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GLOBALISATION AND POLICY REFORMS: SCIENCE EDUCATION RESEARCH

1. INTRODUCTION

It is interesting to note that while most globalisation theorists would acknowledge education is, or should be, implicated in accounts of globalisation (Fitzsimons, 2000), its literature does not explore the relationship at any length (exceptions are Beck, 2000; Scholte, 2000). Globalisation theorists' preoccupation with elaborating the political, economic, legal, civic and other material and cultural dimensions of globalisation unfortunately seems to have marginalised education as a key field within these categories. This is somewhat surprising given the centrality of knowledge to globalisation, and its obvious intersection with education as a major player in its production, rationalisation and allocation (Delanty, 1998). It is also surprising considering education's powerful ability to explore different thinking of whatever persuasion. Consequently, it is left to the discourses of education to explore the way globalisation constructs contemporary education, and education represents and circulates globalisation. Theses discourses draw together around the two main positions of globalisation commonly identified by theorists like Jameson (1998, p. 56) as the "twin, and not altogether commensurate, faces" of the universalising and hegemonic economic-political globalism, and the fragmented, diverse and opening cultural form (see also Delanty, 2000; Tomlinson, 1999; Wilson & Dissanayake, 1996). The rapidly growing educational policy literatures for example, have begun to investigate questions of global economic and political restructuring and the implementation of various reform agendas (see for example Apple, 2001; Ball, 1997; Lingard & Rizvi, 1998; Morrow & Torres, 2000; Wells, Carnochan, Slayton, Allen & Ash, 1998), while globalised cultural flows, and growing diversity have been explored within comparative and multicultural education discourses (see for example Dimitriadis & Kamberelis, 1997; Stoer & Cortesao, 2000).

Educational policy scholars have largely argued that the discourses of neoliberalism and neoconservatism have dominated the agenda of educational reform precipitated by globalism (see for instance Apple, 2001; Morrow & Torres, 2000; Wells et al., 1998). Educational reform is the consequence of the extension of

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globalism's enterprise form to all areas of sociality, including education. Pertinent here is the dynamic relationship between the nation state, neoliberalism and globalism, as it is usually at the level of the nation state that educational reform policies and procedures are produced and enacted. Neoliberalism's imperatives of reduced governance and the rule of the markets has meant for the nation state restructuring around the twin tendencies of centralisation and decentralisation. Decentralisation is achieved through devolution of administrative and other structures to the local site, while centralisation reconstitutes selected areas of strategic control with procedures for increased surveillance and accountability. In effect, this has generally meant there are fewer restrictions on educational institutional infrastructures with fiscal and other responsibilities being assumed at the school level. At the same time, control over areas like teacher autonomy and professionalism, and the curriculum, which were once at the discretion of school communities, have been tightened and centralised. Control is also exerted through standardised testing and auditing procedures across a range of student and teacher performance indicators, constituting schools as performative spaces providing increasing amounts of feedback upwards. These practices take place within an educational rhetoric that has become constructed around discourses of competition, fairness and equity for all, flexibility, wider choice and higher standards to be assessed against international measures. It is aimed at improving performance and efficiency, and so promote better results for the national goals of education.

While educational policy scholarship is expanding as it inquires into the complex manifestations of globalisation, other educational literatures remain relatively silent on the whole question of their relationship to globalisation. Gough (1999) has identified curriculum theorising as a case in point, with McLaren and Fischman (1998) suggesting the same of teacher education. For McLaren and Fischman (1998), many categories of educational debate are much as they have been for the previous two or three decades, reflecting education's deeply rooted dependence upon restricted social and cultural forms. Science education is another category I suggest, that has paid scant attention to globalisation. With few exceptions (see for instance, Gough, 1999; Ninnes, 2001), there is little exploration of globalisation in the science education literature. This apparent reticence to explore the changing global landscape is ill considered, as not only does it ignore a range of issues prominent in contemporary inquiry, but it also means that opportunities to better theorise what science education is, and could be, are likely to be missed. Moreover, the obvious and mutually productive relationship between advances in science and technology, and globalisation, holds profound yet clearly unexplored implications for science education. Consequently, there is a need for science education to inquire into the ways in which it is shaped by globalisation, and in turn, the ways in which it represents and circulates globalisation, so that it can engage in dialogues about key issues that are practically and intellectually urgent, and which will advance science education as a discipline (after Lemke, 2001).

In this chapter, I argue that globalisation is indeed implicated in the discourses of science education, even if the relationship is underacknowledged and underexplored. To this end, I begin with a brief overview of science education and its current areas of research. Globalisation is clearly at work as 'absent presences' in the conceptual

language science education uses, and is particularly apparent in its more recent policy and practical transformations. I thus go on to argue that the latest *Science for All* policy reform movement and its development of scientific literacy as the universalised goal of science education, is a case in point. I conclude that the *Science for All* reforms are a hegemonic move to convergence that reiterates Jameson's (1998) narrowing and universalising economic-political dimensions of globalism as one of the twin faces of globalisation.

2. AN OVERVIEW OF CONTEMPORARY SCIENCE EDUCATION RESEARCH

Science education is a vast and diverse field that has developed its own areas of concern distinct from those of scientists, educational researchers or science teachers, only since the curriculum reforms of the early 1960s (Fensham, 1992). Its interests range from classroom-based teaching and learning, curriculum, teacher education, student-related factors, historical perspectives and so on, to policy development and implementation, and to the more theoretical concerns of epistemology, philosophy and sociocultural influences in the nature of science itself. While these categories are predominately conceptualised from normative, mainstream positions, a small body of science education scholarship adopts more critical and oppositional perspectives (see for example, Calabrese, Barton & Osborne, 1998; Kyle, 2001; Weaver, Morris & Appelbaum, 2001).

One way of obtaining some sense of the current preoccupations of science education is from a quick review of the types of manuscripts submitted for publication to the *Journal of Research in Science Teaching (JRST). JRST* is a leading science education research journal and the flagship of the world's largest science education research organisation, the United States-based National Association for Research in Science Teaching (NARST). It attracts a broad range of scholarship from those who aspire to international recognition of their work. In the period January to December 2001, the editors considered 139 articles from 21 different countries for publication, two thirds of which came from the United States (see Lemanowski, Baker & Piburn, 2002, *Editorial: report from the editors*). Research on teachers, their education, and their knowledge and beliefs, and investigations into learning and learning theories accounted for about forty-five percent of all the submissions. Studies designed to investigate the science education's relationships with its broader social, cultural, political or global context were few in number. Indeed, Lemanowski et al., (2002) did not even include such as a category for their manuscript reviews. Other submissions included 'as expected' studies on curriculum development, achievement, and so on, indicating I suggest, that the traditional and mainstream trajectories of science education continue to hold a great deal of sway in its research agenda.

But these manuscripts do not tell the whole story. In terms of centralised policy development and implementation, science education in many parts of the world has recently undergone an era of major reform. This latest phase of reform began with the American reports, *Project 2061: Science for All Americans* (American

Association for the Advancement of Science, 1989) and the National Academy of Science's *National Science Education Standards* (National Science Council, 1996). These documents were produced in response to the perceived crisis in science education and its implicated role in international challenges to the techno scientific supremacy, and the subsequent declining economic fortunes, of the United States during the 1980s. Together with other similar reports, *Project 2061* and the *National Science Education Standards* reiterated the prevailing orthodoxy in place since the Second World War in national policies of all sorts, that of 'science, and by extension science education, for economic development' (see Drori, 2000). This model established the causal link between the amount and type of science taught and the objectives of national economic development. It took a utilitarian view of science, and assumed that a systematic programme for the development of a scientifically and technologically skilled workforce would lead to greater economic progress. Despite the dominance of this developmental model, Drori (2000) has shown that its policy assumptions have been rarely tested, and any evidence provided by the small number of studies investigating the connection between science education and economic development are at best, inconclusive. Nonetheless, *Project 2061* and the *National Science Education Standards* have been highly influential within this conceptual model, and through their international dissemination have in effect, crystallised the directions for the curricula and teaching reform agendas for science education globally.

Like many countries, Australia was influenced by these and comparable British reports into science, technology, economic development and education. Consequently, Australian science education developed very similar national standards to those produced by the American National Science Council on the substantive content of science education (Dekkars & de Laeter, 2001). In general terms, these standards promoted the mastery of scientific knowledge, and changes in teaching and learning practices. For example, in the Australian state of Victoria from which I write, the official school curriculum now comprises standards-based, planning documents known as the *Curriculum and Standards Framework (CSF)* (Board of Studies 1995, 2000), organised into eight key learning areas, two of which are science and technology. They are the basis for curriculum planning and implementation, and student reporting, for the compulsory years of schooling (Preparatory – Year 10).

Science standards like those of the *CSF* and the American National Science Council are usually couched within a benign rhetoric of access, equity and diversity but are conceptualised in precise and predictive terms, and are benchmarked against international 'best practice' and performance through state, national and international testing regimes. Hence, not only have we seen regular standardised testing in Victoria through the Assessment Improvement Monitor (AIM) that attempts to use testing as a mechanism to improve student performance, but the National Education Performance Monitoring Taskforce (NEPMT) established in 1999 is planning to implement a national monitoring of primary science achievement (Goodrum, Hacking & Rennie, 2001). In addition, like the other Australian states we have also participated in the recent Third International Maths and Science Study (TIMSS), and will participate in 2006, in the OECD's

Programme for International Student Assessment (OECD/PISA) evaluation of scientific literacy in the 15-year-old cohort. Goodrum et al., (2001) suggest that the OECD/PISA assessments represent a new commitment by OECD countries to monitor outcomes of education systems in terms of the functional knowledge and skills. Participation in these assessments indicates the increasing acceptance of tests of student knowledge as a means of providing information for range of purposes, including surveillance, auditing and accountability. In the context of science education, they are underpinned by the conceptual model that embraces science and technoscience (and hence science, technology and mathematics education), as a means of national economic development and competitiveness in the globalising world (Drori, 2000).

3. THE IMPORTANCE OF SCIENTIFIC LITERACY

Project 2061, the *National Science Education Standards,* the *Victorian CSF* and other similar science education reform documents aim to achieve their purposes through the development of scientific literacy as the main goal of science education. Embodied within the slogan of *Science for All* by which these reforms have become known, scientific literacy is regarded as an essential characteristic for living in a world increasingly shaped by science and technoscience. It argues equity considerations demand all should have available to them an education in science of an appropriate type and standard. First coined as a term in the 1950s, scientific literacy has not always been regarded as an important goal for science education. Earlier science curricula and practices contextualised within the political and economic agendas of the Cold War, and an unbridled confidence in the social benefits and utility of science, were explicitly aimed at training the small and elite group of vocational scientists and engineers. Over the decades, however, this approach proved to be in tension with a more general education required by the diverse learners staying on longer at school. Consequently, scientific literacy that aimed at producing better informed general citizenry, gradually grew in prominence alongside other ideas as more appropriate goals for science education. Fensham (1997) in Australia, Millar and Osborne (1998) in England, and Bybee and DeBoar (1994) and Hurd (1998) in the United States have documented the changing goals and consequent struggles of science education over these decades.

DeBoar (2000) argues that despite its widespread endorsement, the meaning of scientific literacy has remained highly contested, and can be interpreted across a range of complex conceptualisations. He has traced its historical pathway through a number of significant government position papers, policies, reports, scholarship and calls for reform. He concludes there are up top nine meanings of scientific literacy as a goal for science education including understanding science as a particular way of examining the natural world, exploring science as a culture force including multiple views of science, learning science as part of a liberal, humanist education, being able to apply science to socially-just and redistributive ends, learning science as preparation for work, teaching students to be informed citizens who are able to utilise scientific and technological everyday applications and make judgements

about media reports, teaching students enough science to sympathetically support its continuing progress, and so on. DeBoar (2000) uses this overview of scientific literacy to argue that the vision of scientific literacy adopted within the American-based and contextualised *Project 2061* and the *National Science Education Standards* was particularly narrow. It is based on the achievement of sets of content standards of scientific knowledge, with scientifically literate students becoming those able to met these standards. He draws from the documents themselves to show that this version of scientific literacy was built on the belief that all students needed scientific knowledge to be able to make choices, to engage intelligently in public discourse, to develop the appropriate technological and intellectual skills for rapidly altering jobs, to produce a citizenry capable of competing in global markets, and to share in the excitement of learning about the natural world.

It seems then, that within the current centralising policy reform climate fostering the proliferation of these science education reform documents, a contracted meaning of scientific literacy has come to prevail. In these documents, scientific literacy has been conceptualised and conflated with the mastery of sets of readily implementable, content-based standards and habits of mind. Moreover, these standards are drawn from a narrow interpretation of what knowledge can constitute science, legitimating only that which commentators like Gough (2003) identify as modern Western science. Modern Western science for Gough (2003) and others (see for example Harding, 1998; Weinstein, 1998) is that endeavour produced in Europe during a particular historical period, and whose cultural characteristics have endured, as a consequence of Western cultural imperialism, to dominate and regulate the boundaries of global understandings of science. It systematically marginalises and excludes all other views of science, including indigenous and local knowledge systems. This perspective on modern Western science has developed from literatures collectively known as the sociology of scientific knowledge (SSK), and famous for their role in the so-called 'Science Wars' (Ross, 1996). SSK explores the nature, history, production and sociocultural location of European and ethnosciences, and has broadened the debate within science education research on what school science should contain. Despite allowing those like Snively and Corsiglia (2001) to argue for the inclusion of indigenous knowledge systems as part of multicultural science education, the curriculum standards reforms have largely ignored the SSK findings, and have constructed scientific literacy only in terms of canonical Western science.

Some indication of the extent to which this narrow meaning of scientific literacy has grown to become *the* overall goal of science education comes from its inclusion as one of three domains in the OECD/PISA programme of international testing scheduled for 2006, along with reading and mathematical literacy (Harlen, 2001). Goodrum et al., (2001) comment on the similarities between OECD/PISA's version of scientific literacy and that of *Project 2061* and the *National Science Education Standards,* arguing it represents strong international agreement about the nature and importance of scientific literacy as an outcome of schooling. The OECD/PISA programme defines scientific literacy in a way that allows it to be easily testable internationally. It will require students to demonstrate an understanding of thirteen major scientific concepts, and scientific processes including recognising scientifically investigable questions, identifying evidence needed in a scientific

investigation, drawing or evaluating conclusions, and communicating valid conclusions. In this context, it is hardly surprising that Australia too, has adopted an attenuated version of scientific literacy as its overall goal of science education. The recent report for the Department of Education, Training and Youth Affairs (DETYA) *The Status and Quality of Teaching and Learning in Australian Schools* by Goodrum et al., (2001) argues scientific literacy "is fundamental to quality teaching and learning in science" (p. 11), and of national importance in the promotion of public acceptance of scientific and technological change, flexibility, and economic growth. Goodrum et al.'s (2001) report is significant in the Australian context because it outlines future directions for science education here.

4. GLOBALISATION AND SCIENCE EDUCATION

The preceding overview of science education brief though it is, nonetheless serves to indicate that science education has been relatively silent on the whole question of the practical global transformations, and conceptual refashioning of contemporaneity expressed within it, and by which it is shaped. Its focus has remained largely preoccupied with conventional categories of analysis including classroom-based teaching and learning, alongside a growing interest in better ways of implementing the now apparently universalised goal of scientific literacy within reforms embodied by the slogan *Science for All*. Analyses within the science education research of the decentralising and centralised tendencies recognised within the educational policy literatures as indicative of globalisation, are rare. Drori (2000) for example, is one of a handful of studies that investigates the implications of devolution and macro systems-level reforms on science education. While there are more analyses of the centralising tendencies of standards, testing regimes, and accountability, these too are relatively infrequent. Indeed, as editors of *JRST*, Gallagher and Richmond (1999) have repeatedly called for more scholarship on the science education reform agenda (also Gallagher, 2000; 2001). Some examples include the discussion of standards-based curricula in various Australian states (Cross, 1997; Ninnes, 2001), within Canada (McNay, 2000), America (Rodriguez, 1997), and in England and Wales (Donnelly, 2001), moves to inquiry-based pedagogies (Keys & Bryan, 2001), comparative international testing (Harlen, 2001), and TIMSS (Olson, 1999). Even within the large scientific literacy literature that acknowledges the social contexts of science and argues for students to better understand and make critical judgements about science as a cultural (and now global) force, the complexities of our increasingly globalised world and technoscientific society are presented as a type of sedimented common sense, a normative state in need of little further probing (this is obvious in accounts by De Boar, 2000; Goodrum et al., 2001; Hurd, 2002; Millar & Osborne, 1998).

Although overt analyses of the relationship between globalisation and science education remains elusive, that science education like other educational fields has come under the influence of globalisation can be readily seen in a number of ways. For instance, referring again to National Association for Research in Science Teaching (NARST) as the world's largest science education research organisation,

David Treagust (2000), in his outgoing presidential address, developed and celebrated the themes of internationalism and diversity. The growing non-American membership of NARST numbering just under thirty percent, and the increasing ease of communication and travel enabled Treagust, as a Western Australian science education academic, to fill the leadership role and oversee policy and planning meetings held a hemisphere away. Treagust welcomed such internationalisation and looked forward to a broadening collegiality and diversity in scholarship from all parts of the world. The new president, Sandra Abell (2001) went on to clarify the ways NARST saw itself and its future reform imperatives. Somewhat reminiscent of the sentiments of performativity, Abell suggested NARST's potential was underdeveloped and its members needed to identify research problems connected with real problems of practice. Recently released American reports like the teacher reform focussed *Before It's Too Late: A Report to the Nation from The National Commission on Mathematics and Science Teaching for the 21st Century* could help establish a research agenda, she argued, that would "impel reform in science education in the U.S. and around the world" (p. 2).

While neither Treagust or Abell refer to globalisation as such, it is nonetheless clear that globalisation is at work in their sentiments; as 'absent presences' in the conceptualisations of internationalisation, hegemonic universal beliefs and practices, performativity, diversity, and so on that constitute their remarks. These conceptualisations are among the lexicon of key terms Ozga (2000) uses to link education with globalisation. While much science education literature could be similarly analysed for the presence of globalisation, the clearest manifestation of globalisation within science education is in the recent growth of the science education reform agendas embodied within *Science for All*. These reforms can be viewed as part of the larger discourses of neoliberal and neoconservative education reform, extensively described in the educational policy literatures as a consequence of the globalism's extension of the enterprise form to education. The same questions of global and political restructuring precipitating such reform also abound in science education, even if they remain largely underacknowledged, and consequently undertheorised. The same neoliberal desire for strategic control through increased centralised surveillance and regulation, and the same neoconservative nostalgia for 'real knowledge' is manifest in the science education curriculum standards. Their focus on scientific literacy as the universalised generalised goal of science education, the conflation of scientific literacy with the mastery of content standards and measurable outcomes, and the privileging of this meaning of scientific literacy to the exclusion of others, refigures it as a type of shorthand for the progression and sedimentation of the reform agendas. Hence, *Science for All* and its development of scientific literacy becomes a narrow and instrumental construct universally able to be implemented and tested, and consequently able to meet the requirements of globalism's strategic control through procedures of surveillance and accountability.

That these tendencies remain largely unacknowledged within science education research exemplifies, I suggest, Britzman's (1998 p. 80) "passion for ignorance". Derived from psychoanalytic theories of education, Britzman's (1998) formulation of a subject's capacity to be unencumbered by what it need not know or cannot tolerate, by its 'passion for ignorance', act to construct normalcy, she argues, as the

great unmarked within educational sites. The collective 'passion for ignorance' displayed in the paucity of particularly critical science education scholarship on reform, acts to normalise the reform agendas and discourses within/of science education, ensuring they become the 'great unmarked', and consequently underacknowledged and undertheorised. There is a naturalisation of globalisation's shaping forces, influencing and changing science education in ways that remain opaque. While there may be a number of ways to account for this, I suggest science education as traditionally constituted and in its mainstream trajectory, predominantly inhabits a realistic paradigm that means it not only lacks self-reflectivity, but also tends to ignore a range of issues in contemporary social and cultural analysis prominent in the broader social sciences of which it is a part. (I recognise the smaller critical and oppositional literatures within science education are exceptions to these comments.) The issues I refer to here are those that have emerged from the critical and postmodern/poststructural approaches interested in a closer examination of the normalising, regulative and productive aspects of power/knowledge relationships of dominant discourses. Such perspectives are crucial for recognising and analysing the impacts of globalisation on education, and the ways in which education constructs and circulates globalisation. However, as Lemke (2001) suggests, with their backgrounds predominately in cognitive psychology, science education researchers do not know enough about these fields. Hence, their focus is limited to a narrow range of traditionally framed concerns. In a similar vein, Kyle (2001) argues science education lacks an interest in questioning its foundational canons and revising any of its frameworks. Consequently, there is a conceptual difficultly, as well perhaps as an unwillingness, to move beyond science education's conventional categories of analysis and explore the impact of the changing theoretical and global landscape. It is clear that science education like other educational fields needs to inquire into the relationships between itself and globalisation, so as we can address the many gaps in our current understanding and advance it as a discipline.

5. CONCLUSION

Here, I have argued that globalisation is indeed implicated in the discourses of science education, even if it remains underacknowledged, and consequently undertheorised. To this end, I briefly reviewed science education and its current areas of interest. While my review was not exhaustive, I have been able to identify and cluster tendencies in the science education research literature. I see them as the continuation of science education's previous trajectories, and the growing evidence of significant reform.

Science education, it would seem, works somewhere in the spaces between globally influenced nation state policy production, and local sites of practice, strongly influenced by self-referencing, continuing trajectories of normative science education research on teaching and learning. Although science education's traditional categories continue to dominate the research agenda, the growing emphasis on reform indicates globalisation is clearly at work in the conceptual language science education uses, as well as in its more recent policy and practical

transformations. This is apparent particularly in the latest *Science for All* policy reform movement and its development of scientific literacy as the universalised goal of science education.

The universalising and centralising tendencies of neoliberal and neoconservative reform agendas permeate, and are enacted, in science education by the increased surveillance and regulation of the curriculum standards and testing regimes. They work to reinscribe teachers and students, and to (re)produce Western canonical scientific knowledge. Science education hence, like other forms of education, has been (re)constructed by the enterprise ethic of globalism, reiterating part of Jameson's (1998) globalisation dialectic as the narrowing, universalising and hegemonic economic-political dimensions of globalism, and the fragmented, diverse and opening cultural characterisation.

There remains a clear need for further scholarship within science education to inquire into the ways in which it is shaped by globalisation, and in turn, the ways in which it represents and circulates globalisation, so that issues which are practically and intellectually urgent can be debated.

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