Inaugral Address
Environmental Education and Teacher Development: Engaging a Dual Curriculum Challenge

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Introduction

Few events in South Africa have been as dramatic and sudden as the demise of apartheid (the institutionalised separation of 'races' in all spheres of life) and the introduction of a majority, multi-party government by democratic process in 1994. The events immediately following the demise of apartheid prompted a series of changes in the political and economic systems of the country. While political reorientation and economic redress were of immediate concern, there was also an acknowledgement of the importance of educational change in the rebuilding of the country.

Lotz and Olivier (1998) indicate that the change in government in 1994 has enabled fundamental change in the education policy environment in South Africa, which is primarily aimed at transformation at systemic, social and methodological levels. Johnson (1997) notes that educational policy changes are potentially far-reaching in that the proposals for education transformation are situated within a broader strategy for national reconstruction and development. Hargreaves (1998:vii), in writing about educational change in the United States of America, mentions that,

> [e]ducation change is everywhere. Never have so many schools and their teachers had to deal with so much of it. Responding to wide-ranging educational reform is an inescapable reality of teachers' work in the United States and most other advanced industrial nations as well.

Although this quotation refers to the United States, it is applicable and relevant to the current South African context, where widespread changes have been proposed for education at all levels. These changes needed to occur in a very compressed time frame. Polyzoi and Cerna (2001:64) suggest that educational changes under such conditions are like a 'living laboratory' that is different from the situation in more developed countries, where change occurs in an 'essentially stable societal context'.

Blenkin, Edwards and Kelly (1992) write that many attempts have been made to create conceptual frameworks for analysing and understanding the process of educational change and that a number of different though related perspectives have been offered. The authors add that such attempts have revealed the conceptual complexities of educational change and that social change has far greater ramifications than might at first be recognised. Change processes

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are complex and they influence – and are in turn influenced by – many factors and conditions.

In essence, policy changes and developments have been influenced by socio-political conditions in the country as well as external political and societal factors, including global shifts in thinking about education and economics. However, implementation of policies occurs at local level and this requires adoption by and the support of educational institutions and professionals. I contend that the responses of teachers are an important indicator of the degree of support and adoption of change initiatives and policies and have located my research around this issue.

It is in this process of curriculum change and ferment that environment and environmental education entered the education debates on South Africa. In this paper I review the process of inclusion of environment in the South African curriculum and focus on the roles of teachers and their capacity to implement the environment as a curriculum concern in South Africa. In this paper I cover broader issues in environment and environmental education and also engage critically with issues of teacher development efforts implemented to develop capacity in this regard. It is not possible to unlink the processes of curriculum and teacher development as these complex processes are closely intertwined and impact on each other, presenting a dual yet integrated curriculum challenge for environmental education.

Currently, global environmental issues dominate the mass media, spelling doom and gloom for humankind. Amidst this furore there is often a call for education to 'do something' to address the problem. Environmental education as a field has been in existence for almost four decades, constantly engaging with both local and global environmental issues, and has in a sense served as a response to environmental issues and problems. Environmental education has been variously defined as understandings of the concept of environment broadened and changed and I use the essential description presented by Sauvé (2002:1) as a frame of reference for environmental education in this paper:

> EE [environmental education] is therefore not a form of education among many others; it is not simply a tool for environmental problem-solving or management. It is an essential dimension of basic education that lies at the root of personal and social development: the sphere of relationships with our environment, with our common home of life.

The importance of including environmental education in formal curricula is indisputable, but its implementation has often been described as less than ideal and below potential. Many authors have described environmental education as having potentially transformative impacts, and it is particularly what Robottom (1987) refers to as the 'counter-hegemonic' potential of environmental education or the ability to create the antithesis of a technical paradigm that tends to favour transmissive teaching of discipline-based curricula in education. At a time when the global environment has been described as unsustainable and in a crisis of galactic proportions, education approaches need to address the issues and problems of the day in order to contribute to reducing current problems and preventing future problems in the environment.

The implementation of curricula focused on environment and teacher development processes that will enable implementation of such curricula represent a dual challenge for

education at school and other levels and needs to be addressed so as to maximise implementation in meaningful ways and in this way to contribute to more sustainable living practices in the twenty-first century.

In this paper I argue for environmental education as one of the social agencies through which the transformation to an ecologically sustainable society can be achieved. I also highlight the importance of environmental education as a curriculum innovation in areas of national/international significance, such as environmental studies and teachers as change agents. Further, I provide a history of the field internationally as well as in South Africa. I trace the South African curriculum process to include environmental education and review teacher development approaches for educational change in general and for environmental education in particular. It is my contention that to promote these ideals and take up the dual challenge outlined, we need to respect the complexity of the challenge and deal with curriculum and teacher development as complex processes. This, in turn, requires a departure from what Stevenson (2007a) calls the traditional organisation of schools, which constitutes a major barrier to change and transformation, as it encourages the reproduction of dominant social values and safeguards the status quo, a vital error in these times of environmental crisis.

The Concept 'Environment' and a Perceived Environmental Crisis

Since the early 1970s, often seen as the start of the environmental movement, there has been a growing social awareness of the negative consequences of most human–environment relationships. There is increasing evidence of ecosystem change and destruction and thus malfunction, making it impossible for the environment to support human needs and life. Environmental problems are diverse and include global warming, deforestation, biodiversity depletion and population resource imbalances. Edwards (2011:1) suggests that these relationships are 'unsustainable and indeed detrimental to human life and will undoubtedly lead to an irreversible plummet: a rapid decline in life caused by a cascade of global environmental changes unprecedented in human history'. Even more ominously, Suzuki (2003) argues that the rate of population growth and use of the earth's (natural) resources will lead to a decline in the capacity of the earth's systems to continue to support human needs.

Environmental problems have reached unprecedented levels to the extent that few would disagree that our planet is on the brink of ecological disaster. Many environmental problems, such as climate change, transcend national borders, but the effects thereof are felt by local communities (Le Grange *et al.*, 2011). Many of the problems mentioned above are visible, manifest in many locations and are linked to a variety of causes. The root causes are often found in human activities that are detrimental to the ecosystems of the earth.

Before we continue, however, we should note that the term 'environment' is a complex social construct. As Di Chiro (1987) points out, we imbue a concept with meaning by virtue of providing a name for it. She says:

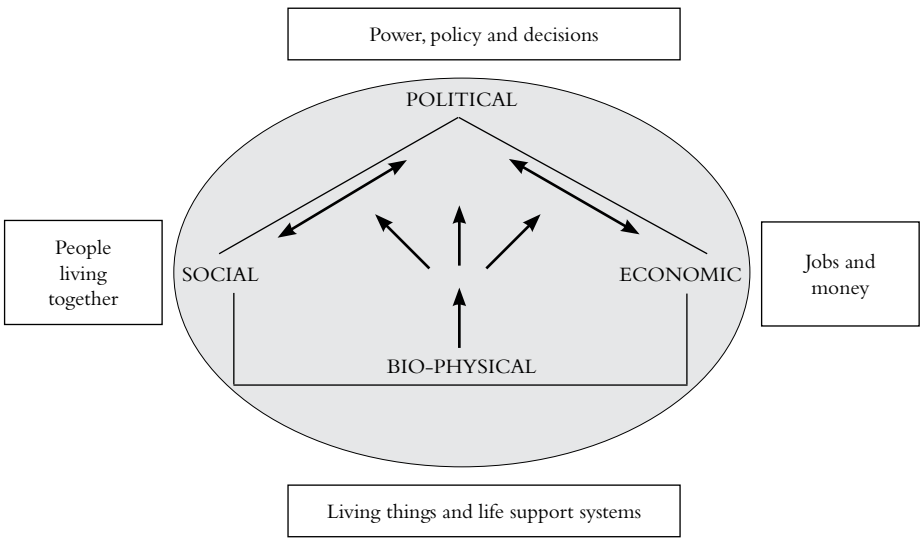
> We define (the environment) as such by use of our individual and culturally imposed interpretive categories and it exists as the environment the moment we name it and

> imbue it with meaning. Therefore the environment is not something that has reality outside or separate from ourselves or our social milieu. Rather it should be understood as the conceptual interactions between our physical surroundings and the social, political and economic forces that organise us in the context of these surroundings. It is in this sense that we say the concept environment is *socially constructed*.

Fein (1993) sees 'environment' as essentially a social construct that can be viewed as having interacting ecological and social activities in various dimensions. These are largely human activities (social) and natural processes (ecological) that reflect the concept of human–nature interactions or socio-ecological systems. In these terms, the environment is essentially a product of these interactions and can be viewed as different dimensions interacting with each other and providing a balanced life. However, these interactions have deteriorated to a state of, as described by Edwards (2011:1), 'humanity sitting on the edge of a precipice faced with making decisions that will influence life on earth'. She adds that the current state of affairs on earth has been presented as an environmental crisis of global proportions that is threatening the very existence of humanity.

The diagram below (see Figure 1) shows the interdependence of humans and nature, often referred to as the socio-ecological interactions described above. The main activities of humans as indicated are social, economic and political, and these all impact on the natural or biophysical environment in various ways. These activities include exploitation of natural resources for manufacturing various products used by people as well as developing what is often called the human environment.

Figure 1. Socio-ecological interactions



The diagram illustrates that environmental problems have multiple and interacting dimensions and that the biophysical dimension forms the base that supports all life and all human activity, manifesting in the interacting social, economic and political dimensions. The environmental problems described above are largely evidenced in the biophysical environment and are often described as a consequence of negative socio–ecological interactions. These have been linked to humankind and are often seen as contested problems with varying interests and are thus described as environmental issues. A simple illustration is one of development as opposed to conservation. A local developer in the area where I live wants to build a small shopping mall. However, the site earmarked is one of the last remaining pockets of natural fynbos veld so the development is being contested by local residents led by a conservation-oriented organisation. Promises of convenience, potential jobs and an improved local economy are countered by the need for green open space, the importance of conservation of rare biodiversity, aesthetic issues and the social problems often associated with such developments, including loitering and traffic congestion. This local problem is magnified on a global scale and includes deforestation to provide resources (like trees for wood pulp or wood), mining and manufacturing plants and the resultant negative impact of air, ground and even noise pollution and the loss of habitats and biodiversity. All these have an impact on the ecosystems of the earth and their ability to maintain balance on earth to allow for habitation and the preservation of biological life as we know it.

Authors such as Beck (1992), Capra (1983:3) and Le Grange (2004:3) argue that the roots of the current environmental crisis lie in modernism, which began with the European philosophic and scientific revolutions of the seventeenth and eighteenth centuries. According to Le Grange and Reddy (1997), this environmental crisis has manifested itself globally as large-scale biophysical destruction, global warming and other environmental issues. The authors also suggest that these issues have complex interacting social, economic and political dimensions and that human lifestyles characterised by consumerism, unbridled economic growth and materialism have exacerbated the problems. Furthermore, curricula in schools play a major role in reproducing the ecologically unsustainable values in modern society, thus contributing to the environmental crisis.

Early responses to environmental problems by scientists highlighted a variety of problems related to the use of pesticides, biodiversity loss as well as increases in human populations and resource use. Much of this evidence was collated in later investigations funded by and published as the *GEO-2000 Report* (GEO, 2000), which provided a shocking account of the state of the planet. *Time Magazine* presented a more popular version of the crisis in its articles 'Situation critical' (Linden, 2000) and 'The tipping point' (Kluger, 2006). These publications show the negative impact of the interactions between humans and nature and describe humanity as being on an unsustainable pathway if its destructive lifestyle and activities persist. According to Fein (1993:64), ecological sustainability concerns relationships between people and nature and includes the following elements: interdependence (people are part of nature and dependent on it), biodiversity (all life forms should be respected by people), living lightly on the earth (biophysical resources should be used carefully and degraded ecosystems should be restored) and interspecies equity (all life forms have value independent of their perceived importance to humans). Environmental education is one of the responses to the crisis we appear to be facing.

Environmental Education: A Response to Environmental Issues and Problems?

The field of environmental education is complex and has developed almost parallel to the social movements in environment and ecology. I will briefly trace the history and development of the field internationally and also highlight significant moments in environmental education in South Africa.

Environmental education is a complex concept open to many interpretations. Janse van Rensburg (1994: 4) argues, '[e]nvironmental education is widely regarded as a key response to the Environment crisis'. Much of the formal work in the development of environmental education was spearheaded by international agencies such as the United Nations Educational, Scientific and Cultural Organisation (UNESCO) and the United Nations Environment Programme (UNEP) internationally. This formal work included international conferences starting as far back as the United Nations Conference on the Human Environment (Stockholm Conference) in the early 1960s, the Belgrade Conference in 1968 and the early and important UNESCO Conference on Environmental Education held in Tbilisi, Georgia, USSR, in 1977. The main idea was that environmental education should be viewed as a process aimed at developing a world population that is aware of and concerned about the total environment and its associated problems and that has the knowledge, attitudes, motivation, commitment and skills to work individually and collectively toward solutions of current problems and the prevention of new ones. A set of principles for environmental education was also developed. All these conferences developed some form of charter or position on environmental degradation and often provided guidelines and ideas for environmental education. The Tbilisi conference has by far been the most influential and the principles developed there for environmental education are as valued and highly regarded today as in 1977 when they were first formulated.

The 1992 United Nations Conference on Environment and Development held in Rio de Janeiro was another landmark event that had strong implications for the direction taken by the field. The idea of sustainable development was promulgated here and a set of principles for sustainable living was developed and disseminated. These principles aimed at promoting sustainable development and improving the capacity of people to address environment and development issues. At the Earth Summit held in Johannesburg in South Africa in 2002, a Decade of Environmental Education for Sustainable Development (2005–2014) was declared, and many countries, including South Africa, were signatories to this declaration.

Le Grange and Reddy (1997) indicate that early approaches to environmental eduation have been assessed as being rather narrow in terms of the conceptions of environment, the nature of the crisis and the kinds of action to be taken. Environment was mainly seen as synonymous with nature, with a focus on ecology and biophysical surroundings. Now, however, environmental educators accept that the concept of environment includes interactions among the social, economic, political and biophysical dimensions.

Lotz-Sisitka (2002) notes that environmental debates and discussions have expanded. There is now increasing emphasis on the need for education to respond to the wide-ranging complex environmental issues and risks and environmental education seems to be emerging as the best approach as a broader understanding of the environment is developed. Environmental education

has experienced many shifts and name changes (Tillbury, 1995), with the most recent shift linked to environmental education for sustainable development (ESD), which is linked to the declared Decade of Environmental Education of the United Nations (2005–2014). Robottom (2006) refers to these processes as an ongoing re-badging of environmental education with little change to the substance and processes of the field.

In the next section I briefly describe the formalisation of environmental education in South Africa.

Development of Environmental Education in South Africa

For a long time environmental education was not part of the formal curriculum and was largely encouraged by conservation organisations, non-governmental organisations and individual teachers. Many other organisations, such as the Environmental Education Association of Southern Africa (EEASA), also adopted and advanced the agenda of the formalisation of environmental education into formal education curricula. The first formal discussion concerned with environmental education included discussions related to a white paper on it in 1989. Not much came of this as bigger developments were occurring politically and socially with potential impact on education in the country. For this progression in South Africa, I draw largely on the work of Lotz-Sisitka (2002).

One of the first formal groupings, which in a sense emanated from EEASA membership, was the Environmental Education Policy Initiative (EEPI). This group introduced a participatory policy-making process to environmental education curriculum work in South Africa just prior to and after the first democratic election (Lotz-Sisitka, 2002). An important contribution was the inclusion of environment in the broader education debates and its eventual inclusion in the Education White Paper of 1995, which paved the way for environmental education in the formal curriculum. As the policy process evolved into a curriculum process, the EEPI shifted its emphasis to curriculum and was renamed the Environmental Education Curriculum Initiative, (EECI). The EECI was a state–civil society partnership project (1996–2000), enabling staff from the Department of Environmental Affairs and Tourism, provincial government education departments and environmental education practitioners to give inputs into the emerging new school curriculum known as Curriculum 2005 (Lotz-Sisitka, 2002). The above initiatives represent the major national curriculum intervention in environmental education curriculum development work between 1992 and 2002 and eventually led to the inclusion of environmental education in the formal curriculum, as is discussed later.

In South Africa environmental education was introduced into the formal school curriculum for the first time in 1997, when a new curriculum framework (Curriculum 2005) was instituted. Curriculum 2005 has since been revised, and in the year 2002 a Revised National Curriculum Statement (RNCS) for General Education and Training (GET) was introduced. General education refers to the first ten years of compulsory schooling and the first four levels of Adult Basic Education and Training (ABET) in South Africa. One of the five principles on which the RNCS is based is social justice, a healthy environment, human rights and inclusivity. In the elaboration of this theme, two important points are made: the South African curriculum

should play a role in creating awareness of the relationship between the different elements of this principle, and the principle should not be advanced in a single learning area only but instead should be integrated into the discursive terrains of all eight learning areas. In 2006 a new curriculum was phased in for Further Education and Training (FET), and as in the case of GET, environmental concerns have been infused into the learning outcomes and assessment standards of all subjects (Le Grange *et al*., 2011).

Including environmental concerns in national curriculum frameworks might be necessary and an important step. However, certain challenges are associated with this development in the South African context. It is not automatic that implementation will happen and barriers and impediments were encountered. One of the major 'obstacles' was the capacity of teachers to implement the environmental education content in the curriculum. The attitudes and skills of teachers are central in determining the mix of different types of knowledge, skills and affective objectives in environmental education programmes and the political and social interests that they serve (Fein, 1991). Stevenson (2007b) indicates that principles that frame the environmental education (sustainability) discourse need to be translated into curriculum and pedagogical practices. This will intellectually and emotionally engage students in developing deep, meaningful understandings and enduring dispositions, by no means an easy or simple task for teachers. Simply put, policy discourse must be (re)-contextualised and transformed by teachers into their own discourse of practice and, most importantly, into pedagogical actions.

However, most teachers have not been assisted in this task because environmental education policy and academic communities have maintained a focus on the development of environment-related goals and have neglected to probe deeply enough into pedagogy, particularly at the level of the teacher (Stevenson, 2007b).

If environmental education is to be one of the social agencies through which the transformation to an ecologically sustainable society is to be achieved, the role of teachers as change agents is vital. Environmental education is important to promote curriculum innovation in areas of national/international significance, such as environmental studies. I take a detour into the field of teacher education and professional development in this area in the next section.

Teacher Education and Teacher Development for Environmental Education: Engaging Curriculum Issues

Teacher education is generally viewed as the formal and systematic preparation of teachers for professional work (Garm & Karlsen, 2004). Tatto (1997:405) writes that 'teacher education refers to organised (formal) attempts to provide more knowledge and skills to prospective or experienced teachers and occurs in either education institutions or school contexts'. Garm and Karlsen (2004) describe teacher education (in Europe) as a field filled with a high degree of complexity and variation yet with common trends identifiable. Teacher education programmes, however, seem to be much the same throughout the world, and Tom (1995) indicates that programmes in the United States of America have not changed in almost a hundred years. He describes the general structure of teacher preparation courses as including several foundational courses followed by so-called 'methods' courses that are capped by a few months or weeks of

apprenticeship or student teaching practice (practicum). This model is widely applied in South Africa.

As part of the changes in education, the teacher education system was also overhauled in this process as part of both educational change and transformation of the higher education sector. As part of this transformation, teacher education shifted from being a provincially controlled activity to a national competence (Sayed, 2002). This in turn involved the shift from the dominance of teacher education colleges as providers of teachers to university faculties of education as providers of professional education for teachers (Gordon, 2009).

In addition to the political and social transformation in South Africa, teacher education has had to adjust to societal shifts towards what Green (2004) refers to as a technologically textured, knowledge-based form of social existence and organisation. Robinson and McMillan (2006:327) indicate that 'teacher educators, in addition to keeping up to date with developments in their discipline, also have to keep abreast of a range of new curricular and policy imperatives in the country'. Sayed (2002) indicates that the school curriculum, Curriculum 2005 (and subsequent revisions), committed the education system to an outcomes-based approach with learning areas instead of subjects, which had further implications for teacher education, training and provision. Robinson and McMillan (2006) further indicate that this has placed pressure on teacher educators who now have to prepare teachers for schools very different from the schools they experienced. This highlights an important curriculum debate for teacher education on whether what happens in schools should influence teacher education curricula. This is where environmental education featured as this presented a new challenge to teacher educators, most of whom were probably not introduced to environmental education in their own teacher education or studies beyond initial teacher education.

Fein (1991) indicates that there has been a historical inattention to environmental education in teacher education programmes. Not much has improved in this sector recently and although formally required to include environmental education, many institutions were left wanting in terms of its introduction into teacher education programmes. With environmental education in the school curriculum, this presented a problematic scenario and did not augur well for environmental education in the formal teacher education sector.

Teacher Development and Professional Development for Environmental Education

In-service teachers also need to overcome the disadvantage of not having had environmental education in their initial teacher education (Lotz & Robottom, 1998). Little and Houston (2003) indicate that viewing the shift in approach to teaching and learning as a change process necessitates providing new and deeper levels of knowledge and practice necessary for quality professional development while focusing on policies and practices, such as curriculum. The implication of this is that teachers have to be given the opportunity for further education and training so that they can fulfil their changed role. This has been part of the change process in South Africa, and I discuss programmes and processes currently running in South Africa.

What do programmes for in-service teacher education (INSET) presented for teachers look like generally, and what is considered as 'good' INSET processes? Professional development

(PD) has been given a number of meanings in academic literature, which makes it difficult in practice to define the answer. In a broad sense, PD covers all forms of learning undertaken by experienced teachers, from courses to private reading to job shadowing (Craft, 1996). PD has also been used to describe moving teachers forward in knowledge or skills (Bell, 1994). In addition, Craft (1996) refers to in-service learning, in-service education and in-service training as PD as they provide opportunities for teachers to learn.

PD has also been variously described in the literature and is used fairly loosely and interchangeably with INSET. Craft (1996) indicates that both terms tend to cover a wide range of activities designed to contribute to the learning of teachers who have completed their initial teacher education. Similarly, Veenman, Van Tulder and Voeten (1994:303) describe INSET as 'a coherent set of activities to deepen and broaden knowledge attitudes and skills that are directly connected with the profession of teaching to improve teachers' professional competence and the effectiveness of their school'. Little and Houston (2003:76), however, take a broader view: '[p]rofessional development is a goal-orientated and continuous process supported through mentoring, coaching and feedback and contextualised to address the perceived needs of students within individual classrooms and schools'. Evans (2002:134) indicates that teacher development can be seen as a developmental process including the stages of 'awareness of an imperfect job related situation, formulation of remedial action strategy and effecting remedial action'. The term is used here to mean all types of professional learning undertaken by teachers beyond the point of initial training, the concomitant skills learnt and developed in these learning processes, and changes in approaches to practice resulting from them.

In South Africa, INSET and PD programmes currently offered to teachers are related to school reform and educational transformation. If teachers in schools are to meet the needs of all students and implement the curriculum imperatives developed in policies (Curriculum 2005 and the RNCS), the instructional practices (teaching approaches) of teachers are one aspect of the education system that must be examined. In order to change instructional practices in meaningful ways (learn new instructional practices), teachers must not only need to learn new instructional practices and content but must also alter their current practices through a revised process of professional development that includes continued support.

The formal processes described by Reddy (2004) included mainly advocacy campaigns during which teachers were introduced to new terminology and ideas for teaching and learning. Very few opportunities were provided for putting new ideas into practice, as advocated by Bell and Gilbert (1994).

The Environmental Education Programme University of Stellenbosch (EEPUS) was established to promote environmental education in the Faculty of Education at Stellenbosch University. In the years since its establishment, EEPUS staff members have introduced environmental education into all programmes in the Faculty of Education and have been instrumental in developing many resource materials for use in pre-service courses in the faculty and by in-service teachers during in-service teacher education aimed at continuous PD. The main operational thrust at EEPUS has been by way of a triadic relationship between materials development, professional development of teachers and curriculum development. The materials developed through consultative processes have served to assist curriculum innovation,

development and innovation, which in turn have had an influence on the professional development of teachers.

Further work was done as part of other national initiatives, such as HSRC meta research on environmental education (Le Grange & Reddy, 2000; Louw, 1999; Reddy, 2000). All were geared towards assisting teachers with the challenges of environmental education implementation in the formal school curriculum.

The Learning of Sustainability pilot project, a donor-funded pilot project (1997–2000), focused on the professional development of teachers to enable them to enhance their skills for learning programme development in a context of rapid curriculum change in two provinces (Janse van Rensburg & Lotz-Sisitka, 2000).

The National Environmental Education Project for General Education and Training (NEEP-GET) was a large-scale, donor-funded initiative (2000–2002) aimed at providing professional development to curriculum advisors and teachers to enable the integration of environmental learning in schools. This project operated in all nine provinces (NEEP-GET project document, 2005).

These processes have been running parallel to formal processes in some cases and concurrent with these processes in other cases. All have been focused on professional development in environmental education to provide opportunities for teachers to better implement the curriculum imperatives for environmental education documented in curriculum documents for schooling and other formal education processes. Has the dual challenge of curriculum implementation for environmental education and teacher development been taken up, and has some headway been made in these processes?

Environmental Education Curriculum and Professional Development as Complex Social Processes

The term 'curriculum' has been variously described in literature and texts in education. The construct is complex and is linked to and influenced by many social processes and interactions. According to Goodson (1997), the most popular interpretation remains the literal interpretation of curriculum, as based on the original meaning of the word as derived from the term *currere*, which means to run or to move and was literally a description of the track on which athletes competed or on which chariot races were held. It seems an appropriate metaphor in educational discourse to refer to the processes that educators plan and through which learners proceed to reach certain learning objectives or outcomes.

Curriculum can be described as the sum total of learning opportunities provided and can include aspects that affect learning processes directly and indirectly, aspects such as teaching methods and styles, our views of and interactions with learners and the ways in which assessment and evaluation is done. The resource materials used (or not used) are important functions of curriculum or curriculum choices. Apple (1983:111) describes curriculum as 'educative environments in which students are to dwell' and Grumet (1981:115) describes curriculum as the 'collective story we tell our children about our past, our present and our future'. Dillon (2009:347) indicates that teachers enacting curricula are faced with a number

of practice questions which influence choices. These include what should be taught, by what means, to whom, under what circumstances and with what in view. These elements he suggests all form part of the enterprise called curriculum and link to a fundamental question teachers are faced with during implementation: 'how to think and act' (Dillon, 2009:349).

Environmental education as a curriculum process fits into all the above descriptions and has had an impact on teachers' work and practices. In referring to the many groups that successfully shaped the curriculum in distinctive ways, Chisholm (2005:199) mentions the environmental education lobby as having agitated for 'recognition of environmental issues across the curriculum'. She credits this group with emphasising the 'integratedness' of knowledge. Through a ministerial advisor on environment, this lobby sought to raise knowledge, skills and awareness of sustainable development in all learning areas. Significantly, Chisholm (2005:199) concludes that 'a healthy environment became a key concept in curriculum'. Since the process was not entirely inclusive, environmental education may be construed, like many other changes, as a top-down imperative. It has certainly been construed in this way by many teachers. It has also been frustrating. As Wexler (2002:471) writes, school reform and curriculum have a big impact on the day-to-day working lives of teachers:

> The point is that incorporating school reform into the working day of teaching requires not only expertise and sagacity. It is an enormous amount of often frustrating additional work that is taken on by teachers, sometimes as an organic professional innovation and at other times as a no less professional adaptation to an external imposition which becomes part of a changing definition of good professional performance.

According to Collinson, Kozina, Yu-Hao, Ling, Matheson, Newcombe and Zolga (2009), nations typically try to institutionalise new ways of thinking and educational innovations by means of policies, and South Africa is no exception to this. Policy implementation is, however, left to practitioners, although they may have had little or no communication with policy makers. Thus even if policies represent desirable change, like environmental education in this case, significant difficulties and unintended consequences may surface during implementation in schools. The authors indicate that top-down policies may fail because practitioners have not been given the reasoning behind new policies or linkages to existing practices.

Collinson *et al.* (2009) indicate further that sometimes an educational policy is created in isolation or it may be inconsistent with existing financial or social policies, that sometimes short-term political thinking may weaken social goals or aspirations and that sometimes existing structures and norms in schools are inadequate to support innovative thinking and policies. This resonates with Stevenson's (2007b) view that existing school practices serve as barriers to environmental education implementation.

In 1997, Le Grange and Reddy argued that outcomes-based education and environmental education were incompatible. They also warned that the formalisation of environmental education in the school curriculum could lead to diluted forms that were narrowly linked to predetermined outcomes. They point out that the perceived mechanistic, reductionist and instrumentalist epistemology of outcomes-based education might be antithetical to

the holistic understanding of knowledge in environmental education, which is accepted in environmental education circles worldwide. The authors also point out that outcomes-based education tends to favour a narrow conceptualisation of environmental education that entails moulding learners through behaviour modification. Le Grange and Reddy further share the sentiments of Robottom (1996), that formalisation could rob environmental education of its important counter-hegemonic nature. It might be better for environmental education to remain peripheral than to be in the central education debate and risk losing its socially critical character, which is invaluable in dealing with environmental issues and problems. Curriculum debates and inclusions are not simple linear processes (Clarke & Collins, 2007), as will be illustrated later.

Stevenson (2007b) indicates that the gap between policy rhetoric and school practices in environmental education has not only persisted, but also appears to have increased over the past 20 years. Stevenson argues for reconceptualising the rhetoric–practice gap so that practices in schools are not simply assessed in relation to policy discourse, but so that policy discourse itself is re-examined in relation to teachers' practical theories and the context shaping their practices. Although the structures and norms of schooling continue to work against enquiry-based, action-oriented environmental education practices, several trends are identified that can offer promising spaces or opportunities. However, this requires fairly sophisticated and willing responses from teachers to engage the processes, and often capacity is lacking, as is the case in South Africa. Do PD programmes for teachers hold some hope for environmental education implementation?

Professional Development Processes as Complex Activities

Some of the programmes presented to teachers, as described in Reddy (2004), particularly the formal programmes, were the exact opposite of what is conceptualised as 'good' or 'effective' processes for professional development in environmental education. There are probably both logistical and academic reasons for this, but it has not served the cause of environmental education well. Other programmes, such as the NEEP, Learning for Sustainibility (LFS) and various EEPUS programmes, have strived to incorporate what is considered to be good practice for environmental education. The six important characteristics for environmental education professional development, namely contextual, responsive, emergent, participatory, critical and praxiological, shaped the conceptualisation of the programmes (Robottom, 1987; 2000) presented in these instances.

Effective professional development, according to Little and Houston (2003), is a complex and comprehensive process of change, including multiple constituents within a system. Fullan (1993:257) suggests that to achieve a desired change, 'professional development must be reconceptualised as continuous learning, highly integrated with the moral task of making a difference in the lives of diverse students under conditions of somewhat chaotic complexity'. Garet, Porter, Desimone, Birman and Yoon (2001:925) indicate that teachers need to be involved closely in the PD and INSET processes. They refer to active learning, which they describe as providing opportunities for teachers to become 'actively engaged in meaningful discussion, planning and practice, particularly how new curriculum materials and teaching

methods will be used in the classroom'. According to these authors, this active learning would include opportunities to link ideas introduced during professional development experiences to the teaching contexts in which teachers work.

Fraser, Kennedy, Reid and McKinney (2007) provide lenses for examining PD processes. They use the ideas of Kennedy's (2005) to illustrate that PD processes can provide learning opportunities that can be located along a continuum where the underpinning purposes of the modules can be categorised as transmissive, transitional and transformative. Transmissive professional learning is generally viewed as the top-down, uni-directional, technical, expert-driven processes whereby experts teach others who are passive, and it thus does not support professional autonomy. Transitional professional learning has the ability to support transmissive and transformative processes. It includes coaching and mentoring whereby some external support is provided but some space exists for adaptation and development of communities of practice using initial ideas. Transformative professional learning suggests strong links between theory and practice and promotes internalisation of concepts and construction of new knowledge by participants and its application in situations of the professional and political context. This approach supports considerable professional autonomy at both individual and profession-wide levels.

Fraser *et al.* (2007) further use Reid's quadrants of professional learning for analysis of learning from programmes. This model comprises a two-dimensional quadrant with formal–informal learning as one axis and planned–incidental learning as the other axis. Formal opportunities are organised by outside agencies and informal opportunities by teachers themselves through networking. Formal learning therefore represents planned opportunities that are pre-arranged, and informal learning has more of an incidental nature, often spontaneous and unpredictable.

A combination of the work of Kennedy (2005) and Reid (Fraser *et al.*, 2007) seems to suggest that a mix of transmission and transformative opportunities for learning, and combinations of formal as well as incidental and informal opportunities, would have a strong influence on teacher learning. This points to less rigid and more open processes for teacher learning.

Collinson *et al.* (2009:4) indicate that the twentieth century has marked a rare conceptual revolution that has affected countries and individuals by reframing understandings of change. They write:

> Gone are formerly accepted modernist concepts such as closed system models, stability and certainty, natural laws and order and linear thinking. These have been replaced by postmodern concepts such as organic systems, unpredictability, interdependence and constructed perspectives.

Collinson *et al.* (2009) indicate further that this kind of thinking envisions systems that are self-regulating and capable of transformation in an environment of turbulence. In this setting, the teacher's role is no longer causal but is seen as transformative. The authors indicate that this implies that teachers require advanced continuous learning as well as opportunities to engage in dialogue and enquiry to create new knowledge. Clarke and Collins (2007) suggest that teachers need opportunities to work collaboratively, disseminate their learning and contribute to their own and their colleagues' and the organisation's continuous learning.

Environmental Education Curriculum, Teacher Development and Complexity Theory: Will the Curriculum Caterpillar Fly?

Both curriculum processes discussed above clearly show the features of what Clarke and Collins (2007) describe as complex systems. Clarke and Collins (2007) use Weaver (1948) to distinguish among systems. Weaver worked at a time when 'scientists' divided phenomena into two main categories for investigation: simple and complicated, later called complex. Simple phenomena have few variables in their interactions, and it is possible to predict possible outcomes fairly accurately. Complicated or complex phenomena have many variables and it is difficult to predict or specify exact outcomes. Over a long period of time, outcomes can be predicted within acceptable limits and even with some confidence.

Complex phenomena have many variables but the outcomes are rarely predictable. Weaver observed that when outcomes emerge, they are not random but display a unique pattern. Complex phenomena seem to have an inherent unpredictability about them, but at a critical point, referred to as 'emergence' by Johnson (1997), they display a clearly discernable pattern. In short, Clarke and Collins (2007:161) indicate that 'complex phenomena represent interactions of events and practices that coalesce in ways that are unpredictable but nonetheless highly patterned'.

Important characteristics of complex systems are the following:

- Networks - Complex systems exhibit networked rather than hierarchical structures. This means that there are multiple horizontal lines of control, as opposed to vertical lines of control (Senge, 1990). Complex systems are thus difficult to control or constrain. Multi-branched or non-linear complex systems mean that development occurs but the exact direction is unknown prior to its emergence.
- Feedback loops - Networks allow loops that provide opportunity for learning at local level. This means that new knowledge returns to and is taken up at the point of origin. This provides quick communication due to multiple branching as there is no single point for order, direction control or organisation.
- Self-organisation - Stacey, Griffin and Staw (2000) write that self-organisation refers to patterned behaviour arising from agents interacting locally according to their own principles or 'intention', in the absence of an overall blueprint for the systems. Complex systems can have the capacity to change and alter based on information sent and received at the local level, independent of an authorising and directing agent. Local effects can thus have system-wide implications. It is, therefore, not possible to fully control or know a complex system, which means that we must accept that there is an element of indeterminacy.
- Disequilibrium - This runs contrary to the notion that successful systems need to have a state of equilibrium as an essential characteristic. Stability is important for closed systems, but because of the generative potential of open or complex systems, it is important to have a degree of disequilibrium as this creates opportunity for change and development and allows for spontaneity and the capacity to change.

- Nested nature of complex systems - Davis and Sumara (2005) note that complex systems are systems within systems. Complex systems are a collection of similarly complex systems and are part of larger complex systems, for example school districts and provincial and national political processes.

A complex phenomenon is therefore irreducible. It transcends its parts so it cannot be studied strictly in terms of a compilation of those parts and must be studied at the level of emergence. The characteristics of complex systems, namely networks, feedback loops, self-regulation, disequilibrium and nested nature, represent dynamic interactions that cannot be accounted for by simple or complicated views and applications/renderings.

Haggis (2005), in Clarke and Collins (2007), notes that if a sufficient number of these interactions take place over a sufficiently long period of time, forms of order or organisation will periodically emerge from within the system. It should be noted, according to Clarke and Collins (2007), that it is possible for all these characteristics to exist. However, there is no guarantee that complexity will emerge.

It is clear that environmental education as a curriculum process and professional development for environmental education are complex systems. I believe that we should take Clarke and Collins's (2007) warning seriously that control kills and stifles and is a sure way to ensure that innovation is stillborn. These systems can and will become moribund in regimes of high control that stifle the qualities inherent to complex systems. Davis and Edwards (2001) use the analogy that caterpillars need to develop into butterflies by a complex process and will not fly if *we* add wings to them. Similarly, complex processes such as curriculum for environmental education and PD for teachers need to unfold in time to develop the outcomes they show the potential for in education.

Concluding Remarks

Education is a dynamic social process that is influenced by different and varying social and political conditions and it needs to adapt and adjust often. It is, however, well known that education is a notoriously conservative 'enterprise' that requires much effort to effect change.

Morrow (2001:1) captures the essence of this change process in education in South Africa when he writes:

> Although the social and political world never remains stable for very long there are key symbolic moments of change, and 1994 provided such a euphoric moment in our shared experience. However, social transformation itself is not a single dramatic event, it takes decades (sometimes centuries) to unfold and requires the combined efforts of many people … Social transformation always raises fundamental questions about education, schooling and teaching. Embedded convictions that carried our thinking and practices fairly comfortably in the past are challenged by the new situation, and issues we once thought settled press forward for articulation and reconsideration.

While no one doubts its importance, the implementation of environmental education leaves much to be desired. Since the continued existence of humankind is at stake, it is vital that this be set right. However, for this to happen, we need to acknowledge the complexity of the field of environmental education and the many influences on it. Hoban (2002) suggests that education and change in education are a dynamic and complex system, where varying aspects of the field impact and are in turn impacted on by other aspects and activities in the field by way of complex interactions that are self-limiting and yet open. It is my contention that education would best be viewed, treated and practised in this manner.

In the practical world of schools, shifts are neither simple nor easy, especially in environmental education as there are major differences in aspirations of it, as laid out in policy discourses internationally, and dominant purposes and structures of schooling in Western industrialised societies (Stevenson, 2007a). Thinking about schooling in the short-term frequently subverts collaboration, which is more time-consuming and messy, but real change requires long-term visions of schooling and society and new understandings of learning and the assumptions underpinning curriculum and teacher development.

Stevenson (2007b) states that teachers are both subjects and agents of change. They have their own practical theories of education and their own understanding of the practical and conceptual constraints of their work. Although practical theories are often tacit, any new policies, frameworks or ideas are filtered through the lens of theories and dominant ideologies. According to Collinson *et al.* (2009), education policies that are not coherent with or supported by social and financial policies have a long history of failure and unintended consequences. Teachers and other knowledge workers in a world of change need continuous PD, some from the bottom up and some through collaboration. Recent emerging trends for broadening and enhancing teacher learning through continuous PD suggest that a collaborative model for change can contribute to better understanding, stronger policies and improved implementation in schools. Discourses of professional learning that reflexively build, sustain and develop spaces for meaningfully enacting environmental education in schools and recognise the importance of teacher agency and professional communities, have the potential to move the focus from educators' implementation (as expressed in policy discourse) to building their normative and technical capacity, both individually and collectively, to shape their practice.

We probably need to adopt the suggestion made by Cvetek (2008) and ground or theorise such complex education activities in order to do full justice to education's complexity, non-linearity and sensitivity to initial conditions. I fully support Cvetek's view that if education professionals accepted complexity and unpredictability as part of education processes (education and research), environmental education as a field could be more responsive to the real needs of education and the environment. It would also be able to make relevant contributions not only to professional education but also to the improvement of social, economic, political and biophysical conditions. In my view, these are the core functions of the field of education.

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