International education and sustainable development: an American experience in Bangkok, Venice and Guayaquil

PETER H. HANSEN*

Worcester Polytechnic Institute, 100 Institute Road, Worcester, MA 01609, USA

Worcester Polytechnic Institute's (WPI) unique academic plan enables students to study sustainable development and the environment as part of an international educational experience. As a technological university, WPI requires students to complete an interdisciplinary project on the interaction of science or technology and society. Many of these projects have been related to sustainable development and the environment. This paper describes the environmental projects completed by WPI students in Bangkok, Venice and Guayaquil. The lessons from WPI's experience provide a model for environmental education at other institutions. These interdisciplinary projects not only promote environmental awareness among students, but they also provide tangible assistance to regions which are developing strategies for sustainable development.

Introduction

Environmental education has been recognized as crucial to creating awareness of sustainable development (Badhu *et al.*, 1990; Schneider, 1992). Environmental literacy or awareness may be inculcated through a variety of programs or curricula (Disinger and Howe, 1992; Disinger and Roth, 1992; Martin *et al.*, 1993). Yet few academic programs encourage undergraduate students to study sustainable development in a society other than their own. Likewise, most international education programs concentrate on the language, history and culture of another region, or they focus on the commanding heights of political economy and international relations. The dearth of opportunities to study sustainable development in a foreign country is particularly acute in technological education. Inflexible and sequential distribution requirements in science and engineering often constrain students to their classrooms and laboratories.

Worcester Polytechnic Institute (WPI), the third oldest technological university in the United States, has developed a series of international educational experiences in which undergraduate students examine practical problems related to sustainable development and the environment. A

small, comprehensive university of 2800 undergraduates, WPI accounts for less than 1% of all engineering students in the USA. Nevertheless, WPI sends more engineering students to study abroad than any other school in the country, representing more than 15% of all undergraduate engineers from the US who study abroad.

This paper describes the structure of WPI's global programs relating to sustainable development and identifies some of the broader lessons from WPI's experience. In particular, the environmental projects WPI students have undertaken in three cities – Bangkok in Thailand, Venice in Italy and Guayaquil in Ecuador – provide a model for other institutions. The WPI experience not only promotes environmental awareness among students, it also provides tangible assistance to regions which are developing strategies for sustainable development.

WPI's success in international and environmental education stems largely from the flexible and interdisciplinary structure of its curriculum. In the early 1970s, WPI adopted an innovative academic plan intended to produce socially aware engineers, scientists and managers (Grogan *et al.*, 1988). The university replaced the rigid and highly structured sequence of semester-length courses that characterizes traditional education in science and engineering with a flexible combination of intensive, 7-week courses and three practical, problem-solving projects. One project examines in depth a theme in the humanities and arts, while another demonstrates mastery of the skills, meth-

*Dr Peter H. Hansen is assistant professor of history in the Department of Humanities and Arts at Worcester Polytechnic Institute, USA.

ods and knowledge of a student's major discipline.

WPI's interactive qualifying project

The third and most distinctive graduation requirement at WPI is an explicitly interdisciplinary project. The interactive qualifying project or IQP requires students to explore an aspect of the interaction of science or technology, on the one hand and social and cultural values, structures and needs, on the other. The objective of the IQP is to enable WPI graduates to understand, as citizens and professionals, how their careers will affect the larger society of which they are a part. These interdisciplinary projects are often sponsored by professional, educational or governmental organizations where students may work after graduation. Each project is advised by a WPI faculty member and someone from the sponsoring organization. The projects are usually completed by teams of three to five students. Since an IQP is equivalent to 9 credit hours (three courses) per student, these teams, through their joint efforts, are often able to tackle big problems and to make recommendations that may have a significant impact on the sponsoring organization and in their own lives (Schachterle and Watkins, 1992).

In recent years, WPI students have completed many IQPs relating to sustainable development and the environment on WPI's campus in Worcester, Massachusetts. Projects have examined local recycling efforts by WPI, the city of Worcester and other local institutions. Students also have studied the impact of over-fishing off the coast of New England and the cleanup of polluted rivers and wetlands, hazardous wastes and contaminated soils, from nearby ponds to Boston Harbor. Other studies have assessed the risks of radon exposure, the feasibility of reducing emissions of carbon dioxide or chlorofluorocarbons and the effects of acid rain and global warming. One team created a systems dynamic model of a nearby town and another trained the local planning authority to use it. A few projects have examined sustainable technology, such as electric automobiles or biodegradable plastics. Student teams have also constructed their own examples of appropriate technology, such as a slow sand filtration system, for use in the less developed world. Projects have also examined alternative technology transfer policies for the US. Yet further studies assessed strategies of economic self-sufficiency for the Navajo nation or the impact of gambling on the Mashantucket Reservation in Connecticut.

Global project centers

In the 1980s, WPI expanded its international exchange programs and opened 'project centers' at off-campus sites where student groups may complete their IQPs in a concentrated 7 week effort. In addition, students may now study abroad for their projects in the humanities or in their major discipline. To date, WPI has sent student project teams to work in six continents: in Africa (Botswana), in Asia and Australia (China, Hong Kong, New Zealand, Taiwan and Thailand), Europe (Belgium, France, Ireland, Italy, Germany, Russia, Sweden, Switzerland and the UK) and in North and South America (Canada, Costa Rica, Ecuador, the US and Puerto Rico). Within a few years, WPI would like half of its undergraduates to have an international educational experience. To broaden the horizons of all students and faculty, WPI is also committed to instituting 'global perspectives' across the curriculum. These efforts have enjoyed the generous support of the Xerox Foundation, the US Agency for International Development and the US Department of Education. WPI is also a leading institution in a joint United States/European Union coalition for developing environmental exchanges.

These overseas project centers offer a tremendous opportunity for WPI students to apply their knowledge and skills to solve real-world problems as they learn about another culture first hand. While the purpose of the IQP is first and foremost to provide a challenging and rewarding educational experience for students, they are not the only beneficiaries of the project. The local sponsors and host countries of IQPs also benefit from the conclusions of the projects and from the expertise and enthusiasm of WPI students. Projects on the environment and sustainable development in Bangkok, Venice and Guayaquil illustrate the mutual benefits of these interdisciplinary projects.

Bangkok, Thailand

A network of WPI alumni has been instrumental in locating projects related to the environment for teams of WPI students in Bangkok. For example, a prize-winning project sponsored by the Duan Prateep Foundation investigated the chemical storage practices of the Port Authority of Thailand after an explosion in a chemical warehouse killed and injured many nearby residents. After completing on-site analysis of chemical residues, the student team established what chemicals had been stored at the site, identifying 53 when only ten had been known before. They also interviewed the residents of adjacent slums about their medical symptoms, local doctors about diagnoses and officials in the health ministry about health policies. The team wrote and designed pamphlets and posters to distribute among residents to educate them about the chemical hazards. In addition, the students reviewed international chemical storage procedures and recommended several simple, inexpensive and effective procedures for storing chemicals in the Bangkok facility. Their project led directly to a public debate in Thailand about the policies of the Port Authority. After their report, the WPI students were interviewed

on Thai television and wrote a commentary piece for the local English language newspaper.

Also in Bangkok, another student group examined the problem of how to encourage plastic recycling in Thailand. These students concentrated on high-density polyethylene, a high-volume commercial plastic that is readily recyclable. The team followed the recycling chain from discarded plastic water bottles to a finished product of recycled material. They also evaluated the adverse economic impact that automating the recycling process would have had on the people who currently eke out a living collecting, washing, cutting and grinding the water bottles. Yet another WPI group in Thailand looked at the destruction of Thailand's rainforests. While studying the legal, political and economic framework of forest management and conservation, this team identified a company that made furniture and other items out of recycled plastic. However, this group found that consumer preferences for wood were a major barrier to a broader acceptance of goods made out of recycled plastic. Thus, all of these groups confronted the cultural and political, as well as technical, obstacles to pursuing sustainable development.

Venice, Italy

In Venice, local and international government agencies, especially UNESCO, have provided WPI student teams with numerous environmental projects. In a series of projects over several years, WPI students have literally immersed themselves in the canals of Venice to make field observations. Students measured the canals' physical attributes (length, width and depth), hydrodynamic characteristics (level of tidal flows and mud build-up) and the level of boat traffic (by type of boat and size of wake). These factors were related to structural damage along the canals. In addition, teams assessed the impact of blocked sewage holes and identified the type of stone as a material for canal walls that was least susceptible to further sewage damage. To facilitate comparison among studies, teams have used database and mapping software to build a comprehensive geographical information system for the Venetian canals. Similar WPI studies have also examined air quality, the effects of acid rain and the condition of microbiotic life in the ecosystem of the Venice lagoon. The results of these studies are used by the Commune of Venice, the Italian Government and UNESCO to develop policies for Venice.

A number of other WPI projects have focused on the environmental threats to the cultural heritage of Venice. For the Archeoclub of Venice, one team made an inventory of outdoor art and sculpture, noting the location, type, state of decay and cost of restoration for each item. Students also surveyed Venetian churches and museums. In a single church, the students identified and created a computer database of artistic works, estimated restoration costs and developed a scale of priority for restoring the works of art. On behalf of *forum per la Laguna di Venezia*, an environmental advocacy group, another team of WPI students surveyed the programs of similar US environmental organizations, including the Chesapeake Bay Foundation. The team recommended new programs and ways of disseminating information or raising funds, for the *Forum* to consider in its lobbying and educational efforts.

Guayaquil, Ecuador

In Guayaquil, WPI's newest project center, students examine sustainable development with the support of the US Agency for International Development and Ecuadoran universities. An exchange program with Escuela Superior Politecnica del Litoral (ESPOL), a technological university in Guayaquil, also provides opportunities for Ecuadoran faculty members to study at WPI. One team of WPI students analyzed the environmental and socioeconomic impact of a new oil and gas pipeline. This group of students identified several adverse impacts of the pipeline, many of which may be examined in greater detail in future projects: the impact of the oil industry on the Amazonian rain forest, reforestation, low-technology products, the pollution of local rivers, the impact of the mining industry and ecotourism. Another team worked with the *Fundacion Natura*, to investigate the application of concepts of sustainable development in community planning by a small town outside of Guayaquil.

WPI students have also completed similar projects in other parts of Latin America. Several studies have examined ecotourism in Costa Rica or Puerto Rico. In these projects, as in others, the technical background of many WPI students is often a considerable asset. For example, one project made a detailed economic and technical assessment of the feasibility of using photovoltaic energy to replace an existing diesel generator system in a nature reserve on Mona Island, Puerto Rico.

Lessons from the WPI experience

WPI's experience provides a number of lessons for other institutions. Firstly, a commitment to interdisciplinary education is essential. This is the foundation for sound international or environmental education (see Braddock *et al.*, 1994). A graduation requirement that compels students to explore the social context and the multisided and open-ended nature of interdisciplinary problems is, at the very least, desirable. WPI's flexible curriculum and the 7-week term are also advantages. The project-based character of WPI's curriculum enables students in technical fields to avoid the 'lock-step' pattern of traditional engineering and

Fig. 1. Registration of delegates at the Global Forum '94 Academic Conference in Manchester, UK.

Fig. 2. Delegates at the international Global Forum '94 Academic Conference, Manchester, UK.

scientific education. The shorter terms also allow students to undertake a sustained work experience without requiring the commitment of time and money necessary for a year abroad.

Secondly, because WPI's interdisciplinary projects are based on practical problems, students have an integrated learning experience. They apply their knowledge to technical problems – and learn about the interaction of society and technology – while they work in another culture. This experience is closer to that of a professional on overseas assignment than to traditional educational exchanges that focus on language and culture. This arrangement is also more likely to produce practical benefits for the host country in the area of sustainable development.

Thirdly, the WPI faculty who travel overseas with student project teams also benefit from the experience. Overseas project advising broadens faculty perspectives and enriches their professional development. Faculty, as well as students, benefit from the experience of working on practical problems with colleagues in businesses or government agencies. Some faculty propose topics that fall within the area of their research. Others find that they begin to pursue new avenues of research as a result of their experience. All return to the campus with a new appreciation for living and working in another part of the world.

Finally, contacts with independent project sponsors are as important as relationships with other universities. Projects sponsored by government agencies, businesses, professional organizations, museums and charities are often more successful than projects sponsored by foreign universities. In such agencies, students are given more responsibility. They are treated like interns or colleagues instead of students. In contrast, the rigidly hierarchical student–faculty relationship that characterizes universities in much of the world deters students from taking responsibility and initia-

tive for their work. Moreover, projects sponsored by business, government or professional organizations are usually focused on practical, real-world problems. The results of their project are immediately put to use. All too often it is apparent to the students working on projects sponsored by foreign universities that the results of their work are, in the negative sense of the term, merely academic.

However, in conclusion, a wide network of support outside WPI remains essential. This support may be financial. However, financial support, while necessary, is not sufficient. There is no substitute for becoming acquainted with the local situation – with all its problems and potential – before students and faculty can formulate a problem, much less offer a solution. Acquiring this local knowledge is not easy. In Latin America, contacts with local governments and universities have made WPI's work possible. In Venice, contacts with UNESCO and local professional organizations have been well developed. In Thailand, however, a loyal network of WPI alumni, who came to the US for an education and have now returned home to teach or work, has been more significant to WPI's success. In the long run, this sort of collaboration is essential if higher education is to promote environmental awareness and sustainable development both at home and in the world.

Acknowledgements

References

Badhu, D., Singh, H. and Maitra, A.K. (1990) *Environmental Education and Sustainable Development*. New Delhi: Indian Environmental Society.

Braddock, R.D., Fien, J. and Rickson, R. (1994) Environmental studies: managing the disciplinary divide. *The Environmentalist* **14 (1)**, 35–46.

Disinger, J.F. and Howe, R.H (1992) Environmental education research news. *The Environmentalist* **12 (1)**, 3–7.

Disinger, J.F. and Roth, C.E. (1992) Environmental education research news. *The Environmentalist* **12 (3)**, 165–8.

Grogan, W.R., Schachterle, L.E. and Lutz, F.C. (1988) Liberal learning in engineering education: the WPI experience. In *New directions for teaching and learning*, no. 35. San Francisco: Jossey-Bass.

Martin, E.S., Lewis, D., Tumman, L.J., Smith, B.J. and Brown, P. (1993) Environmental education in Sweden. *The Environmentalist* **13 (3)**, 221–7.

Schachterle, L. and Watkins, M. (1992) The WPI interactive qualifying project – a model for British engineering education? *Engineering Science & Education Journal* **1 (1)**, 49–56.

Schneider, H. (ed.) (1992) *Environmental Education: An Approach to Sustainable Development*. Paris: OECD.