Abstracts of Refereed Articles


Abstract: Processes of globalization have played a major role in economic and cultural change worldwide. More recently, there is a growing literature on rethinking science education research and development from the perspective of globalization. This paper provides a critical overview of the state and future development of science education research from the perspective of globalization. Two facets are given major attention. First, the further development of science education as an international research domain is critically analyzed. It seems that there is a predominance of researchers stemming from countries in which English is the native language or at least a major working language. Second, the significance of rethinking the currently predominating variants of science instruction from the perspectives of economic and cultural globalization is given major attention. On the one hand, it is argued that processes concerning globalization of science education as a research domain need to take into account the richness of the different cultures of science education around the world. At the same time, it is essential to develop ways of science instruction that make students aware of the various advantages, challenges and problems of international economic and cultural globalization.


Abstract: In many places in the world, school science appears to be enmeshed in a global economic system that prioritizes enrichment of relatively few holders of capital, largely at the expense of the wellbeing of many individuals, societies and environments. Associated with this unsustainable situation appears to be fields of professional science and technology. In so-called knowledge economies, much of the focus is on creation of consumer desires for idealistic abstract images that often occlude problematic features of for-profit products and services. In this article, a theoretical framework for organizing science and technology education is discussed that may help to address these issues and, hopefully, contribute to general personal, social and environmental wellbeing.


Abstract: In response to David Burns and Stephen Norris’s (2012) article entitled Activist Environmental Education and Moral Philosophy, we offer a collection of thoughts in pursuit of activist pedagogies in SMTE research and practices. Drawing on literature in SMTE, Science Technology Studies and Environmental Studies, we reflect on political agency, hauntings of value-free-education, social imaginaries, symmetry and boundary work. We highlight environmental ethics and distinctions between political and politicizing education as potential referent points for pedagogical renewal. We conclude with reflections on Derek Hodson’s issue-based curriculum and some suggestions for future work.


Abstract: Progress has been made in addressing socioscientific issues, such as debates about merits of nuclear power, by encouraging school students to consider complex issues and take positions about them. We contend, however, that they also need to learn to take research-informed actions to address issues. In the study reported here, we aimed to determine and explain the nature and extent to which student-teachers develop commitments to research-informed activist projects through participation in such projects during their pre-service education. Based on constant comparative analyses of qualitative data associated with such projects, it appeared that student-teachers increased their commitments to advocacy for research-informed actions on socioscientific issues. Among a complex of factors apparently contributing to this change were findings from student-teachers’ primary and secondary research. This research appears to have implications for science teacher education, science education, and the wellbeing of individuals, societies and environments.

Abstract: In many educational contexts throughout the world, increasing focus has been placed on socioscientific issues; that is, disagreements about potential personal, social and/or environmental problems associated with fields of science and technology. Some suggest (as do we) that many of these potential problems, such as those associated with climate change, are so serious that education needs to be oriented towards encouraging and enabling students to become citizen activists, ready and willing to take personal and social actions to reduce risks associated with the issues. Towards this outcome, teachers we studied encouraged and enabled students to direct open-ended primary (e.g., correlational studies), as well as secondary (e.g., internet searches), research as sources of motivation and direction for their activist projects. In this paper, we concluded, based on constant comparative analyses of qualitative data, that school students’ tendencies towards socio-political activism appeared to depend on myriad, possibly interacting, factors. We focused, though, on curriculum policy statements, school culture, teacher characteristics and student-generated research findings. Our conclusions may be useful to those promoting education for sustainability, generally, and, more specifically, to those encouraging activism on such issues informed by student-led research.


Abstract: It is apparent that many of us live in a hyper-economized world, in which personal identities and routine practices are significantly oriented towards production and consumption of for-profit goods and services. Extreme consumerism resulting from this orientation often is associated with many personal, social and environmental problems. Implicated as an agent, among many, in this problematic hyper-economized process is science education. Briefly, our literature reviews suggest that, under influences from apparently hegemonic forces of neoconservatism and neoliberalism, school science often functions to generate knowledge producers, including engineers, scientists and other theoretical workers — who, in turn, may develop and manage mechanisms of production of goods and services on behalf of global economic elite. At the same time, it also is apparent that school science generates a large class of citizens who are prepared, essentially, to serve as consumers — both in terms of faithfully following labor instructions from the aforementioned knowledge producers (who may be accountable mainly to their financiers) and also enthusiastically engaging in repeating cycles of consumption of goods and services. Such a use of education seems undemocratic, at the very least, and highly problematic, assuming an association between school science and many personal, social and environmental problems. To perhaps bring about a more just and sustainable world, we offer a theoretical framework, along with a more pragmatic version of it, for organizing science and technology education in many contexts. Although based on principles like holism, altruism, realism, egalitarianism, and dualism that we suggest may help school science generate a citizenry willing and able to proactively contribute to the common good, we also urge readers to use it as a basis for further research and development.


No Abstract


Abstract: The body of literature connecting science education and citizenship is growing, through the lens, for example, of science, technology, society and environment (STSE) education. The case study highlighted here explores ways in which students in a seventh-grade science class used studies of waste management to engage in active citizenship. In our analyses of their action projects, we suggest that students formed new connections between science education and citizenship. Through personal changes they appeared to undergo, it seemed that they gained recognition of the impact that an individual can have on the well-being of self, society, and environment. Factors influencing their personal changes, including changes in their science literacy and self-efficacy beliefs, indicate directions for possible expansion studies of interactions between science and citizenship education.


Abstract: Despite indications of the problematic nature of laissez faire capitalism, such as the convictions of corporate leaders and the global financial crisis that appeared to largely stem from a de-regulated financial services industry, it seems clear that societies and environments continue to be strongly influenced by hyper-economized worldviews and practices. Given the importance of societal acceptance of a potentially dominant ideological perspective, it is logical to assume that it would be critical for students to be prepared to function in niches prioritizing unrestricted for-profit commodity exchanges. Indeed, in their article in this issue, Lyn Carter and Ranjith Dedivalage appear to support this claim in their analyses of the large-scale and expensive Australian curriculum and instruction project, Sustainability by the Bay. More specifically, they effectively demonstrate
that this project manifests several characteristics often would suggest neoliberal and neoconservative influences—ideological perspectives that they argue are largely fundamental to the functioning of the global economic system. In this forum article, possible adverse effects of neoliberalism and neoconservatism on school science are discussed—with further justification for Carter and Dediwalage’s concerns. Additionally, however, this article raises the possibility of subverting neoliberalism and neoconservatism in science education through application of communitarian ideals.


**Abstract:** Future elementary school teachers often lack self-efficacy for teaching science and technology. They are particularly anxious about encouraging children to carry-out student-directed, open-ended scientific inquiry and/or technological design projects. Moreover, because this often also is the case with practising elementary school teachers, it is difficult for student—teachers to gain practical experience facilitating student-led project work during practicum sessions. To provide student—teachers with expertise and motivation for promoting student-directed, open-ended project work, therefore, a group of future elementary teachers were taken through a constructivism-informed ‘apprenticeship’ during their university-based teaching methods course and then invited to make project work the subject of the action research that they were required to complete during their practicum. In this paper, successes that one student—teacher (out of 78 studied) experienced in promoting student-directed, open-ended technological design projects are reported. Although she judged children’s designs to be modestly successful, data indicate that her self-efficacy for promoting project work increased significantly. Analyses of qualitative data collected during the methods course and practicum also indicate that aspects of the curriculum, teachers, students and milieu appeared to contribute to this success. Such findings suggest that teacher educators should focus on helping future elementary teachers to develop expertise and motivation that would enable and encourage children to conduct technological design projects before conducting scientific inquiries. Such a tack may be the most pragmatic—and, arguably, epistemologically-sound—approach for helping ‘science- and technology-phobic’ student—teachers to move from the periphery to the core of practices in science and technology education.


No abstract.


**Abstract:** ‘Inquiry’ is a nearly ubiquitous part of recommendations for effective practice in school science worldwide. Teachers often experience difficulties, however, in engaging students in inquiry activities in which they are asked to explore physical phenomena (and energy) and, from their inquiries, derive appropriate conclusions about nature. It has long been recommended that teachers guide students through such inquiry activities. In Alandeom W. Oliveira’s paper, teachers are encouraged to conduct this guidance in polite ways: that is, to use polite discourse practices. A key strategy for accomplishing this was to engage teachers in a summer institute, in which they were asked to socially construct conceptions of discourse practices that might effectively engage students in science inquiry activities. For the most part, the summer institute appeared to be quite effective, particularly for a teacher highlighted in the paper who experienced great improvements in student engagement in association with her increased use of polite discourse practices. There were a number of positive aspects of this paper, not the least of which seemed to be the effectiveness of the summer institute. However, the paper raised a number of concerns—largely around the use of what I call guided “quasi-inductive” science inquiry activities. In this paper, I explore these issues in terms of four themes, namely: depth of learning, intellectual independence, representing science, and professional conscription. My major contentions include that: politely guided quasi-inductive inquiry activities are highly problematic; school science inquiry activities aimed at supporting scientists’ conclusions should be more deductive; and, inquiry activities should be set within the context of personal, social and environmental issues stemming.


**Abstract:** Student-directed, open-ended scientific investigations and invention projects may serve to deepen and broaden students’ scientific and technological literacy, and, in so doing, enable them to succeed in democracies greatly affected by processes and products of science and technology. Science fairs, events at which student-led projects are evaluated and celebrated, could contribute to such positive personal and social outcomes. Qualitative data drawn from a national science fair over succeeding years indicate (after analyses of largely qualitative data, using constant comparative methods) that, apart from positive outcomes
regarding science literacy, there may be some significant issues about the fair that warrant critical review. It is apparent from these studies that there are issues of access, image, and recruitment associated with the fair. Qualification for participation in the fair appears to favour students from advantaged, resource-rich backgrounds. Although these students do benefit in a number of ways from the fair experience, it is apparent that science fairs also greatly benefit sponsors—who can, in a sense, use science fairs for promotional and recruitment purposes. These findings and claims raised, for us, some important questions possibly having implications for science education, and for society more generally.


**Abstract:** School science systems tend to emphasize teaching and learning about achievements of science (such as laws and theories) at the expense of providing students with opportunities to develop realistic conceptions about science and science inquiry and expertise they could use to conduct their own science inquiry projects. Among reasons for such an emphasis, teachers’ lack of experiences with realistic science inquiry appears to be particularly problematic. Accordingly, we engaged student-teachers in a university-based course that attempted to balance instruction about science and science inquiry with student-teachers’ own theorization about science and science inquiry. Qualitative data collected mainly from nine student-teachers in four focus groups indicate that these student-teachers’ motivation for promoting student-led science inquiry projects in schools significantly increased by the end of the course. Analyses suggest that this outcome was influenced by changes in their conceptions about the nature of science, changes in how they associated science inquiry with student learning, and the inductive-deductive dialectic immersion that was built into their pre-service methods course. Implications of these findings for science teacher education are explored in this paper.


**Abstract:** Results of various studies suggest that multimedia ‘case methods’ (activities associated with case documentaries) have many benefits in university-based teacher education contexts. They can, for example, help to ‘bridge the gap’ between perspectives and practices held by academic teacher educators and those held by student-teachers—who may adhere to perspectives and practices commonly supported in schools. On the other hand, some studies, along with theoretical arguments, suggest that there are limits to the effectiveness of multimedia case methods—because, for example, they can never fully represent realities of teaching and learning in schools. Furthermore, often missing from multimedia case methods is the student-teacher in the role of teacher. To address these concerns, we modified an existing multimedia case method by associating it with a special practice teaching situation in a school context. Qualitative data analyzed using constant comparative methods suggest that student-teachers engaged in this modified multimedia case method developed relatively deep commitments to encouraging students to conduct technology design projects—a non-traditional practice in school science. Factors that appeared to influence development of this motivation included student-teachers’ preinstructional perspectives about science and the personalization and contextualization inherent to the modified multimedia case method.


**Abstract:** Science fairs are an almost unavoidable experience for students at some stage in public school. This paper examines how student projects and science fairs—and, by extension, professional science—are portrayed in newspaper media coverage of national and local science fairs. Despite a high student participation rate and a high number of science fairs (100+ regional fairs/year), media coverage is infrequent. Of the newspaper coverage that does occur, much of it reflects four ideological themes: i) Science is competitive, ii) Science is instrumentalist, iii) Commodification of science, and (iv) Corporatism. Notably, we found that detailed descriptions of student involvement in science investigations were infrequent. We conclude by posing questions for possible future action, both in regards to the media discussing the ideologies identified earlier, and for shifting focus to more about the student projects themselves and the student participation in those projects.


**Abstract:** Although governments, educators, and others have made significant efforts to promote education that would help students to develop more realistic conceptions of the nature of science, there continue to be difficulties in that regard. Fields of professional science often are represented in school science as isolated from fields of technology and, as well, from societies. Such a view may assist scientists in relatively freely pursuing topics of interest to them, using methods common to their
communities, and sharing their findings and conclusions with colleagues. In this view, it would be left to engineers, politicians, and others to determine appropriate uses of products of the sciences. In practice, fields of science seemed to have — to a great extent — held close interactions with fields of technology and with societies. An aspect of such relationships that has had very little attention in school science is the nature of associations between fields of business and science. In this paper, analyses of the nature of business-science relationships is explored, with reference to problem-setting, problem-solving, and peer-persuasion aspects of knowledge-building and dissemination in the sciences. In association with these analyses are references to Robert Merton’s institutional imperatives for the sciences. The article finishes with some general recommendations for science education.


Abstract: Although science, technology, society and environment (STSE) education has gained considerable force in the past few years, it has made fewer strides in practice. We suggest that science teacher identity plays a role in the adoption of STSE perspectives. Simply put, issues-based STSE education challenges traditional images of a science teacher and science instructional ideologies. In this paper, we briefly describe the development of a multimedia documentary depicting issues-based STSE education in a teacher’s class and its subsequent implementation with 64 secondary student-teachers at a large Canadian university. Specifically, we set out to explore: (1) science teacher candidates’ responses to a case of issues-based STSE teaching, and (2) how science teacher identity intersects with the adoption of STSE perspectives. Findings reveal that although teacher candidates expressed confidence and motivation regarding teaching STSE, they also indicated decreased likelihood to teach these perspectives in their early years of teaching. Particular tensions or problems of practice consistently emerged that helped explain this paradox — including issues related to: control and autonomy; support and belonging; expertise and negotiating curriculum; politicization and action; and biases and ideological bents. We conclude our paper with a discussion regarding the lessons learned about STSE education, teacher identity and the role of multimedia case methods.


Abstract: Educational systems often orient students’ science education toward learning about the many products (such as laws, theories and inventions) of professional science and technology. Such an orientation can compromise students’ opportunities to develop more comprehensive literacy related to science and technology—including the skills, attitudes and preinstructional expertise students possess for conducting independent (although collaborative) science inquiry projects on topics of interest to them. This article discusses a field-tested framework for scaffolding students’ development of expertise they could use in conducting their own inquiries, in the context of specific examples and freely available resources. Based on constructivist learning theory, the framework involves students in expressing their preinstructional expertise relating to science inquiry before being tutored in various concepts of evidence frequently used by scientists to develop knowledge. The benefits of student-led inquiry projects that could follow apprenticeship lessons and activities are many and varied. Nevertheless, continued efforts are needed in order to overcome various barriers to widespread student-led science inquiry. Readers of this article may take various innovative approaches to achieving this goal.


Abstract: Despite official government support (in various jurisdictions around the world) for providing students with opportunities to construct their own knowledge within the context of formal schooling, school science systems continue to place greatest priority on teaching and learning of products of science (e.g., laws and theories), while compromising students’ opportunities to develop realistic conceptions about science and expertise for doing science. Based on qualitative data analyzed using constant comparative methods (based on constructivist grounded theory), we found this also to be the case – paradoxically – in a school belonging to the Canadian Coalition for Self-directed Learning (CCSDL). Schools in this coalition espouse, among various goals, enabling students to construct their own knowledge, in ways and directions suiting their individual needs, interests, perspectives, and abilities, in addition to gaining access to knowledge developed by society. The science department within the coalition school in this study experienced considerable difficulty realizing this goal, despite school-level administrative support for a concerted effort to reinvent itself along these lines. Factors that appeared to influence the science department’s efforts included those in each of Schwab’s (1969) educational “commonplaces;” that is, the curriculum, teachers, students, and the milieu surrounding teaching and learning. Further analysis suggests that results can be explained through reference to a Kahnian (1962/1996) paradigm conflict – in which the school’s administrative and curricular committee and other members of the CCSDL were unsuccessful in convincing members of the science department (who, in turn, appeared to be supported by the provincial government, parents, and students) to make provisions for more student-directed, open-ended science inquiry.
Assuming that student-led scientific inquiry continues to be an important curricular goal, efforts must continue to be made, therefore, to convince members of the mainstream paradigm that it is a worthy goal.


**Abstract:** Many teachers in elementary schools lack school science self-efficacy, largely because of their inexperience with the subject. This frequently leads them to avoid teaching science or to teach it in ways that compromise the development of aspects of students’ scientific literacy. This paper describes how one teacher was able to improve her school science self-efficacy through facilitated action research. In response to becoming aware of a discrepancy between her school science practices and her fundamental educational beliefs, Lisa developed a drama-based, integrated science unit that she judged successful in helping students to achieve relevant learning goals. This experience led Lisa and her students to feel much more positive about teaching and learning in school science. Rather than learning from another, however, ‘Lisa, the science teacher’ learned—to a great extent—from ‘Lisa, the drama-based educator.’ This finding has implications for science-phobic teachers and for facilitators of their action research.


**Abstract:** School science students can benefit greatly from participation in student-directed, open-ended scientific inquiry projects. For various possible reasons, however, students tend not to be engaged in such inquiries. Among factors that may limit their opportunities to engage in open-ended inquiries of their design are teachers’ conceptions about science. To explore possible relationships between teachers’ conceptions about science and the types of inquiry activities in which they engage students, instrumental case studies of five secondary science teachers were developed, using field notes, repertory grids, samples of lesson plans and student activities, and semi-structured interviews. Based on constructivist grounded theory analysis, participating teachers’ tendencies to promote student-directed, open-ended scientific inquiry projects seemed to correspond with positions about the nature of science to which they indicated adherence. A tendency to encourage and enable students to carry out student-directed, open-ended scientific inquiry projects appeared to be associated with adherence to social constructivist views about science. Teachers who opposed social constructivist views tended to prefer tight control of student knowledge building procedures and conclusions. We suggest that these results can be explained with reference to human psychological factors, including those associated with teachers’ self-esteem and their relationships with knowledge-building processes in the discipline of their teaching.


**Abstract:** In this study, we hypothesize that cases demonstrating exemplary practice in the science classroom can be used as a source for learning content and pedagogical skills that will improve teachers’ self-efficacy beliefs. Twelve preservice elementary science teachers are followed as they participate in a case and case method activity illustrating the Grade 7 topic of robotics and fluids. While there was little evidence to show improvements in content knowledge, results indicate that the case acted as a boundary object for brokering between individual experiences and those found in the science teaching community by scaffolding for multiple points of entry, bridging the theory practice gap and offering beginning teachers more immediate access to the community of already practicing teachers.


**Abstract:** Efforts to promote more realistic conceptions about science are often limited by teachers’ inexperience in this domain. In this paper, we describe an ‘inductive–deductive, dialectic immersion’ approach towards assisting teachers in developing more realistic conceptions about science — along with corresponding revised perspectives about science teaching. Three secondary teachers of science with minimal science research experience engaged in a case study of science in action — specifically, in an episode of northern alpine ecological field research. Qualitative data analyzed by constant comparative methods suggested that these teachers shifted along a modernist through postmodernist continuum — as indicated by increased support for a more Naturalist epistemology of science, a more Antirealist ontology of science, and corresponding priorities towards science teaching and learning. Results suggest that teachers of science can develop postmodern views about science and science teaching if given opportunities to induce and deduce propositions about science in realistic cases of science in action.
Abstract: As institutions housing society's collective knowledge and as sites for public education, museums can complement formal educational efforts to promote citizen literacy. In this paper, we document and discuss a curriculum renewal activity in an Ontario museum of science and technology designed to allow school students significant control over their learning. Qualitative data suggest that the reconstructed museum educational experience successfully addressed initial concerns about the workshop's disconnectedness from school programs and its technological conservatism. The experiences described here identify some interesting possibilities for collaborative reflective practice in museum program development.


Abstract: In recent years, there has been growing interest in the use of multimedia cases for the purposes of preservice teacher preparation. Case-based learning typically involves an analysis of a teaching scenario followed by a discussion of issues that emerge. While this kind of activity is consistent with theories of situated learning and social constructivism, it usually casts the preservice teacher in the role of a detached observer who studies and critiques some aspect of another teacher’s lesson. It is proposed that it may be advantageous to personalize case methods by focusing preservice teachers more directly on their own pedagogical decision-making processes. This article describes an innovative study in which teacher candidates’ immediate reactions to videotaped teaching scenarios were recorded and made the subject of personal and group analyses. Results from the research suggest that this approach has the potential to help candidates develop deeper insights into their own classroom practice.


Abstract: Although governments espouse development in students of comprehensive science literacy, excessive teaching of achievements of science tends to compromise students’ development of realistic conceptions about science and expertise for doing science. For most students, school science is like being chained inside Plato’s cave, only able to experience and interpret the world of science from flickering, shadowy images. This can be particularly problematic for students in elementary schools, who may not be developmentally ready for abstract topics inherent to nature of science discussions and whose teachers tend to have low science self-efficacy beliefs. In the mainly qualitative ethnographic study of a 3-year, large-scale collaborative action research project reported here, a significant additional factor limiting students’ access to more contemporary views about and realistic experiences with science, however, was government curriculum policy—which promotes highly idealized portrayals of and regulated experiences with science. Data and arguments for these claims are provided.


Abstract: In school science, students often experience simplistic representations of knowledge-building practices in science and technology – which, in reality, are complex, unpredictable and theory-limited. While there are a great variety of reasons (many of which are beyond teachers’ direct control), this occurs partly because teachers of science generally have not had such realistic experiences. While student-teachers can develop this kind of ‘meta-scientific’ literacy in university-based science teacher education programmes, this depends on the extent to which activities are legitimized through close associations with authentic school contexts. In this paper, we report effects on science specialist student-teachers’ conceptions about science and technology, and corresponding priorities for school science, after interacting with a case documentary that depicted students collaborating in development and evaluation of pneumatic-controlled robotic arms. Data, including video footage of student-teachers’ interactions with cases and audio recordings of interviews with them and their teacher, indicated that many student-teachers developed more naturalistic perspectives on knowledge development in science and technology and corresponding pedagogical priorities. At the same time, most also recommended an ‘apprenticeship’ for students, gradually moving them from unrealistic (e.g., following a linear model for technological design) to more realistic (e.g., accommodating flexibility in design, while pointing out such limits to creativity as techno-determinism) problem solving contexts.

**Abstract:** The status quo for school science and technology is unacceptable. While the former often is required for admission to university engineering, as well as to science programmes, the latter is deemed most appropriate for less able, concrete thinkers. This situation persists, despite the fact school science tends to generate large groups of citizens who are relatively scientifically and technologically illiterate, largely as a result of its preoccupation with identifying and training potential scientists and engineers. This practice is tyrannical. It must be abandoned forthwith. A realistic alternative is a combined technology and science programme – perhaps called ‘technoscience’ education – that would treat science and technology as equals. Such courses may, as well, be more democratic in the sense that technological problem solving often is more natural to everyday situations that everyone may find useful, not just future scientists or engineers. A framework for combined technology and science courses is described and defended here. Originally developed through collaborative action research amongst practising teachers of science, the approach appears to be feasible, under certain – perhaps ideal – conditions. A number of changes to science and technology education may be necessary for broader implementation, not the least of which is a general retreatment in expectations for pre-determined learning, along with adjustments to teacher education. Nevertheless, the approach is recommended because of its emphasis on: personalization, inclusion, problematization, explicitness, apprenticeship, authenticity, contextualization and freedom.


No abstract.


**Abstract:** In recent years, teacher educators have looked to case methods as one means of bridging the theory-practice gap in university-based pre-service programs. This paper explores how case methods may be used to foster habits of praxis – that is, critical, reflective practice – that enable beginning teachers to adapt to the many diverse contexts they may encounter in the field. Our research used qualitative ethnographic methods to determine the efficacy of a case method designed to encourage critical analysis of a Year 8 science Optics lesson. Results suggest student teachers: (1) understood an associated analytical framework; (2) effectively analysed curriculum and pedagogy; and (3) exercised prudence in their assessment of the case. These findings tentatively indicate emerging habits of praxis. Notwithstanding such gains, we encourage designers of case-based curricula to: ensure case authenticity, protect subjects from critique and use multi-media case methods in conjunction with other approaches to promote habits of praxis.


No abstract.


**Abstract:** Although pedagogical approaches drawing on constructivist learning theories often place students in environments that are to resemble professional knowledge-building communities, paradoxically, they also orchestrate students’ re-constructions to harmonize with canons of Western science. Under the cover of social-constructivist epistemologies and Vygotskian pedagogies, students’ prior conceptions are denigrated, their experiences regulated, their investigations shepherded, and their conclusions restricted. Such actions are undemocratic—citizens’ literacy is confined to that narrowly defined by society’s élite and, therefore, is not egalitarian. Students have few opportunities to become self-actualized—to develop in ways unique to their needs, interests, abilities and perspectives. After elaborating these concerns, I provide a framework for curriculum development that may help democratize science education. It is an approach that gives priority to personalization, inclusion, problematization, explicitness, apprenticeship, authenticity and freedom.

Abstract: In many parts of the world, school science, especially at the secondary school level, is a sort of selection and training camp for future scientists and engineers. For most students, their general lack of cultural capital (Apple, 1990) minimizes their opportunities to survive the rapid coverage of large volumes of abstract, decontextualized laws, theories, and inventions so typical of school science. Most graduates and “drop-outs” become relatively scientifically and technologically illiterate. They either have forgotten or have confused conceptions of scientific and technological knowledge; often view science and technology as relatively certain, unbiased, and benign with respect to effects on society and the environment; and lack resources necessary to effectively judge products and processes of science and technology or, crucially, to create their own explanations for and changes to phenomena. Citizens with illiteracy to this extent may have little control over their own thoughts and actions and be prey to whims of those who control knowledge, its production and dissemination. Curriculum frameworks are required that enable all students to achieve their maximum potential literacy and, as well, to create their own knowledge, to develop in directions unique to their needs, interests, abilities, and perspectives; that is, to become self-actualized. This latter goal can, in part, be achieved through apprenticeship education in schools, such that students acquire a measure of scientific and technological connoisseurship—expertise enabling them to conduct open-ended scientific investigations and invention projects of their own.

In collaboration with five teachers of secondary school science, such a framework was, indeed, developed, and field-tested. Through a spiraling, cyclical process involving synchronous reconstruction of conceptual and procedural understandings, evidence suggests students were able to carry out experiments, studies, and tests of their inventions with minimal teacher involvement. Furthermore, they appeared to accommodate more realistic conceptions of scientific and technological work. Moreover, many seemed to have made progress toward intellectual independence; able to judge knowledge claims independent of authorities. It is hoped that with more schools, systems, and teachers enabling development of such connoisseurship, all students will be better served by school science and, as well, the larger society will be more diverse, adaptable, and free.


Abstract: Recent policy documents from the Ontario Ministry of Education called for teachers to present a more authentic view of the nature of scientific practice at all levels of education. Sadly, this call for substantial curriculum change coincided with severe cuts in the education budget. The authors describe how two teachers collaborated with a university-based researcher/teacher educator to design and implement more authentic science in a Grade 7 classroom. The ways in which the teachers changed their views about science and science teaching, the anxieties they experienced, and the institutional constraints that impacted on their practice are discussed, and some more general features of the action research experience are described.


Abstract: Recent policy documents from the Ontario Ministry of Education have announced a shift towards greater decentralization of the curriculum. Coincident with this announcement is the call for science teachers to present a more authentic view of scientific practice. This article describes how two grade 7 teachers in an Ontario (Canada) school collaborated with a researcher/teacher educator to meet these challenges. The ways in which the teachers changed their views about science and scientific inquiry, the anxieties they experienced and the institutional constraints that impacted on their classroom practice are discussed. Some common pitfalls of action research are identified and some tentative guidelines are advanced for the adoption of action research strategies by central educational authorities wishing to implement new curricula during recessionary times.


Abstract: In recent years, a great deal of attention has been directed towards the purpose and organization of practical work in school science, with several writers urging a radical reappraisal and reorientation of laboratory-based and field-based learning. However, for all kinds of reasons, changes of this magnitude are not readily accomplished by traditional means of curriculum development. This article describes how a group of teachers sought to overcome the difficulties of major innovation by working with a change agent to critique their current practice, devise a more 'authentic science' for the secondary school curriculum, and translate their ideas into feasible classroom activities.


No abstract.
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