convincing politicians that it would enhance literacy and the understanding of science (p. 169).

Kahle and Woodruff (Chapter 3) explored the impact of policy decisions such as the *National Science Education Standards* (NSES) and *No Child Left Behind* (NCLB) that specified types of content and pedagogical knowledge leading to curriculum design and to defining highly qualified teachers. However, "research does not provide support for the proposition that teacher content knowledge translates directly to student achievement" (p. 69) since much of the research on content knowledge did not consider the mediating effects of school environment and classroom practices, which points to the need to consider pedagogical content knowledge and end-user friendly ways of reporting results.

Chapters 4, 5, and 7 outline the influence that major foundations, federal funding agencies, and state departments of education, have had on US science education. Cheek and Quiriconi (Chapter 4) provided historical and current perspectives, described policies, and identified institutions directly linked with the work of tax-exempt foundations (especially the Ford, Carnegie, and Rockefeller foundations). "Many major reform efforts in science education were initiated by the

prompting of foundations or supported by foundation dollars long before any governmental entity was willing to extend support." (p. 112). Earle (Chapter 5) examined federal funding agencies and focused on the overall structure, goals, and mission of the National Science Foundation (NSF), its relationship with other federal agencies, and how it has influenced policy. "The priorities that NSF establishes through the budget development process, the development of program solicitations that call for particular kinds of work addressing national needs, and through the proposal submission and award process are all mechanisms that, over time, can result in incremental shifts in policy direction." (pp. 141-142). Cheek and Quiriconi (Chapter 7) described the constitutional relationships and early history of public education, which is delegated to the states and means that educational policy and practices vary within the uniqueness of all 50 states. They noted that there is a "paucity of research on state education agencies and K-12 science education policy to draw upon" (p. 175).

Chapters 8 and 9 focus on the central efforts and strategies to implement science education policy. Bybee (Chapter 8) discussed how assessment became the influential driver of education policy (including science); he stated that, "science education requires a consistent and coherent system that has a clear and coordinated set of purposes, policies, programs and practices" (p. 215). He described the structures and functions underlying the Programme for International Student Assessment (PISA) and the National Assessment of Educational Progress, reviewed their intended and unintended impacts on educational systems and policy, and pointed out how international assessments, state tests, and end-of-course evaluations influence future policy. Peterson (Chapter 9) reviewed the political process as to how scientific organizations, in this case the National Science Teachers Association (NSTA), influence politicians, policymakers, and bureaucrats. "Advocacy and the more specific type of advocacy known as lobbying are important activities in a democratic society" (p. 254); however, she is careful to delineate key differences between advocacy and lobbying in the legal sense regarding federal law and tax status.

Part II addresses the strategies used to influence and implement federal and state policy in science education and explores teaching, curriculum, and equity issues. DeBoer (Chapter 10) focused on the intersection of policy and its influence on teaching, using a historic perspective and his experience with Project 2061. He stated, "When compared to the curriculum traditions in other countries, this change is certainly significant. (p. 281). … [T]he courses taught, the content of many of those courses, and sequence in which they are taught in the United States is now determined by state-level policymakers" (p. 282). He pointed to how the accountability movement influences school practices and how policymakers and activists have attempted to include pseudoscience ideas: "[E]ven though anti-evolution groups have consistently lost in the courts, they continue to limit the teaching of evolution and to introduce non-scientific content into the science curriculum" (p. 289). Lynch (Chapter 11) stated that "[p]ublic policy often is seen as created in the best interests of the society, but looking back from the current vantage point, it is possible to see many policies have had negative consequences" (p. 306) within the multiple meanings of equity. She argued that, while progress is made in some areas, significant gaps remain in science education as it relates to equity and that the NCLB, funding inequities, level of educational resources/laboratories, and re-segregation of some public schools have implications for science educators.

De Lucchi and Malone (Chapter 12) discussed the positive and negative impacts of federal, state, and local policies on the design and implementation of science curriculum. Curriculum development "work is contoured by government and school policies and humanized by the realities of actual classroom practice" (p. 355). A current challenge revolves around some state standards that dissect the science curriculum into grade-specific requirements, making deeper understanding of science concepts more difficult. They outlined how less-specific learning outcomes

(i.e., state and local districts specify the details) allows "the flexibility of developing a wide range of materials, all of which would fit into the broader set of goals that had been described" (p. 391) and would promote students to "think critically about the natural world and be productive problem solvers" (p. 392).

Part III addresses managing educational reform and planned change. Halverson, Feinstein, and Meshoulam (Chapter 13) identified an apparent paradox for science education: "From the outside, it would seem inevitable that this wealth of science learning materials and professional development opportunities would make American science education a shining example of innovation and effective practice. On closer examination, however, this 'garden of plenty' looks very different (p. 398). These authors examined implementation and leadership within the context of reform movements. "The prevailing theory of action for science education reform is guided by a decontextualized view of teaching practice in which teaching can be shaped by standards, curriculum, and professional development with little regard to the contexts in which the practice takes place" (p. 404). One recurring theme that emerged was how resilient or resistant educational institutions can be to meaningful reform. They concluded that the role educational leadership plays within different school environments presented unique challenges at each level:

> Successful reformers need to work with and through school leaders simply because school leaders are best positioned to evaluate the 'fit' between a reform project and the local context, and can therefore play an important role in directing teachers toward reforms that are well suited to the overall circumstances of the school. (p. 424)

Critique

The book addressed important but poorly understood and engaged areas in science education—policy influence, formation, and implementation. Education in the USA is a decentralized domain, compared to France, with responsibility allocated to state governments. In some states, this responsibility is further devolved to local school boards and administrations. Any federal government involvement in science education has been based on some other justification related to national defence, economic competitiveness, or social justice in which funding is tied to some related aspects of students' lives—technology, postsecondary education and training programs, educational research, curriculum development, and teacher professional development. Some policy and funding insights were illuminating but outdated as contracting state economies and diminishing economic stimulus will hamper educational reforms and implementation (Johnson, Oliff, & Williams, 2011). Briefly, there are six straightforward conclusions drawn from this book.

First, policies do influence science curriculum, instruction, assessment, teacher education and certification, and instructional resources. The effects are varied with the greatest changes detected in curriculum and instructional resources and the least changes in classroom practices and assessment *for* learning. Numerous changes have been demonstrated in state and local curriculum documents and inquiry-oriented, constructivist instructional resources and assessment that reflect the NSES. However, the uptake of inquiry science teaching and formative assessment techniques to empower learning and inform instruction is less apparent. Much of the reform efforts have been devoted to accountability and high-stakes assessment *of* learning required by NCLB.

Second, understanding what affects policy formation and interpretation is much less clear and complex within the federal–state–local political processes even when consideration of policy is limited to the binding statements made by governments' legal representatives. Environmental and science education advocates, lobbyists, and other change agents need to understand both the

target government's political process, priorities, and committee structures and its policy formation procedures and agents (politicians, bureaucrats, committee staffers, external experts, etc.) as well as to recognize the window of opportunity and to realize that evidence is necessary but not sufficient to establish policy (Norris, Phillips, & Macnab, 2009; Shelley, 2009; Yore, Shelley, & Hand, 2009). Like a pendulum, educational policies are a constantly shifting target as different political interests gain control of the government and address their priorities. Therefore, environmental and science education advocates and lobbyists need to work with the existing government, its priorities, its policy-setting processes of task forces, royal inquiries, and other fact-finding actions and current windows of opportunity (Yore, et al, 2009).

While the NSES effects are more substantive than earlier reforms, there is still very little that federal efforts can do because of existing constitutional relationships and tensions between the federal and state governments. Since the standards do not have the force of government regulations and law, they need official adoption by state or local governments to have impact. This has taken skilful negotiations, extended efforts, and considerable time during the 15 years since publication of the NSES. Similar time and trends have been documented in Canada with the publication of the *Pan-Canadian Common Framework of Science Learning Outcomes* (Milford, Jagger, Yore, & Anderson, 2010) and in British Columbia with the environmental education reforms (Zandvliet, Holmes, & Starzner, 2011).

The interpretation of a policy, the procedures implemented, and the curriculum, instruction, and assessment practices justified by such a policy are equally as important as the policy itself. Local school districts' and school-based administrations' influence on policy, interpretation and implementation of policy, and procedures and practices was lacking in this book. This local autonomy results in significant variation in environmental and science education programs in many states unlike the more rigorous, top-down management practices in Asian countries, Canada, Finland, or France, which are amongst the highest performing participants in PISA.

Third, foundations, federal funding agencies, and professional organizations do advocate or lobby policymakers and indirectly influence priorities and policy, related budget, interpretations, and implementation. Similar groups operate in most countries (Australian Academy of Science and Carrick Institute, Centre for Development Enterprise and Joint Education Trust of South Africa, National Science Council of Taiwan, Nuffield Foundation in the United Kingdom, Royal Society of New Zealand, etc.; She et al., 2009). There seems to be a fine line between tax-exempt advocacy status of some organizations and declared taxable lobbyist status of other organizations. Furthermore, the coordinated effort of environmental and science education organizations appears to be ineffective as evidenced by the fact that many expert panels, task forces, and royal inquiries lack official representative memberships to important environmental and science education associations.

Fourth, while individual researchers may have some influence in the initiation, development, interpretation and implementation of policy, most do not. The knowledge utilization (also known as knowledge mobilization or knowledge transfer) process involves dissemination targets and techniques that are neither common nor addressed by environmental and science education researchers, even with some calls-for-proposals clearly requesting such skill sets and actions (Yore & Van der Flier-Keller, 2011). Many researchers are not experienced in writing to policymakers and bureaucrats as the end-user audience. Unfortunately, this advocacy process is labour intensive, poorly understood, and awarded low value and currency within the academy.

Fifth, there is little policy research on environmental and science education issues and few researchers actively engage in policy research. A quick survey of the major international environmental and science education research, teacher education, and professional practice conferences reveals very few presentations related to policy research or to inform, influence, and

implement policy. Many researchers believe that someone else will take their published theoretical and practical research findings and then transform and disseminate these results for other audiences. Based on evidence from recent political campaigns and actions worldwide, there is a real need to use modern information communication technologies (ICT) to present research findings in formats (e.g., electronic briefs and summaries) and on-going contact and follow-up that are easily accessed by educational leaders and policymakers. Examples of this might include briefings by the Society for Research and Child Development with its links that connect interested end users to more comprehensive, evidence-based recommendations (www.srch.org). Researchers should also utilize popular print and online educational news media outlets and publications such as the *Education Weekly* or *Educational Leadership*. Finally, research organizations need to embrace social networking platforms and other multimedia formats that are the everyday tools of ICT literate politicians, bureaucrats, advocates, and lobbyists.

Sixth, leadership is a perplexing problem within elementary, middle, and secondary school environmental and science education. 'Grass roots' leadership in the USA for science education is represented by the NSTA, and environmental education is represented by the North American Association for Environmental Education. Canada has provincial teacher associations under their teacher federations, which conducts advocacy actions on an as-needed basis. Unfortunately, leadership at the school and district levels is less apparent and recent attempts to enhance school-level leadership resulted in limited success. Most teachers were reluctant to become school district or provincial leaders and advocates for science education (Blades, 2011; Tippett & Anthony, 2011). One exception to these results was found in environmental education where teachers were passionate about the need to enhance environmental education and actions and, therefore, willing to advocate for changes beyond the classroom and school (Zandvliet et al., 2011).

Closing Remarks

The Role of Public Policy in K-12 Science Education provided significant background and insights into science education policy agents, formation, and implementation in the USA, which parallels stories in other countries and for environmental education policy. Unfortunately, the academic research communities appear to play limited roles in these actions. Knowledge utilization needs to be a major goal of the environmental and science education research communities.

References

Blades, D. W. (2011). Time and teacher control in curriculum adoption: Lessons from the lighthouse schools project. In L. D. Yore, E. Van der Flier-Keller, D. W. Blades, T. W. Pelton, & D. B. Zandvliet (Eds.), *Pacific CRYSTAL centre for science, mathematics, and technology literacy: Lessons learned* (pp. 203-215). Rotterdam, The Netherlands: Sense.

Johnson, N., Oliff, P., & Williams, E. (2011). *An update on state budget cuts: At least 46 states have imposed cuts that hurt vulnerable residents and caused job loss*. Retrieved from Center on Budget and Policy Priorities website: http://www.cbpp.org/cms/index.cfm?fa=view&id=1214

Milford, T. M., Jagger, S., Yore, L. D., & Anderson, J. O. (2010). National influences on science education reform in Canada. *Canadian Journal of Science, Mathematics and Technology Education, 10*(4), 370–381.

Norris, S. P., Phillips, L. M., & Macnab, J. S. (2009). The gold standard and knowing what to do. In M. C. Shelley II, L. D. Yore & B. Hand (Eds.), *Quality research in literacy and scien-*

ce education: International perspectives and gold standards (pp. 603–620). Dordrecht, The Netherlands: Springer.

She, H-C., Yore, L. D., Anderson, J. O., Erduran, S., Graber, W., Jones, A., Klumpers, J., Parker, S., Rollnick, M., Sherwood, R. D., & Waldrip, B. (2009). Funding patterns and priorities: An international perspective. In M. C. Shelley II, L. D. Yore, & B. Hand (Eds.), *Quality research in literacy and science education: International perspectives and gold standards* (pp. 467-509). Dordrecht, The Netherlands: Springer.

Shelley, M.C., II. (2009). Speaking truth to power with powerful results: Impacting public awareness and public policy. In M. C. Shelley II, L. D. Yore, & B. Hand (Eds.), *Quality research in literacy and science education: International perspectives and gold standards* (pp. 443-466). Dordrecht, The Netherlands: Springer.

Tippett, C. D., & Anthony, R. D. (2011). Explicit literacy instruction embedded in middle school science classrooms: A community-based professional development project to enhance scientific literacy. In L. D. Yore, E. Van der Flier-Keller, D. W. Blades, T. W. Pelton, & D. B. Zandvliet (Eds.), *Pacific CRYSTAL centre for science, mathematics, and technology literacy: Lessons learned* (pp. 133-148). Rotterdam, The Netherlands: Sense.

Yore, L. D., Shelley, M. C., II, & Hand, B. (2009). Reflections on beyond the gold standards era and ways of promoting compelling arguments about science literacy for all. In M. C. Shelley II, L. D. Yore, & B. Hand (Eds.), *Quality research in literacy and science education: International perspectives and gold standards* (pp. 623-649). Dordrecht, The Netherlands: Springer.

Yore, L. D., & Van der Flier-Keller, E. (2011). Epilogue of Pacific CRYSTAL—Lessons learned about science, mathematics, and technology literacy, teaching, and learning. In L. D. Yore, E. Van der Flier-Keller, D. W. Blades, T. W. Pelton, & D. B. Zandvliet (Eds.), *Pacific CRYSTAL centre for science, mathematics, and technology literacy: Lessons learned* (pp. 237-252). Rotterdam, The Netherlands: Sense.

Zandvielt, D. B., Holmes, M., & Starzner, M. (2011). Seaquaria in schools. In L. D. Yore, E. Van der Flier-Keller, D. W. Blades, T. W. Pelton, & D. B. Zandvliet (Eds.), *Pacific CRYSTAL centre for science, mathematics, and technology literacy: Lessons learned* (pp. 83-97). Rotterdam, The Netherlands: Sense.

Larry D. Yore and Michael Hammond-Todd
Department of Curriculum and Instruction,
University of Victoria, Victoria, BC, Canada
E-mail: lyore@uvic.ca or ecostudy@uvic.ca