1. PACIFIC CRYSTAL CENTRE FOR SCIENCE, MATHEMATICS, AND TECHNOLOGY LITERACY: LESSONS LEARNED

Overview

The Centres for Research in Youth, Science Teaching and Learning (CRYSTAL; Natural Sciences and Engineering Research Council of Canada [NSERC], 2009) were funded by NSERC as a 5-year pilot project (2005–2010) to foster science and mathematics education research and development (R&D). These five Canadian centres (see Notes) focused on science, mathematics, and technology (SMT), including engineering and computer science, in response to the widespread and growing recognition that the SMT literacies are vital skills in the 21st century economy. CRYSTAL has provided a forum for the many partners who share an interest in developing and enhancing the skills of and resources available to teachers, nongovernmental agencies, and public awareness educators and in enriching the SMT preparation of young Canadians. The CRYSTAL projects have attempted to:

– improve understanding of the skills and resources needed to enhance the quality of science, mathematics, and technology education (K–12), and
– improve understanding of the best ways to enrich the preparation of youth in these foundation subjects.

The five interuniversity and interdisciplinary centres are composed of one or more universities and colleges, faculties of education, science and engineering, local community partners, and nongovernmental agencies. Partners and agencies were recruited from user groups that focused on the public awareness of SMT, First Nations, informal learning environments, public and private schools, and ministries of education.

CONCEPTUAL FOCUS AND ORGANIZATION OF PACIFIC CRYSTAL

Pacific CRYSTAL consisted of a partnership of universities (University of Victoria, Simon Fraser University, and Vancouver Island University [formerly Malaspina University College]), faculties within the universities (Education, Science, and Engineering), British Columbia school districts on Vancouver Island and the Lower Mainland, First Nations (Saanich First Nations including Tsartlip and Tsawout), and nongovernmental agencies (Canadian Geological Foundation, Centre for Excellence in Teaching and Learning Science, Constructivist Education Resources Network,
EdGEO, Victoria Foundation, SeaChange, and WestWind SeaLabs). Pacific CRYSTAL examined ways to improve SMT teaching and learning in elementary, middle, and secondary schools by building on Canada’s successful foundation, as demonstrated by recent (2003, 2006, 2009) general mathematics and scientific literacy performances on the Programme of International Student Assessment (PISA; Organisation for Economic Co-operation and Development [OECD], n.d.). General SMT literacies are focused on citizenship and active participation in society. Improving SMT literacies among youth as a whole helps address access and equity issues and increases the supply of students qualified for and interested in science, mathematics, engineering, and technology programs at postsecondary levels, thereby addressing the higher-level elite literacies related to SMT careers and the needs of the provincial, national, and international economies.

Pacific CRYSTAL and its projects emphasized research inquiries that develop and evaluate knowledge about SMT literacies, underserved and underrepresented peoples, and science and technology fields including biology (ocean ecosystems, botany), environmental science, earth science (weather, climate, geologic history, plate tectonics, natural hazards, resources), chemistry (water quality, qualitative and quantitative analyses), computer science (problem solving, graph theory, foundation concepts, programming, robotics), and mathematics (data displays, probability, geometry) in Years 1–3 (2005–2008). Greater emphasis was placed on education, professional development, and leadership for teachers, wider implementation, dissemination and outreach activities to influence public policies, education and curricular decisions, classroom practices, and instructional resources in Years 4–5 (2008–2010). A no-cost extension request was approved to complete ongoing projects, finalize resources, disseminate outcomes, and influence policy makers (Year 6, 2010–2011). Over the duration of the project, the participants changed (~30%) as projects were completed and graduate students finished their research programs. As well, the focus of the Centre and projects morphed to meet changing emphases and interpretations of the CRYSTAL program and to reflect the Centre’s successes, progress, and opportunities.

Pacific CRYSTAL established a mission statement through a deliberative process involving faculty members, partners, and research associates as a centre to promote scientific, mathematical, and technological literacy for responsible citizenship through research partnerships with university and educational communities. A strategic Build–Expand–Lead plan was developed in which ideas, resources, and research inquiries would evolve from small-scale authentic learning opportunities viewed as extra-curricular and outside the prescribed curriculum and school program (Build), to controlled applications of evidence-based classroom practices and resources (Expand), and to scaled dissemination and implementation, leadership experiences, and policy actions (Lead). The emphasis changed from small-scale authentic opportunities in the early years to classroom-scale trials in the middle years and finally to systemic-scale implementation, leadership, and knowledge transfer efforts in the final years. The partners identified project foci and intentions within the mission statement and formed three functional nodes under a central leadership and administration node at the University of Victoria, which was guided by (a) an