



National Case Study Teacher Professional Development with an Education for Sustainable Development Focus in South Africa: Development of a Network, Curriculum Framework and Resources for Teacher Education¹

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Abstract

This national case study reports on the development of a national network, curriculum framework and resources for teacher education, with specific focus on the inclusion of environment and sustainability, also known as education for sustainable development (ESD) in the South African teacher education system. It reviews and reports on the history of environment and sustainability education in teacher education, and from this, the national case study begins to conceptualise a new approach to environment and sustainability teacher education within a new curriculum policy environment, and a new teacher education and development policy environment.

Action research case study methodology is used to document the first phase of the emergence of this network, and this report covers Phase 1 of the initiative, which covers formation of the network, review of previous practices, three conceptual development pilot studies undertaken in both in-service and pre-service teacher education environments and a piloting of a 'Train the Trainers' or 'Educate the Teacher Educators' programme, which complements and extends the actual teacher education and development (TED) programme under development.

The study highlights critical insights of relevance to the shift to a content referenced curriculum in South Africa, and shows how the 'knowledge mix' which forms the foundation of the new Teacher Education Qualifications Framework can be engaged. It also highlights some features of the changing knowledge environment, and what dominant knowledge practices are in environment and sustainability-related teaching and teacher education practices, opening these up for further scrutiny. It raises concerns that dominant knowledge work, while integrating a range of forms of knowledge (as is expected of the teacher education system under the new policy), tends to be limited by content on problems and issues for raising awareness, and fails to develop deeper conceptual depth and understanding of environment and sustainability, as issues-based knowledge dominates. Similarly, it fails to support social innovation as a response to environment and sustainability concerns, as awareness raising dominates in dominant knowledge work. The study provides a revised conceptual framework for the Teacher Development Network (TEDN) programme, with guidance on key elements necessary to take the programme forward in Phase 2.

Executive Summary

This national case study reports on the development of a national network, curriculum framework and resources for teacher education, with specific focus on the inclusion of environment and sustainability – also known as education for sustainable development – in the South African teacher education system. It reviews and reports on the history of environment and sustainability education in teacher education, and notes that the previously numerous efforts to strengthen environment and sustainability in teacher education have failed to make systemic impact, and have suffered from a range of quality-related problems which have paradoxically been reproduced through ongoing reliance on similar concepts and approaches. From this, the national case study begins to conceptualise a new approach to Environment and Sustainability Teacher Education within a new curriculum policy environment, and a new teacher education and development policy environment. It seeks to disrupt taken for granted ‘old’ practice as practised within the former emphasis on Outcomes-Based Education. The new curriculum policy environment introduces a more strongly content-referenced curriculum which has commitments to active and critical approaches to learning, and to environment and sustainability content, which is integrated into a range of subjects at all levels and phases of the schooling system. It also has clearly defined, structural guidance for assessment. Analysis of the Curriculum and Policy Assessment Statement (CAPS) shows that in some subjects, up to 50% of content is ‘environment’ or is related to ‘sustainability’; and that environment and sustainability content permeates a wide range of subjects, in line with a curriculum principle that seeks to ensure an environmentally literate citizenry. The new policy environment foregrounds approaches to dealing with a critical issue associated with educational quality in South Africa, teachers’ knowledge and knowledge practices, which form the foundation of an interesting differentiated ‘knowledge mix’ in the new Teacher Qualifications Framework. This knowledge mix has different emphases within different types of teacher education qualifications and programmes, with differentiation being linked to purpose. The initiative is also conceptualised and linked to the UN Decade on Education for Sustainable Development’s (UNDES) objective to improve the quality and relevance of education, and to priorities teacher education in the second half of the UNDES.

Action research case study methodology is used to document the first phase of the emergence of this network and programme. This report covers Phase 1 of the initiative, which deals with formation of the network, review of previous practices, three conceptual development pilot studies undertaken in both in-service and pre-service teacher education environments, and a piloting of a ‘Train the Trainers’ or ‘Educate the Teacher Educators’ programme, which complements and extends the actual teacher education and development (TED) programme under development. Conceptual piloting took place within a B.Ed Honours 20 credit programme; and within two Post Graduate Certificate of Education contexts, one where environment and sustainability topics were dealt with from a range of different subjects, and another where the focus was on science knowledge specifically. At the heart of the piloting were questions about teachers’ knowledge, how teachers and teachers-in-training work with knowledge in teaching practices, and what issues they encounter when dealing

with environment and sustainability knowledge specifically. The pilots, however, recognise that teaching is a complex practice in which a variety of different forms of knowledge intersect, and the pilots therefore also investigated pedagogical content knowledge, and the relationship between knowledge, and teaching practice; i.e. knowledge-practices of teachers in training (in-service and pre-services). It also investigated the scope of material and orientation relevant to such a programme, and an associated Training of Trainers Programme (for teacher educators), which was also piloted.

The study highlights critical insights of relevance to the shift to a content referenced curriculum in South Africa, and shows how the 'knowledge mix' which forms the foundation of the new Teacher Education Qualifications Framework can be engaged in an integrated manner. It also highlights some features of the changing knowledge environment, and what dominant knowledge practices are in environment and sustainability-related teaching and teacher education practices, opening these up for further scrutiny. It raises concerns that dominant knowledge work, while integrating a range of forms of knowledge (as is expected of the teacher education system under the new policy), tends to be limited by content that teachers are familiar with, and content on problems and issues for raising awareness, and fails to develop deeper conceptual depth and understanding of environment and sustainability, as issues-based knowledge dominates. For example, knowledge of climate change as an issue will be shared, but teachers fail to work with underlying concepts to *understand* climate change, and how it comes to be present, and also fail to consider what can be done about it (i.e. their conceptual frameworks tend to be limited by dominant knowledge practices around environment and sustainability that exist in society). Similarly, these dominant knowledge practices fail to support social innovation as a response to environment and sustainability concerns, as awareness-raising dominates in dominant knowledge work. This has implications for how knowledge and pedagogical content knowledge are conceptualised and worked with at teacher education level. A teacher education curriculum that simply aligns with the CAPS appears to be inadequate, as a more critical, expansive orientation to knowledge and pedagogical content knowledge is required, if quality education is to emerge. The study provides a revised conceptual framework for the Teacher Development Network (TEDN) programme, with guidance on key elements necessary to take the programme forward in Phase 2. These include developing deeper understandings of the CAPS and its assumptions (and flaws); and the 'knowledge mix' expectations of teacher education policy, as well as dealing with a range of practical/structural factors such as materials development; accreditation and quality management; ongoing partnership formation and differentiation of roles, research, integration with national teacher education and development priorities and structures; and business planning to ensure a sustainable intervention that will have long-term quality impacts. All of these are considered as ongoing for Phase 2 development, which will commence in 2012 with materials development piloting, and expansion of the programme, which will include giving attention to the concept of professional learning communities, which provide a mechanism for ongoing learning and change.

Introduction and History

Rationale for the contribution

Key principles of education for sustainable development (ESD) (environment, society and economy) have been incorporated into the National Curriculum Statements (NCS) for General Education and Training (GET) and the Further Education and Training (FET) National Curriculum Statement for Schools (Grades R–12) since 1996 in post-apartheid curriculum transformation in South Africa. This is best captured in the principle of the NCS which required all schools and teachers to ensure that the relationship between a healthy environment, social justice, inclusivity and human rights was incorporated into curriculum and teaching and learning activities (DoE, 2002). One of the former Ministers of Education established a National Environmental Education Programme (NEEP) in 2000, building on an earlier pilot ‘Learning for Sustainability’ programme implemented in two provinces. The National Environmental Education Programme was oriented towards building system capacity for implementing this principle of the NCS. The NEEP supported the emergence of the Education for Sustainable Development Strategy in South Africa, but tended to concentrate more on piloting models for the professional development of subject advisors at district level than on formal teacher education programmes, although some teacher education clusters were established in which models and approaches to Environment and Sustainability/ESD³ teacher education were piloted.

Through a parallel programme, also supported in part by the NEEP, the South African Eco-Schools Programme, implemented by the Wildlife and Environment Society of South Africa (WESSA), and linked to the International Foundation for Environmental Education and a network of international ‘Sustainable Schools’ initiatives, developed the Eco-Schools initiative in South Africa, which today involves more than a thousand schools in the development of ‘sustainable schools’ through whole school development and curriculum change approaches (Rosenberg, 2008). This programme in particular has captured the interest of teachers and local-level partners as it has useful tools for reviewing current practices in schools, and it provides a practical and useful set of resources and tools for teachers to integrate environment and sustainability concerns (such as biodiversity, resource management, health and nutrition, etc.) into curriculum and teaching practices.

However, both of these programmes – the NEEP and the Eco-Schools programme – have not been able to provide for a sustainable system of teacher professional development (or teacher education and development [TED]) for environment and sustainability education (ESD) in South Africa. While many examples of good practice exist in schools (via the Eco-Schools Programme’s annual portfolios and ongoing school-based practices), and good policy frameworks exist (via the NEEP, which influenced curriculum policy), very little has been achieved in ensuring that environment and sustainability issues are consistently and coherently integrated into teacher education.

The context

South Africa is emerging from 300 years of racial oppression which created a divided education and training system. This system was implemented through social engineering orientations that produced second rate, poor quality education outcomes for the majority of the black African population, and high quality education outcomes for the minority white population. While the ANC-led government has made significant inroads into equalising the system through, for example, equalising budget expenditure (spending the same on all children regardless of race), there are still a number of legacies that continue to impact on the basic education and training system, most notably the achievement of quality learning. Many of the schools are under-developed in the sense that the facilities remain inadequate, and large numbers of children are still affected by poverty-related factors which affect their participation in schooling. Environmental health issues such as sanitation and waste management affect achievement of a healthy environment in schools, and school and community violence affects human rights in schools and their communities. Social justice has not yet been achieved in the sense of providing an equal, high quality education for all learners. Teachers have mostly been exposed to poor quality teacher training, and it has been confirmed through a number of national studies that the issue of teacher's knowledge is a central concern in achieving educational quality. Literacy and numeracy skills are also poorly developed in the national education system, and South Africa has recently scored lowest on both PIRLS (Progress in International Reading Literacy Study) and TIMSS (Trends in International Mathematics and Science Study) tests, indicating that achievement of educational quality is a key issue in the majority of schools (Rosenberg, 2008).

South Africa, like most countries in Africa, is also faced with a number of sustainable development challenges, most significantly water scarcity, climate change mitigation and adaptation and loss of biodiversity. Building capacity at community level for adaptation and sustainable livelihoods and lifestyles is also a critical challenge, particularly for those in rural areas who are most vulnerable to the impacts of social, economic and environmental risks (DEA, 2010; DST, 2010). A poor understanding of sustainable development currently exists in schools and amongst teachers, and teachers have little capacity for integrating these issues into teaching and learning.

Three large scale national studies on the skills development issues associated with South Africa's sustainable development pathway undertaken by the Department of Environmental Affairs (DEA, 2010), the biodiversity sector (HSRC, 2010) and the Department of Science and Technology's Global Change Grand Challenge National Research Plan (DST, 2010) all point to the need to improve South African teachers' knowledge and pedagogical content knowledge (capacity to teach) of environmental and sustainable development content, values and skills. These national skills studies for the environmental sector have all shown that teachers have inadequate environmental and sustainability knowledge to lay the foundation for further environmental learning and career-path development for youth in South Africa, or for associated forms of citizenship development.

The revised Curriculum and Assessment Policy (CAPS) (DBE, 2010) that will be implemented from 2012 requires teachers from a wide range of subject areas to teach new

environmental content knowledge, values and skills. Because the Department of Basic Education (DBE) is concentrating on improving basic capacity in areas of literacy and numeracy, inadequate attention is being given to this new knowledge area (environmental and sustainable development knowledge) that is essential for improving the quality and relevance of teaching in South Africa. Research is showing that engagement with environmental education and place-based knowledge improves learner achievement (Smith, in press) through providing contextually situated forms of epistemological access (access to more complex forms of knowledge offered in schools) (Lotz-Sisitka, 2009). While there are some good examples of excellent practice in a number of universities, teacher education for environment and sustainable development education, has, on the whole, been neglected in teacher education innovations in the past 15 years, as institutions have struggled to adjust to mergers and changed institutional forms. Consequently, most provisioning in this area has been through small-scale NGO- and/or interested partner-based interventions which have not had the desired systemic impact.

The issue of the need to invest in teachers' knowledge for enabling a sustainable development pathway is not only a South African issue. In 2002 at the World Summit on Sustainable Development, agreement was reached to establish a UN Decade on Education for Sustainable Development (2005–2014). This was because progress in halting environmental degradation and establishing a more sustainable, just world order was too slow, and the power and potential of education was not fully engaged (UNESCO, 2005). In 2009 the Decade was reviewed, and it was found that not enough attention was being given to teacher education. Consequently, UNESCO and governments around the world agreed to strengthen teacher education initiatives focusing on environment and sustainability education as a priority for the second half of the UN Decade of Education for Sustainable Development (UNESCO, 2009). UNESCO, in their 2004 Education for All Monitoring Report, noted that teachers were one of the most significant determining factors in ensuring educational quality.

As indicated above, teacher education has been identified as a key priority for the second half of the UN Decade on Education for Sustainable Development (UNESCO, 2009). This has been taken up at continental level through the establishment of the Southern African Development Community/UNESCO (SADC/UNESCO) ESD Teacher Education network; the AFRITEIS network (African Teacher Education Network for ESD); and at a global level through the UNESCO ESD Chair of Teacher Education, which is supporting the establishment of both international and affiliated national teacher education networks and programmes such as the one reported on here. This case study therefore feeds into these regional and international programmes and network initiatives.

All of this feeds into a changing teacher education context in South Africa. Currently, South Africa employs approximately 350 000 teachers, but projections for the supply of teachers indicates that South Africa will be facing a shortage of teachers in the near future, particularly in areas such as Foundation Phase, African Languages, Science and Mathematics. Subjects such as Geography Education have also been put on the scarce skills list. The Department of Higher Education and Training (DHET) is therefore engaged in structural initiatives in partnership with South Africa's 21 higher education institutions that offer teacher education to address these supply and demand issues.

For the purposes of this Environment and Sustainability/ESD Teacher Education initiative, however, issues of supply and demand are not the core focus; rather the focus is on what is taught during teacher professional development programmes and how and why. Environment and sustainability concerns are cross-cutting societal issues influencing all teacher education programmes and specialisms; thus the initiative reported on here is as relevant to a Foundation Phase teacher in training as it is to a high school Science teacher, or an Intermediate Phase Life Orientation or Language teacher. Although the emphasis and specific focus of ESD within these different teacher education streams may differ slightly, there are a core set of issues and principles that cut across all teacher education programmes and different subjects approach environment and sustainability concerns in different ways. It is this emphasis, namely how to improve the quality and relevance of teacher education across all subjects and specialisms through Environment and Sustainability Education or ESD, that is the main driver of this initiative.

Policy Relevance

Broad-based policy relevance

The Constitution of South Africa (RSA, 1996) enshrines the right of every South African citizen to an environment that is not harmful to their health or well-being, and it also secures the right to protection of natural resources for present and future generations. Section 24 of the Constitution, in the Bill of Rights, states that:

Everyone has the right:

- a. To an environment that is not harmful to their health or well-being; and
- b. To have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that:
 - i. Prevent pollution and ecological degradation;
 - ii. Promote conservation; and
 - iii. Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

The South African National Environmental Management Act (NEMA) of 1998 (RSA, 1998) developed from this constitutional mandate, which provides framework legislation for a host of related environment and sustainable development policy that governs biodiversity management, waste management, coastal zone management, natural resources management, water resources management, alien invasive species management and many other issues relevant to the sustainable development of the country. It also introduced a people-centred orientation to environmental management and placed sustainable development at the centre of the country's approach to environmental management, which integrates society, economy and societal issues. Hence environmental education, which is a principle statement of NEMA has, in South Africa, tended to reflect principles and practices that are congruent with most international thinking on ESD.⁴

Environmental management and education in South Africa also supports a human rights and social justice approach to environmental concerns, in response to former policies of disenfranchisement from land, the environment and natural resources during the apartheid era. The National Environmental Management Act (RSA, 1998), which introduced a legal framework for governing sustainable development in South Africa, provides orientation to all government departments to include sustainable development and integrated environmental management approaches in their operations. NEMA includes a clause that emphasises the need to integrate ESD principles into education and training. Under NEMA, South Africa also developed a National Sustainable Development Framework for South Africa, which requires giving attention to capacity building of youth for sustainable development in South Africa.

The government's Medium Term Strategic Framework (MTSF) 2009–2013 includes a strong focus on quality education, skills development, rural development, sustainable human settlements and the sustainable use of natural resources. The sustainable use of natural resources is defined as a specific goal. These issues are also included in Vision 2030, in new green economy plans and the strategy for climate change mitigation. These issues are also powerfully linked to poverty reduction; a social justice approach to sustainable development of South African society and economy; and the national system of innovation. These sustainable development objectives have their roots in the South African Constitution, which includes a focus on poverty alleviation, equitable access to natural resources, sustainable utilisation of natural resources for present and future generations and the right to an environment that is not harmful to health or well-being. However, to address poverty while addressing related new development challenges such as climate change, water scarcity, new energy futures, sustainable human settlements, loss of biodiversity and natural resources and vulnerability to risk, urgent attention needs to be given to strengthening the skills and human capacity needed for achieving these development objectives. New development challenges such as climate change and water scarcity threaten to reverse development progress, thus driving the need for new skills and human capacity to address this risk.

Education sector policy relevance

Within the wider policy context that supports sustainable development, this initiative to develop a sustainable teacher education network – with a curriculum framework that can be operationalised at different levels of the teacher education system, and resources to support school-based praxis and reflective practice of teachers – is also informed by the following education sector policies:

- The 1995 White Paper on Education and Training (RSA, 1995) requires the integration of environmental education for sustainable development⁵ into all levels and phases of the education and training system. It explicitly states that integration of environmental education should adopt an active, integrated approach to teaching and learning.
- The National Curriculum Statement (NCS) (DoE, 2002) and its most recent Curriculum and Assessment Policy Statements (CAPS) (DBE, 2011) require teachers to integrate aspects of environment and sustainable development into almost all subjects (see samples of more detailed analysis in Appendix A). This policy framework requires

that teachers attain the requisite knowledge and pedagogical content knowledge skills for integration of environment and sustainability concerns into the South African National Curriculum. It also has specific associated assessment requirements which include aspects of education for sustainable development.

- The recently approved Higher Education Qualifications Framework for Teacher Education (DHET, 2011) requires teacher education institutions and programmes to foreground knowledge in their accredited programmes. This replaces previous norms and standards for teacher education which were based on reflexive and applied competences. The Department of Higher Education and Training foreground different *types* of knowledge and learning, which include subject-based knowledge, disciplinary knowledge, practice-based knowledge, pedagogical knowledge and situational knowledge. This ‘knowledge mix’ is fundamentally transforming the structuring and content of teacher education qualifications in South Africa at present, and is particularly significant to this initiative, as all qualifications need to be re-oriented within this framework by 2014. The new policy seeks to ensure that teacher education is of the highest quality, which includes issues of relevance and responsiveness to current and future knowledge demands in South Africa.
- The new *Integrated Strategic Planning Framework for Teacher Education and Development in South Africa* (2011–2025) prepared by the Department of Higher Education and Training and the Department of Basic Education (DHET & DBE, 2011) seeks to support continuous professional development of teachers to adopt new orientations and approaches, and to improve their subject content knowledge, pedagogical content knowledge, practice and situational knowledge through a recognised, accredited system of continuous professional development, and through systems that support the establishment of professional learning communities. Significant to this initiative is the commitment in this strategic planning framework to content-rich, pedagogically sound, continuous professional development courses for teachers. To provide these, the DHET and DBE will draw on available specialist knowledge of the specific focus areas, including expertise provided by NGOs and other specialist groups. District Teacher Development Centres will be established, with associated professional learning communities to provide ongoing professional development support for teachers.
- The UN Decade of Education for Sustainable Development (2005–2014) International Implementation Scheme (UNESCO, 2005), and the UNDESD strategy for the second half of the decade emphasise teacher education and the quality of education. According to UNESCO, ESD seeks to improve the relevance and quality of teacher education, and ultimately through this the relevance and quality of the education offered to learners in schools. South Africa is a UNESCO member state, and is also a signatory to the ESD Strategy for Sub-Saharan Africa, which commits government to integrating ESD principles and practices into the education and training system, including teacher education.

Objectives and Methodology Guiding the Case Study Development

Objectives

Objectives were defined for a two phase programme. It was decided that Phase 1 of the programme (2011–2012) must be aligned with the preparations and implementation of the Curriculum and Assessment Policy Statement, which meant that development would concentrate first on the training of trainers, Foundation Phase and Grade 10 (FET) interventions, as these are to be implemented in 2012. As the initiative is ongoing, the main focus of the first phase was to put a clearly structured, high quality initiative in place, which required different kinds of review, scoping, piloting and development work, mainly at conceptual framework and content development levels; as well as structural location and alignment. Four objectives were defined for Phase 1 of the initiative and four for Phase 2. Phase 2 objectives seek to consolidate the developmental phase objectives (Phase 1).

Phase 1: Development phase (2011–2012)

- *Objective 1:* Establish a national consortium and network of environmental education/ESD teacher education providers, with capacity to provide high quality, nationally recognised and accredited continuous professional development short course/s for teachers.
- *Objective 2:* Develop, through careful critical review of past experience of ESD/ environmental education teacher professional development and new policy requirements, a conceptual framework and materials for an environmental education/ESD short course/professional development programme for teachers that is aligned with the new Curriculum and Assessment Policy Statement (CAPS) and teacher development policy environment.
- *Objective 3:* Pilot test the conceptual framework, materials and monitoring and evaluation framework in both pre-service and in-service teacher education contexts with a view to improving the quality, relevance and efficacy of the programme (reach at least 50 teachers in Phase 1 piloting).
- *Objective 4:* Establish a sustainability strategy and implementation plan for the initiative within a nodal framework structure (including further fundraising, institutionalisation into the Continuous Teacher Professional Development (CTPD) system, etc.

Phase 2: Consolidation and limited extension phase (2012–2013)

- *Objective 5:* Expand the development of the programme/s and materials to incorporate a wider range of subjects. Expand the piloting sites and numbers of training providers through a ‘Training of Trainers’ Programme through integration into existing teacher education provisioning systems and structures.
- *Objective 6:* Develop and pilot test the concept, functioning and structural sustainability of professional learning communities associated with the CTPD system and the association of these with the TED programme.

- *Objective 7:* Publish the materials in an open learning system format and integrate the use of the materials and core concepts of the programme into pre-service teacher education programmes and qualifications by 2014.
- *Objective 8:* Establish a substantive research programme and research consortium involving a number of participating teacher education institutions that contributes ongoing knowledge to the development of the initiative over time.

It is envisaged that the programme will develop into a Phase 3, which will be wider adoption and expansion, to eventually reach up to 100 000 teachers in South Africa and be used by all 21 higher education institutions offering teacher education programmes, as well as an expanding network of providers of the CPTD accredited programme. This will require more substantive funding than is currently available, but the intention is to locate the initiative strongly within existing budget and institutional frameworks that exist for providing ongoing teacher professional development.

This initiative is therefore focused on seeding a national initiative that will be of high quality, well-resourced, fully accredited and widely implemented.

Case study design and implementation

As indicated in the title of this contribution, this initiative is a national case study of the establishment and initial implementation of a high quality teacher education programme for ESD that is curriculum and policy aligned and sustainable. It therefore uses case study methodology and research approaches that are consistent with case study research design. As Flyvberg (2011) states, choosing to do a case study is not so much a methodological choice, but rather a choice about what to study (the bounded unit represented by the case). As case studies may be studied in varied ways using a range of different methods or even methodology (e.g. qualitatively, quantitatively, hermeneutically or by mixed methods), the researcher or research team have to make decisions as to what types of data are most useful for informing and/or studying a case. As this is a developmental initiative, action research methodology, involving cycles of review, action and reflection will be used to structure the development of this case study.

Methods used for Phase 1 of the action research process are primarily qualitative, as Phase 1 involves mainly conceptual review and development work. For the purposes of constructing this research report, the following data sources and methods have been used: document analysis of policy documents, previous training materials and course reports and evaluations, minutes of meetings and piloting data gathered during the pilots which included student assignments and course frameworks and materials and teacher evaluations of pilot programmes. Five deliberative workshops involving members of the consortium and participating teacher education institutions were also held, and these provided a valuable source of data for the case study. Three small-scale pilots were also developed to inform the initial work of Phase 1. It is envisaged that some quantitative methods will be used in Phase 2 and in the monitoring and evaluation phases of the initiative.

To ensure quality in the development of the case study, the following methodological points relevant to case study research were observed. Firstly, it is important to define the boundaries

or focus of the case clearly. In this case the establishment of a high quality environment and sustainable teacher education programme and network. Secondly, case studies are ‘intensive’ and require detail, richness, completeness and variance, or depth; they involve what Sayer (1992) calls ‘intensive research’. Thirdly, case studies, according to authors such as Flyvberg (2011) and Stake (2008) should also stress developmental factors, and case studies typically evolve over time, often as Flyvberg (2011:301) states as a ‘string of concrete and interrelated events that occur “at such a time, in such a place”’. These constitute the case, when seen as a whole. Finally, case studies focus on ‘relation to environment’ or context. This requires the researcher to draw boundaries around the case in such a way that he or she is able to differentiate between what is case, and what is context. For example, in this case, supply and demand issues in teacher education in South Africa are dealt with as context, while the ESD quality and relevance contribution to teacher education programming is dealt with as case.

Phase 1 Results

Reporting focus

This section reports on the main outcomes of the Phase 1 action research process, which was to undertake careful review and analytical work to learn from past initiatives. It is to conceptualise a high quality programme that will address the issue of poor quality teacher knowledge of environment and sustainability concerns, develop pedagogical content knowledge, practical knowledge and situational knowledge relevant to the CAPS and established in a manner that will situate and locate it within the Integrated Strategic Planning Framework for Teacher Education and Development in South Africa (DHET & DBE, 2011) and the Qualifications Framework for Teacher Education (DHET, 2011), as the programme and materials can also be used and integrated into formal teaching qualifications.

This has involved the following stages of analysis and development work which forms the first cycle of the Action Research Process:

- *Review and plan*: Review and analysis of previous environment and sustainability teacher education programmes, partnership formation and structural analysis.
- *Action*: Development of a pilot conceptual framework and pilot testing the conceptual framework in pre-service, in-service and ‘Training of Trainer’ teacher education contexts.
- *Reflection and planning*: Refinement of the conceptual framework, programme materials and programmatic structure for further piloting (Phase 1) and implementation in Phase 2.

The main results reported on here therefore reflect the outcomes of this first Action Research Cycle. This also documents the agreed upon framework for the design of courses to integrate Environment and Sustainability Education into teacher education in both pre-service and in-service contexts (for piloting purposes), as well as at the level of ‘Training of Trainers’ (teacher educators). It comments critically on some of the outcomes of the initial piloting work. This will be used to further strengthen development of the initiative and expanded piloting work in 2012.

Lessons learned from similar earlier programmes

As mentioned above, a range of in-service professional teacher development initiatives focusing on Environment and Sustainability Education in South Africa have been implemented by a variety of organisations, including the National and Provincial Departments of Education under the banner of the donor-funded National Environmental Education Programme. Various universities have also offered in-service teacher professional development for environment and sustainability, and a number of NGOs and parastatal organisations have also offered various teacher professional development programmes in this area. These initiatives were, however, all formed under the banner of the outcomes-based approach of Curriculum 2005 and the Revised National Curriculum Statement (DoE, 2002), which have undergone significant changes as the new Curriculum and Assessment Policy Statement (DBE, 2011). The CAPS has retained core elements of the NCS, but has also introduced a stronger content referenced curriculum, more structured delivery frameworks and greater specification at the level of assessment. A review of these earlier programmes therefore needed to take place to identify ‘best available knowledge’ and to re-contextualise this within the new policy framework contexts.

Findings from the review of earlier initiatives identified the following key issues to consider and take forward in the planning of Environment and Sustainability Education in South Africa.

- Inclusion of environment and sustainability issues is generally neglected in formal teacher education institutions, and is often ‘left to the side’ as an extra or separate programme. It is not integral to diverse methods courses, and does not have a strong presence or focus at a broader level either.
- Previous initiatives led by universities, NGOs, parastatals and environmental organisations lacked a sustainable approach for embedding Environment and Sustainability Education programmes into formal teacher education systems and structures.
- Materials tended to be more generic and general, and focused more on active learning approaches and environmental issues, and not on environmental or sustainability content knowledge. There was some engagement with different environmental foci in different learning areas but this requires more differentiation according to phases and grades.
- Assessment and issues of educational quality (e.g. literacy and numeracy) tend to be neglected in Environment and Sustainability Education, where the emphasis tends to lean towards action taking in school and community contexts.
- Workplace-based assignments, linked to programmes such as Eco-Schools help to contextualise and support applied professional development and improvements in practice.
- Courses tend to be high cost and lack sustainable funding infrastructures, and therefore tend to end when funding comes to an end, thus lacking sustainable institutionalisation.

Critical conceptual and orientation problems were also identified in the environment and sustainability education programmes more generally. These were paradoxically being reproduced in teacher education initiatives and include:

- An over-emphasis on activities, projects and experiential learning and an under-emphasis on quality environmental content and concepts, and a failure to make links between issues and concepts.

- An over-emphasis on issues-based approaches to environmental education, which tend to neglect core knowledge, and practice-centred approaches that focus on alternative practices.
- Lack of attention to scope, suitable depth and progression from grade to grade.
- An ‘outside-in’ approach which starts with issues or species and lobbies for their inclusion in the school curriculum, and difficulties in working from the purpose and existing environmental focus of the learning areas ‘inside’ the curriculum.
- Activities that are of too short a duration; longer-term initiatives are needed to develop adequate depth, and once-off workshops are often met by the request for ‘much more’ training.

All of the above point to inadequate engagement with the teacher education system and how it functions, curriculum requirements and in-school educational issues. This review informed the first proposed framework for the Environment and Sustainability Teacher Education Programme, which was subsequently piloted (Figure 1) and refined through ongoing piloting work over a year (Figures 2 and 3). Key features of the first conceptual framework were:

- Emphasis on quality education in a South African setting (e.g. literacy and numeracy issues, learning in a second language, working with large classes and learners’ contexts etc.);
- Emphasis on subject knowledge (and by implication, teachers’ knowledge of their subjects);
- Emphasis on pedagogical content knowledge and assessment practice (emphasis on teaching practice);
- From a ‘Training of Trainers’ (ToT)⁶ perspective, additional dimensions were added:
 - learning from best practice in other parts of the world;
 - wider knowledge and understanding of Environment and Sustainability Education and ESD more specifically (as reflected in international discourse);
 - whole school development, as it relates to the quality of the environment, resources management and longer-term sustainability practices.

Conceptual Pilot 1: Environment and Sustainability (ESD) in the B.Ed Honours curriculum

The main focus of this pilot was to try out the conceptual framework agreed upon after the review of the earlier programmes (Figure 1), and to see if the conceptual framework could be used to design a 20-credit (200 notional hours) B.Ed Honours module. This teacher education programme serves mainly in-service teachers (already practising teachers), and is meant to support the development of research-based competence, since it is an Honours degree. It also aims to support teachers to understand and work with the environmental and sustainability content knowledge which is integrated into all subjects at all levels of the CAPS curriculum. This influenced the way in which the module was developed (i.e. the purpose of the qualification influenced the course design), and the assignments. The 12 teachers involved in the pilot were qualified in a range of different subjects including Science, Geography, Life

Orientation, Languages, Tourism, Mathematics and Technology. They were mostly trained under 'Bantu Education', and were working in rural, poor schools. They could be said to be relatively 'representative' of the majority of teachers in South Africa. Five inter-related, sub-sections were designed using the conceptual framework presented in Figure 1. School-based assignments were set to contextualise the course content and to strengthen both teacher's subject knowledge (with emphasis on the environment and sustainability content aspects of their subjects) and their pedagogical content knowledge, as outlined briefly below:

- *Section 1 – Know your context:* Focus on knowledge of broader (foundational, global and local) environment and sustainability concepts and issues. Assignment involved local research to identify contextually situated environment and sustainability issues and applications of concepts and broader content to local contexts.
- *Section 2 – Know your subject:* Focus on the environment and sustainability content that is specific to different subjects (e.g. biodiversity appears in the Science curriculum, while environmental health appears in the Life Orientation curriculum). Assignment involved finding research-based information on the particular focus topic from the subject, and developing a 'subject dialogue' or information resource to use in teaching. It required using the information resource with learners in the subject concerned, and reflecting critically on use of knowledge in teaching, using theory.
- *Section 3 – Improve your practice:* Focus on teaching methods relevant to teaching the content knowledge researched in section 2 of the module and planning a lesson using the method concerned. Teaching the lesson and reflecting critically on how the method worked in relation to the learning of the content, using theory.
- *Section 4 – Improve your assessment practice:* Focus on assessment theory and assessment of action competence and action learning pedagogies, which are proposed for environment and sustainability education more broadly. Designing an assessment task using the CAPS assessment guidelines for setting different types of assessment questions in tests and exams and assessment tasks, implementing the assessment and reflecting critically on it, using theory.
- *Section 5 – Whole school development:* Focus on strategies to broaden subject-based teaching on environment and sustainability into whole school development programmes and activities. Assignment required development of a whole school plan for environment and sustainability.

Findings related to this pilot showed the following insights in relation to the following key issues that the programme sought to pilot:

- *Knowledge of environment and sustainability content:* All teachers showed a fair understanding of local environmental questions and issues. Their summaries of newspaper articles displayed a reasonable understanding of causes and effects of environmental concerns as well as the associated risks. However, the majority of the teachers (eight out of 12) struggled with critical reflection on local environmental issues. They were unable to synthesise wider views of these concepts and concerns in relation to locally familiar concepts and concerns. This was related to surface or limited in-depth

reading of texts containing information on wider concepts and concerns related to environment and sustainability. The consequences are that the majority of teachers, in their practice, are likely to miss out on the depth and complexity of environmental issues and how they are intertwined with development issues as well as with human rights and social justice issues in both local and global contexts.

- *Complex and new knowledge relevant to subjects:* Teachers showed capacity to analyse their subjects and to identify relevant environment and sustainability content. They were able to produce 'subject dialogues' or information resources on available, straightforward information, and showed an appreciable ability on how they could engage learners with available knowledge, working with well-known concepts and content. Despite some pedagogical technicalities here and there, in the 'subject dialogues' all teachers displayed that they will manage the bigger chunks of environmental content in their learning areas. However, all had great difficulty in dealing with environmental knowledge that is contested, not certain or not available. They seem to have very little aptitude, not only to mobilise other forms of knowledge, but also to use cross-disciplinary links to engage knowledge from other contexts or learning areas in relation to their own subject knowledge. For example, a Geography teacher would get stuck with an idea that is well-managed in Life Sciences, or that can be explained reasonably through indigenous ways of knowing.
- *Methods and learning theory:* Teachers displayed a great deal of competence in working with some educational theories especially social constructivism, but almost all were cautious with other theories, for example socially critical theory. Most of their suggested activities were designed for learners to work together to arrive at the known knowledge or established concepts. There was hardly any evidence of planning to drive the learners to challenge the established norms or to engage with the contested knowledge. Follow up discussions revealed that the teachers themselves are not adequately equipped with necessary pedagogical skills to assist their learners to engage with contested knowledge. They also blamed the school system for not giving them enough space to be socially critical of society. They all agreed that the school curriculum is designed in such a way that if learners do not 'conform' with the known and established norms and values then they may not be successful in examinations.
- *Assessment of environment and sustainability knowledge and approaches:* More than half of the teachers could not design assessment activities in ways that could develop values and skills towards action competence. Some were not clear of any pedagogical activities that could allow action competence. Similarly, about two thirds of the group could comfortably design assessment tasks on knowledge about causes and knowledge about effects, but only a third were able to satisfactorily assess other forms of knowledge (e.g. about visions and knowledge about strategies for change). This reflects similar findings to the above, namely that teachers are inclined to deal with the known knowledge and are hesitant to go into the contested or the unknown.

- *Critical reflexive capacity, as foundational research competence:* The majority of teachers were quite capable of using a reading, model or theory to reflect and critique their own practice (an attribute that the course emphasised throughout), but there remained (throughout) a small group (about 25%) that struggled to make sense of such models or theories. Surprisingly, such individuals seem to know about what the theory says or what the model is all about (judging from their descriptions), but they seem not to have acquired the skills to apply them in their practice. On whole school improvement (Section 5), it was encouraging that the majority could see the curriculum vantage point of environmental knowledge in improving conditions of learning and teaching in addition to maintaining a healthy school environment; showing wider societal reflexivity of their teaching and learning programmes.

The depth, contextualisation and expansion of teachers' subject knowledge and pedagogical content knowledge appeared to be critical issues emerging from this pilot, as did skills to work with new and more complex forms of knowledge as introduced by environmental and sustainability topics into existing (more familiar) subjects and subject knowledge/s. Following this pilot, it was decided to integrate Section 1 and 2 of the conceptual framework and to embed Section 5 into the whole programme, giving it a sharper subject knowledge (within which environment and sustainability knowledge is embedded) and pedagogical content knowledge focus (Figure 2).

Figure 1. First conceptual framework

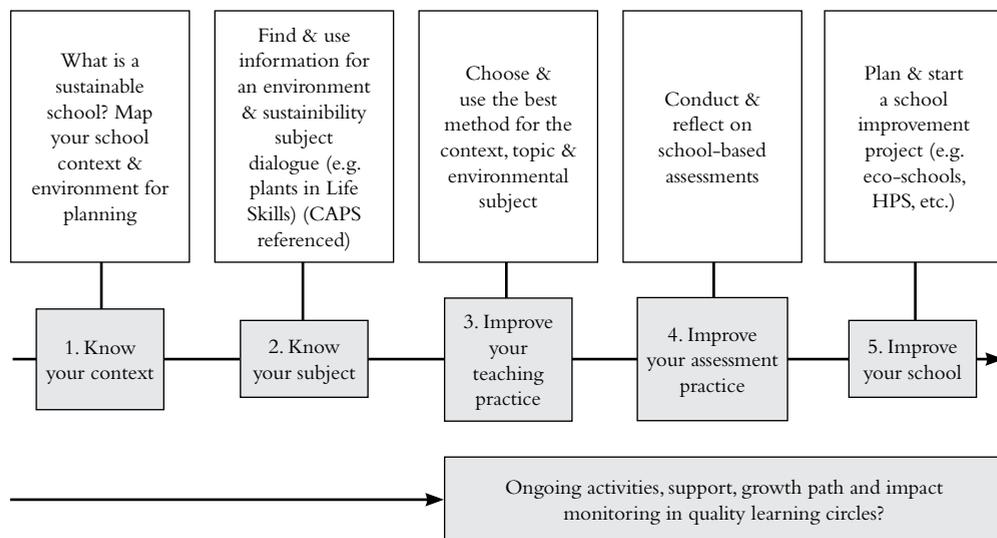
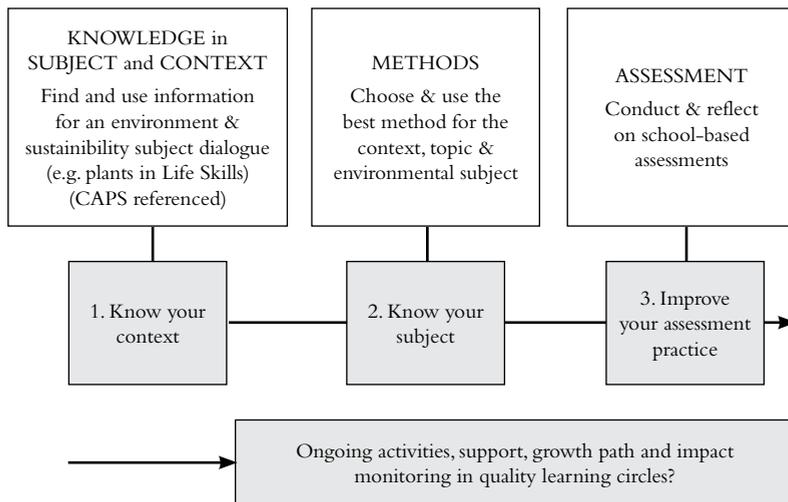


Figure 2. Revised conceptual framework

Conceptual Pilot 2: Environment and Sustainability (ESD) knowledge in a cross-curricular module in the PGCE

The issues associated with environment and sustainability content, its nature and emergence within different subjects and associated pedagogical content knowledge became the core focus of the next two conceptual pilots. Conceptual Pilot 2 was focused on environment and sustainability knowledge of student teachers (teachers-in-training) who were involved in a cross-curricular module on environment and sustainability education in a Post-Graduate Certificate in Education Programme (PGCE) programme. The PGCE is a pre-service, post-graduate, one-year teacher training programme in which graduates specialise to become teachers. From the DHET (2011) ‘knowledge mix’ perspective, the emphasis is on subject knowledge (to know what is meant to be taught in the Science curriculum in schools), pedagogical content knowledge (how to integrate knowledge and pedagogy in and through teaching practice and assessment), practice-centred knowledge (how to practice Science teaching) and situational knowledge (how science is situated in society). The 40 students in the groups had a variety of different disciplinary backgrounds, and were training to teach a variety of different subjects, including Arts and Culture, Mathematics, Physical Science, Languages, Life Science, Life Orientation, Natural Science and Geography. The key research questions informing this pilot were:

- What are the current subject discipline *perspectives* on environment and sustainability education?
- What range of *methods* are seen as appropriate for environment and sustainability education in the subjects concerned?
- How is *content* reflected in ESD teaching practices (of student teachers)?

The analysis focused on the pedagogical content knowledge narratives on subject perspectives and method selections for environment and sustainability in the Science education curriculum,

as represented in PGCE student assignments and practice teaching activities. Key findings emerging from this pilot showed the following patterns associated with the core interests of this pilot, namely environment and sustainability perspectives, methods and how content was being worked with.

- *Perspectives on environment and sustainability and education:* Most students viewed environment as natural systems and/or problems or issues. ESD was seen to be about awareness creation, values and ethics and/or behaviour change. Dominant topics selected by the students (across the different subjects) were recycling, biodiversity, climate change, population and resource use.
- *Methods:* Most students made use of methods that were core to their disciplines, but also worked with methods such as fieldwork, case studies, practical work, awareness campaigns, real life debates and audits.
- *Broad trends:* Students tended to use perspectives centred on the natural environment and issues to create awareness amongst learners, using disciplinary core methods with 'borrowing' of fieldwork, case study materials and problem-solving tasks and deliberation methods. Recycling and field trips were generally 'first up' (or most popular).

From this it was possible to establish that dominant knowledge work appears to be primarily conceptual and descriptive with an issues focus (empirical) towards awareness production to steer problem solving change (narrative) and is borne of an informed understanding of issues (theoretical/dialectical). This reflects student's engagement with differentiated knowledge forms in and through their knowledge practices as described by Hedegaard (2007:251-2).⁷ This evidence of students (teachers-in-training) working in integrated ways with a differentiated knowledge framework in and through environment and sustainability issues or topics in and through their practice in the CAPS curriculum environment is significant to the new Teacher Education Qualifications Framework, which prescribes different types of knowledge and learning as a foundation for teacher education. The DHET differentiates these types of knowledge (as described above), and it indicates that these types of knowledge should not be used to design teacher education curricula in 'types of knowledge/learning' formats, but rather that the teacher education curriculum should seek to develop this 'knowledge mix' in and through teaching practices that show sophisticated engagement with such a knowledge mix.⁸ Thus, it would seem that the teacher education curriculum framework being pilot tested allows for an *integrated engagement* with this 'knowledge mix', refraining from treating the DHET 'knowledge mix' in a technicist, reductionist manner; yet giving adequate attention to this knowledge/learning framework in teacher education.

An additional finding associated with this dominant knowledge work, however, is that within it is a paradox or contradiction which requires further engagement. Through the dominant knowledge work patterns (as evidenced in the teachers-in-training lessons and lesson planning) it seems apparent that people seem to get the message and become aware of issues, but understanding and change to more reasonable practices is not easy. This draws critical attention to the dominant orientations associated with environment and sustainability knowledge and pedagogical content knowledge work and its ultimate purpose and/or outcome. The question

that arises is what absences are there that need to be removed, or what ought to or could be done differently to transform this knowledge work problem?

Conceptual Pilot 3: Environment and Sustainability (ESD) knowledge in PGCE

Science education

The main focus of this pilot was to research the teaching of environment and sustainability content (climate change is one of the topics) in the CAPS Natural Science Curriculum (Intermediate Phase). Key guiding questions for this pilot included:

- How does environment and sustainability education articulate with a content-referenced curriculum?
- What environmental education processes enable better learning of what is now known?
- What does a CAPS emphasis on content mean to environmental learning in the Natural Sciences?

An heuristic (Figure 3) was developed to support teachers-in-training to systematically engage with the interface between knowledge and practice.

Figure 3. Lesson planning template (heuristic)

Topic planning template: 'T-Sheet'	
TOPIC:	
<p>KNOWLEDGE What I know and can find out</p>	<p>PRACTICES How are things being done and why?</p>
Key words to unlock what is known	Planned learning sequence from assessing what learners already know
Summary of what is known: Key concepts and issues in context	Provision for key words, reading and writing to learn through activities, experiments and skills tasks for knowledge acquisition to understand what is now known and extend knowledge into creative innovation
Key points for knowledge-assessment Enquiry and action-awareness ideas Possible innovative change practices	Assessment of: <ul style="list-style-type: none"> • What is now known and remembered • Understanding and application of knowledge • Analysis, evaluation and innovation of what is known and how things might be done in better ways

This heuristic was developed to support the design of practice teaching lessons. It was also designed to address educational quality issues, particularly a context where many learners are learning in second, third or even fourth languages. Language and vocabulary development, or the language needed for learning in such cases, needs to be integrated into the teaching and learning of scientific, environment and sustainability concepts and practices. Socio-cultural language theory is showing that one of the key success factors in enabling learning in

second language learning contexts is adequate vocabulary as well as meaning-making support structures. These issues were considered in the piloting (as mentioned above), and as shown in the heuristic above.

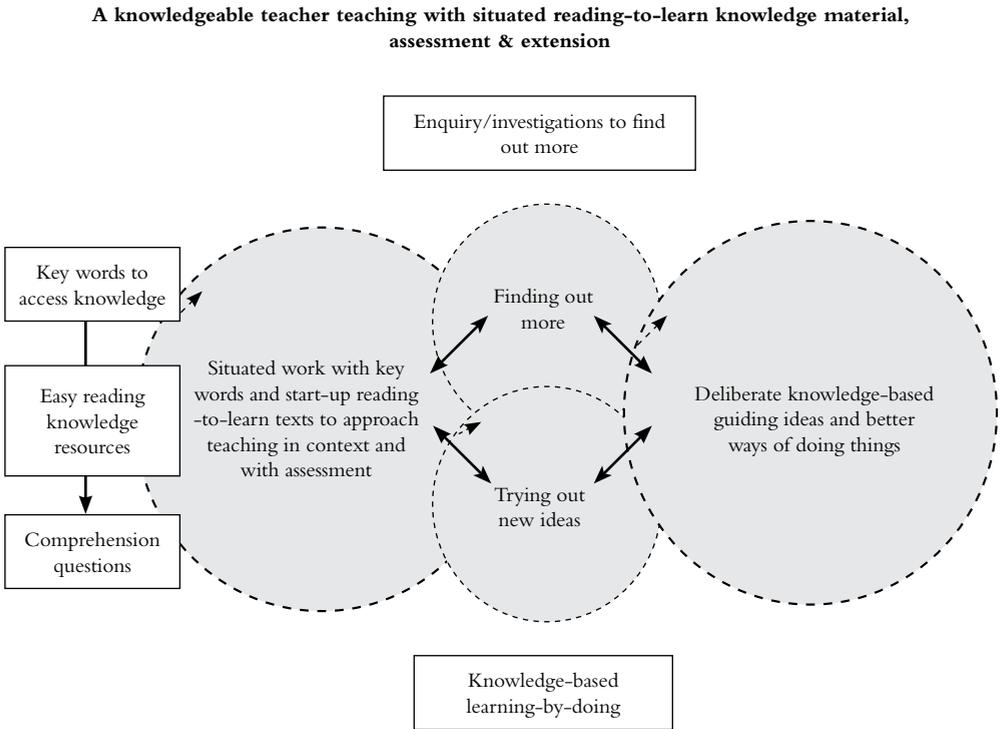
Data analysed included key words, assessment questions and learning sequences produced by student teachers-in-training on climate change content (as produced through working with the heuristic provided in Figure 3).

To address the problem of the limited outcome of the dominant form of knowledge work (identified in Pilot 2), additional elements were added to this Pilot (3) in the teacher education programme. These included stronger conceptual scaffolding using written knowledge texts which focus on core concepts or background content knowledge associated with issues (e.g. concepts such as earth systems which are associated with climate change); giving more attention to what is known about topics and also giving student teachers guidance on innovations (beyond awareness raising) that can enable critical reflection and change through introducing the concept of 'innovation'. This was put forward in another process heuristic that reflects the integrated 'knowledge mix' processes discussed below (Figure 4).

Key findings from this data on subject knowledge, and working with subject knowledge in teacher education programmes showed that:

- Work with prior knowledge (e.g. available scientific information on climate change) and key disciplinary comment (e.g. discussions on the certainty of this knowledge) appears to set up contextual disciplinary tracts for approaching what we know and what we know that we do not yet know. Environment and sustainability questions involve understanding what is already known about the questions (e.g. science of climate change), but also engagement with what is not yet known (e.g. uncertainties surrounding climate change impacts).
- Learning interactions with texts that outline what is now known (reliable content), appears to be very important for providing teachers-in-training with an important sense-making purchase on the environment and sustainability questions or topics that are presented in the curriculum (e.g. climate change; loss of biodiversity). This requires teacher educators to provide teachers-in-training with reliable and high-quality sources of information on relevant curriculum topics; but also to support them to work critically and reflexively with such information.
- Overall there was a stronger sense emerging from the pilot work with content that there is a need in teacher education programmes to carefully review and grasp what is now known (current knowledge status) of curriculum topics, to get a better purchase on a) what the issue is; b) why it is important; and c) what might be done to address it. The latter is a necessary focus if teachers are to steer away from dominant knowledge work that leads only to awareness of, and engagement with, issues in ways that do not fully develop capacity for identifying and practising alternatives.

Figure 4. Heuristic for guiding in-depth work with knowledge, as well as innovation outcomes



Knowledge (Knowing and remembering)	Action/awareness (understanding and applying)	Innovation (analysis, evaluation and innovation)
WITH ASSESSMENT		
What is known & understood now?	tests & exams	
Are grasp & skills being developed?	translation tasks, practical tasks & activities	
Are there relevant applications?	projects, assignments & case studies	

(Source: O’Donoghue, 2011)

Integrating pilot findings into ‘Training of Trainers’ programme conceptualisation

The ‘Training of Trainers’ programme was initially conceptualised as a ‘separate project’, funded by GIZ as an international initiative, linking up South African partners with others in Germany, India and Mexico to document ‘best practices’ and to implement ESD competences in teacher education programmes in South Africa. During the course of the project, it became clear that there was a need to align this international donor funded initiative with the South African initiative to establish a sustainable Teacher Education Programme for Environment and Sustainability Education. Key questions driving this piloting were therefore:

- How can the ‘Training of Trainers’ programme align with the Teacher Education Programme, and yet draw value from the international exchange?
- What needs to be additional to the Teacher Education Programme (other than that which was being piloted above) for a ‘Training of Trainers’ programme so that teacher educators would have a wider grasp of environment and sustainability issues and environment and sustainability education trends globally, so as to more fully and critically work with the locally constituted initiative?

The full scope of the ‘Training of Trainers’ programme development process is not dealt with here, only key findings emerging from a piloting of the ‘Training of Trainers’ programme pilot are highlighted. This involved two large groups of national stakeholders in a total of three days of workshop activities which were also deliberated with national and international partners during the design of the ‘Training of Trainers’ programme, as they relate to the Teacher Education Programme and the evolving insights being gained from the piloting work (which is still ongoing).

- A situated (African) knowledge practices approach appears to enable generative, learner-led change without fearful alienation amidst the complexity of risk and an uncertain future. This was a critical finding in terms of the orientation of the programme. Instead of focusing on fear, ‘nightmares’ and ‘issues’, working with available knowledge and new innovation practices is necessary within new approaches that extend beyond a focus on issues only, and include alternatives and new ways of doing things. This extended focus is necessary not only in curriculum documents, but also in teacher education programmes.
- Heritage knowledge practices and mapping change amidst knowledge of what is now known opens up an engaging learning arena with improved relevance and change potential. This refers to the need to expose students (teachers-in-training) to what is known, and what is known in context, as emerged from the piloting. It is important to support teachers to find out about what is known, and also to work with new, more complex forms of knowledge in teacher education programmes. This means that teacher educators themselves need to engage with knowledge in this way if they are to avoid (paradoxically) reproducing problems associated with dominant knowledge work, and/or superficial readings of knowledge work.

- Work with numerical representations can disrupt ambivalence and open up a more object congruent grasp of reality to support rational change. This refers to making good use of factual material and assessments of what is actually happening. This helps to disrupt and stabilise emotionally constituted knowledge reactions (e.g. fear) and strengthens rationality and rational ways of engaging with complex knowledge problems. It is also important to take full cognisance of different forms and ways of knowing such ‘facts’ or ‘problems’.
- A curriculum journey from intergenerational, lived world contexts of experience and action into more formal and explanatory knowledge systems offers more than a potentially alienating induction into reified abstractions commonly found today. This refers to the need to seek out practice-centred or stories of experience ‘starting points’ which provide teachers with contextual referents (the local knowledge referred to in the B.Ed Honours case). However, as shown in this case, such knowledge needs to be extended through the ‘knowledge mix’ work that is required in the Teacher Education Qualifications Framework.
- Expanding the notion of competencies to a framework which recognises the importance of knowledge in shaping competence, and a framework which recognises teachers’ and learners’ capabilities to define future trajectories that are valued in their societies (Sen, 1990), may be more congruent with the South African policy environment. TED processes must allow teachers the deliberative spaces to negotiate capabilities and develop their knowledge and their competence. The innovations necessary for freedoms to flourish within a quality learning environment is an important orienting feature of such work. This broader view does not only seek to curriculate a set of pre-determined competences for teacher education as is being proposed by UNECE (2011). Curriculating for competence development only may be paradoxical in environment and sustainability education, as a focus on competences may only narrow opportunities for capability development. This calls for deeper theorising of competences, knowledge, learning and capabilities as orientation/s to teacher education.
- Wider knowledge of the emergence of environmental education and its uptake into and transformations under the influence of global education for sustainable development discourse is also necessary for teacher educators to understand the historiography of a newly emerging field of practice that is shaping and that has shaped the South African curriculum landscape substantially. Its implications in relation to the whole curriculum, and other areas of curriculum (e.g. curriculum changes in higher education more broadly) and the wider social knowledge landscape are also necessary elements for a ‘Training of Trainers’ programme, to avoid narrow interpretations of the Teacher Development Programme in single subject context/s.

As indicated from all of the findings above, there are a number of implications for the design and further development of the South African National Environment and Sustainability Education Teacher Education Initiative. These are discussed next, as part of the reflections on Phase 1 and the planning for Phase 2 process.

Implications of Lessons Learned and Phase 2 Preparation

Curriculum policy and teacher education ‘knowledge mix’

As indicated above, the South African curriculum has recently been reviewed (for a third time), and the new Curriculum and Assessment Policy Statement (CAPS) seeks to address problems of knowledge and quality experienced in the first two rounds of post-apartheid curriculum implementation. This has produced a more strongly ‘knowledge referenced’ curriculum that is more tightly structured, and that has more definitive guidelines for assessment. A key feature of the CAPS is the inclusion of environment and sustainability content and concepts in a wide range of subjects (DBE, 2010; see examples in Appendix A). For this initiative, it has therefore been important to develop an in-depth understanding of what knowledge is contained in the CAPS, and what the relationship is that exists between knowledge, and pedagogical content knowledge (how teachers are expected to teach and assess the learning). This required a review of the CAPS to identify the environment and sustainability concepts and knowledge represented in it, as much of this is ‘new knowledge’ and contains the features of contemporary environment and sustainability knowledge. It is newly produced (just being integrated into traditional disciplines), it is inter-disciplinary (occurs across different disciplines in different forms), it is complex (not everything is known about the issues concerned) and it is also contested (not everyone agrees on what is currently known). It is also futures-oriented (it has implications for the future and for future practices), but it is, at the same time, historical (the issues emerge from previous practices and knowledge). Environment and sustainability knowledge is therefore *dynamic* and requires that teachers develop the necessary ‘knowledge work’ skills and competences to a) understand this knowledge, which is an integral part of the curriculum, and b) work with it in open-ended and innovative ways with learners who need to develop a deep understanding of the dynamic nature of this knowledge and its implications for society, now and in the future. To begin to address this the Teachers Development Network partners have undertaken a CAPS review to establish exactly *what* environment and sustainability knowledge is included in the CAPS (see Appendix A for an example of some of this knowledge), and to establish the orientation of this knowledge in relation to contemporary ways of engaging with environment and sustainability issues. Key findings from this review include:

- Environment and sustainability topics are included in all levels and phases of the national schooling system (Foundation Phase, Intermediate Phase, Senior Phase and Further Education Phase) and in a wide variety of subjects. They are, however, very specifically defined, which requires careful engagement with specific knowledge requirements of each phase and grade, particularly in relation to the associated assessment specifications.
- There is a high level of coverage of such topics. In some cases up to 50% of subject knowledge is related to environment and sustainability concerns. This means that a large number of teachers need to be exposed to, and supported by, this programme.
- Most of the environment and sustainability topics included in the CAPS require a mix of general (universal) knowledge and specific (contextual) knowledge, which provides a productive environment for *meaningful* knowledge acquisition (as proposed by Vygotsky, 1978).

- Most of the environment and sustainability topics covered in the CAPS lend themselves to the ‘knowledge mix’ proposed by the DHET (i.e. for development of disciplinary knowledge, subject knowledge, pedagogical knowledge, practice-based knowledge and situational knowledge). As indicated in Pilot 2 above, this needs to be done in an *integrated manner*, if the spirit of the new policy is to be fully understood.
- The orientation to environment and sustainability in the CAPS reflects the dominant knowledge work issues raised in Pilot 3 above. The focus is on problems and issues and awareness raising, and this fails to focus on core concepts necessary to understand the issues, and social innovations that provide ways forward and ‘out of’ or ‘in response to’ the issues presented in the CAPS. This is a serious flaw in the conceptualisation of environmental learning in the CAPS, and needs to be considered critically in teacher education initiatives associated with the CAPS. Teacher education initiatives cannot simply focus on what is in the CAPS, but should present a highly enriched, critically constituted and broader basis for teachers to work critically and productively with these issues in the CAPS, as outlined in the discussion above on what needs to be included in the ‘Training of Trainers’ programmes, and in the Teacher Education Programme itself.

Course orientation and guidelines for materials development

From all of the above, it has been possible to define a set of principles and guidelines for materials writers to produce the kind of teacher education programme that is at the same time:

- aligned with the CAPS, but expansive and critically constituted in relation to its basic tenets, which allows for a more professional teacher, with competence to both implement a curriculum effectively but also expand it, and critically engage with it; and
- aligned with teacher education policy core concepts, particularly its commitment to a complex ‘knowledge mix’ in an integrative fashion, while also critically engaging with the more complex dynamics of curriculum knowledge brought forth by the changing nature of knowledge, and the associated social-ecological conditions which produce the need for engaging with such forms of knowledge.

These will be used to guide the further development of the programme, particularly the materials development and the in-service piloting due to take place in 2012 in tandem with the implementation of the CAPS in Foundation Phase and Grade 10; and thereafter as the CAPS curriculum unfolds and is implemented. The course orientation and curriculum guidelines are included as Appendix B.

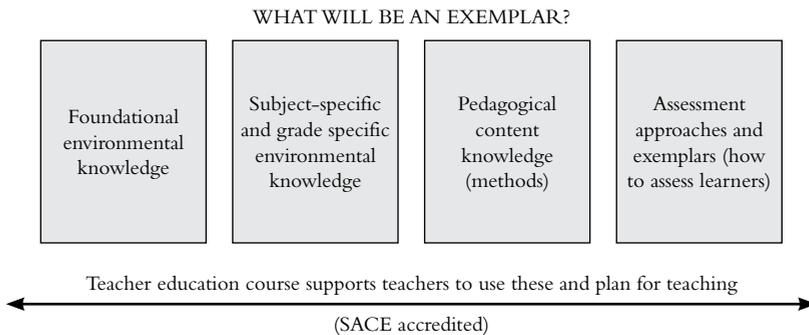
This refinement has also led to a change in the naming of the programme, its general purpose and its core foundational elements. The programme will henceforth be named the ‘Environment, Science, Society and Sustainability (E3S) Teacher Education and Development Programme’, with the sub-heading ‘Transformational curriculum leadership for the future’. This communicates the core focus of the teacher development initiative, and signals its transformative intent. Its core foundational elements include a transformational approach to teacher development which is based on what Kesson and Henderson (2010) call a ‘3S’

pedagogy, which deepens subject knowledge, self development as a teacher and social learning (the relevance of knowledge and quality teaching practice to society).

Teacher education materials development

One of the most critical areas to be affected in the planning of the initiative was the materials development. Initially it was thought that we, as a network or consortium could simply use old materials that already existed, and that were developed in previous teacher education programmes (the ones that had been used before). However, after developing a deeper understanding of the implications of a content referenced curriculum (CAPS requirements), the teacher education ‘knowledge mix’ requirements of teacher education policy, and an understanding of some of the knowledge-related issues associated with integrating environment and sustainability knowledge into teacher education (e.g. the complex, new nature of the knowledge, as well as the dominant knowledge practices), it was agreed that a different approach to resourcing the Teacher Education Programme would be needed. This was defined as a ‘CAPS plus, plus’ approach which oriented teachers to a much wider knowledge scope than that expected by the CAPS, but which at the same time, prepared teachers to teach the CAPS successfully. A decision was made to produce exemplars that provided exemplary knowledge resources as this was identified as a critical need in the piloting, as well as exemplary pedagogical content knowledge and assessment practice resources that could expand teachers’ current practices, and that could extend and challenge the trajectory of the dominant knowledge practices in environment and sustainability related education. A framework was developed for these exemplars which will consist of ‘core’ (relevant across subjects for all subject teachers in all phases), and ‘specific’ (relevant to specific topics or topic areas, e.g. Biodiversity or Climate Change or Environmental Health), as these related to subjects (to be developed within a phase-based framework) according to the principle of maximum coherence.

Figure 5. Contents of a E3S programme exemplar



Funding has been raised to develop ten such exemplars, a process which has already begun. The next phase of piloting will therefore be focused on piloting the actual content of an exemplar in relation to the actual curriculum expectations and teaching practices for a specific grade (the first one to be piloted will be ‘Climate Change’ for Grade 10 (FET phase), due to be undertaken in January 2012. This will be followed by ‘Biodiversity’ for Grade 10 (FET in the second quarter of 2012). These will also be used in the ‘Training of Trainers’ programme scheduled for 2012, but with additional ‘Training of Trainers’ elements, as noted above. The materials are being conceptualised as open learning resources, and in 2012 various mechanisms for making them available in this format will be researched.

Partnership formation and differentiation of roles

As indicated above, this initiative was set up in 2010 by the Department of Environmental Affairs and the South African National Biodiversity Institute, supported by the Tony and Lisette Lewis Foundation, and key partner organisations such as the Rhodes University Environmental Learning Research Centre, the WWF, the WESSA Eco-Schools Programme, the South African National Parks, Delta Environmental Centre and the Endangered Wildlife Trust, who agreed to co-operate within a consortium framework to generate capacity and national competence to impact on the national system of teacher education through a co-ordinated effort to integrate environment and sustainability into teacher education programmes and systems in ways that align with the new Teacher Development Policy of South Africa, as well as the new Qualifications Framework for Teacher Education. This network has met five times since its inception to plan and reflect on the above processes, as reported here. The partnership framework has, however, expanded to include 20 of the 23 teacher education institutions, who attended a start-up workshop, and who are slowly beginning to participate in the development of the exemplars. It is expected that their involvement will expand in 2012 as the piloting, monitoring and evaluation and exemplar development process expands. Additionally, other national partners have become involved, such as the South African Environment Observation Network, the DST Centre of Excellence in Global Change Sciences and the Applied Centre for Earth System Sciences, who have in principle agreed to co-fund some of the materials development and some research associated with the programme. Core national partners, such as the DHET, the Department of Basic Education, the South African Council for Educators (SACE) and the Education and Training Development Practices (ETDP) Sector Education and Training Authority (SETA) have also been consulted and have attended project meetings. They have agreed to support the initiative and a business plan has been submitted to the DBE, which will be submitted to the ETDP SETA for funding support for expanding the piloting phase beyond the next small-scale phase which will review the construction and validity of the exemplar conceptualisation in two cases. Following this the materials will be produced for wider use (hopefully with ETDP and DBE support) and piloting can expand through the ‘Training of Trainers’ programme, which is currently being co-ordinated by the DBE, and supported by GIZ. Faculties of education in universities have been consulted via the deans and, as mentioned above, a large number have shown interest in participating in the programme’s expansion in 2012. Their involvement is critical for longer-term sustainability of the initiative, and also for quality enhancement and monitoring.

It has also been important to define different types of contributions within the consortium/networked partnership framework, and this has helped for the various types of activities that need to be done to be completed. For example, some partners have taken the leadership with policy-based and institutional-links development while others have undertaken curriculum analysis. Others are setting up school-based pilots while some will be contributing more to the development of materials and/or fundraising. Higher education partners are particularly important in working with other partners on ensuring quality at levels appropriate to various teacher education qualifications and levels. It is being noted in early work that their contributions in terms of knowledge, teacher education expertise and reflexive review are invaluable.

Conceptual framework refinement and research

As indicated above, the initiative put substantial time and effort aside to undertake conceptual piloting work, to establish a substantively grounded and carefully developed conceptual framework that is not just reproductive of past practices that no longer hold substance within the new policy environment. This has clearly shown benefits (as indicated above), but will require ongoing refinement. Hence a proposal is being put forward to the Department of Science and Technology's ACCESS programme to support ongoing research associated with this initiative. This proposal will be extended to a research proposal involving teacher education institutions in 2012, to expand depth of knowledge and insight into the quality and impact of this initiative, and also to provide a reflexive orientation to the programme's growth and development. This has been formulated as a key objective for Phase 2.

Integration with national teacher education development priorities

As mentioned above, the programme has carefully sought to locate itself within a quality development framework that is policy aligned, but which also takes policy further through open and critical processes of quality enhancement. A critical aspect of this initiative has been to integrate it with national teacher education development priorities, which, as noted at the start of this paper, are both focused on supply and demand and on quality enhancement through improved teacher knowledge and practices. The initiative has located itself within the latter priority, and seeks to work with Science teachers, Geography teachers Life Orientation teachers and Foundation Phase teachers to begin with, but within this to develop critical competence in literacy and numeracy skills, as indicated in the pilot testing processes above. Most significantly, however, the initiative seems well-poised to strengthen 'knowledge work' and understanding of 'knowledge work' and the 'knowledge mix' notion of the DHET new teacher development policy. It can therefore potentially contribute to understanding of knowledge practices, and what standards for knowledge practices may look like. This has been identified as one of the actions in the 'Integrated Strategy Planning Framework for Teacher Education and Development in South Africa' (DHET & DBE, 2011). The issue of how this initiative aligns and integrates with national teacher education development priorities will need to be monitored as the programme unfolds.

Business planning and sustainable economy development

As mentioned in the review of earlier programmes, most initiatives undertaken to support teacher development in the area of environment and sustainability have suffered from poor business planning and unsustainable economies. This counts for large-scale internationally funded initiatives such as the NEEP, and locally funded initiatives such as university-based or NGO-funded teacher development initiatives. A key element of this programme is therefore to address this problem, and to do this business planning is taking place that must align with DBE and DHET programmes, as well as with nationally available funding systems, such as funding for teacher education programmes provided for by the ETDP SETA. However, locally provided funding from funding partners such as the Tony and Lisette Lewis Foundation, local corporate donors such as Murray & Roberts' funding for materials development, DST ACCESS funding for research as well as the support in-kind funding provided by the participating organisations and partners, has been essential for establishing the initiative within a partnership framework. GIZ funding for supporting a 'Training of Trainers' initiative has also been welcome in this initial phase, but if such funding is extended, it would be good to use it as counterpart funding with local economy funding (say from ETDP SETA). This could make for a more sustainable initiative in the longer term. At the very least, such funding should ideally be channelled through local structures as is the norm with development funding assistance.

Quality management, evaluation and accreditation

Another key issue to be addressed for longer-term sustainability is quality management and accreditation. Several processes are underway to ensure that this is adequately dealt with. Meetings have been held with SACE, who will be implementing the Continuous Professional Teacher Development programme for the DBE. They will have the mandate for endorsing teacher professional development programmes, assigning professional development points (mandatory for teachers) and endorsing providers who offer these programmes. They are therefore an important quality enhancement partner for the initiative. Similarly, the ETDP SETA quality-assure the content and approach of the programme and its materials according to accredited unit standards. The programme is being aligned to a selected sample of these unit standards to obtain national accreditation through the ETDP SETA. Thirdly, university partners are participating in developing the programme and the materials, and through this network of institutions the best available expertise is being used to support the programme in critical areas such as materials development, training and monitoring and evaluation. A monitoring and evaluation system is also being put in place, and monitoring and evaluation research will also commence in 2012, along with the field-based piloting of the materials and the programme impact at classroom level.

Professional learning communities

As mentioned above, one of the new concepts in the Strategic Planning Framework for Teacher Development is the establishment of professional learning communities. These are to support ongoing interactions with teachers, and ongoing professional learning and development. It is envisaged that through the piloting process, initial clusters of teachers will be involved in

the programme which could constitute the foundation of professional learning communities. Teachers involved in these clusters will be oriented to using the online open learning resources that will be freely available, which will enable them to support other teachers to do the same with the support of district curriculum staff. A key element of enabling the establishment and ongoing functioning of such professional learning communities is involvement of the subject advisory services at district level from the start. This will be included in the piloting processes for 2012. The structuring and functioning of the professional learning communities and their establishment will be the subject of monitoring and evaluation and research in 2012/13, during Phase 2 of this programme's development.

Conclusion and Next Steps

As reported on above, the programme has access to a good policy environment for implementation of environment and sustainability issues in teacher education, with expertise for engaging with this policy environment, even though it is currently changing. Members of the network have high levels of experience of the new policy context and content. The programme also has access to good quality resource materials and hands on experiences of teachers in over 1 000 Eco-Schools in South Africa, a large body of research on the issues influencing implementation of environment and sustainability in South African schools, as well as research capacity. The programme has also had access to key international networks to inform its work, and to seed funding for bringing the network of partners together to begin the process of contextual analysis, curriculum framework development and piloting of concepts and frameworks that emerge. Funding has also been raised for initial materials development work, and negotiations are underway for longer-term support for the initiative, although this has not yet been secured. However, our emphasis has explicitly been on quality, and on working together to attain such quality, as past experience has shown that a fragmented approach is not adequate to respond to the challenges faced in South Africa. This has involved both state and non-state actors in voluntary and collaborative configurations.

So far, a combination of careful review work, together with careful conceptual piloting work, has delivered what seems to be an innovative yet substantive and strongly aligned and quality-oriented approach to supporting teachers to work with the environment and sustainability requirements of the schooling system. The initiative has not fallen into the trap of being 'policy compliant' only, but is seeking rather to develop and expand policy, and to enrich both teachers' and learners' knowledge of environment and sustainability, while ensuring that high quality education is achieved at all levels. A number of broader, systemic issues have been taken into account and are the subject of ongoing development and monitoring work.

Ultimately, the aim of this initiative is to extend its reach and its outcomes via the national network and consortium. This will hopefully expand over time and with more materials that reach and cover the full scope of environment and sustainability topics in the CAPS, for all phases of the schooling system, so that teachers are well-prepared and capable of teaching these areas with quality results (as shown in Table 1 below).

Table 1. Projected outcomes and results of the programme

Item	Results	Reach
Programme and materials	Open education materials for all environmental focus areas in CAPS (available to teachers and teacher educators)	Higher education providers and SACE accredited providers can use materials – projected use in all 9 provinces (3–5 providers per province)
Numbers of people trained	Teachers trained in Phase 1: 120 (20 each in 6 pilot sites)	Seeking to reach 50 000 teachers over a 5-year period (10 000 per annum; with ETDP SETA and HEI support)
Changes in teacher education programmes	Intergration into Higher Education TE Curricula (changing by 2014)	Long-term impact on ongoing teacher education

The next steps in this national case study are to finalise the first sets of exemplars and to pilot test their validity and their quality, as well as their impact and influence on teachers' knowledge (within the 'knowledge mix' framework noted above), and on learners achievement and the quality of learning that takes place in classrooms. Slowly but steadily we seek to achieve quality teaching and learning through careful and consistent collaborative working while keeping focused on the most important outcome of all, the future of the children of South Africa.

Endnotes

1. This document was prepared by ADEA for its Triennial Meeting (Ouagadougou, Burkina Faso, 2012). The theme of this conference is Education and Sustainable Development in Africa. It forms part of a series of three papers prepared by the environmental education community in southern Africa for this continental conference. The other two papers will be published in the forthcoming Southern African Journal of Environmental Education in 2012, which will also feature research supported by the SADC Regional Environmental Education Programme (REEP) to coincide with the thirtieth anniversary of EEASA, and the fifteenth year of the SADC REEP.
2. In collaboration with Ms Waheeda Cavella (Department of Basic Education), Professor Esther Kibuka-Sebitosi (African Renaissance Centre, UNISA), Professor Cheryl le Roux and Dr Soul Shava (UNISA), Professor Rob O'Donoghue, Dr Diane Wilmot, Mr Charles Chikunda, Ms Ingrid Schudel (Rhodes University), Mr Thomas Mathiba and Mr Pandelani Dughudza (Department of Environmental Affairs), Dr Eureka Rosenberg, Ms Renee le Roux, Ms Liz Robson and Ms Vivian Malema (South African National Biodiversity Institute), Tony and Lisette Lewis Foundation, the Biodiversity Human Capital Development Strategy, Dr Jim Taylor, Ms Laura Conde and Ms Anisa Kahn (Wildlife and Environment Society of South Africa), Dr Glenda Raven (World Wide Fund for Nature), Ms Presha Ramsurup and Ms Shanu Misser (Delta Environmental Centre), Ms Sibongile Mokoena (SAEON), Ms Janet Snow (Endangered Wildlife Trust), Ms Maria Moate (South African National Parks), Mr Edgar Neluvhalani (Applied Centre for Climate and Earth System Sciences, CSIR), Mr Caleb Mandikonga

(Teacher Education Network Co-ordinator, UNESCO/SADC ESD Teacher Education Network) and Professor Colleen Vogel (Independent).

3. Note that these terms are used inter-changeably throughout this document (see endnote 4 below for a more detailed explanation).
4. In South Africa, ESD is often synonymous with environmental education, as environmental education has tended to work within the same frameworks and principles of ESD, integrating society, economy and environment. The history of ESD in South Africa is strongly shaped by the history of environmental education, which is similar to the way in which ESD emerged internationally out of the Rio Earth Summit in 1992.
5. It is for this reason that the document refers throughout to 'Environment and Sustainability' or 'Environment and Sustainability Education' when referring to ESD. These terms are used interchangeably within the document. An environmental focus, as well as social justice and democracy, is a strong focus of ESD in South Africa. This is linked to the history of environmental education in the country, which generated momentum for ESD. To maintain continuity and focus, 'Environment and Sustainability' is used here, as ESD has often been critiqued for lacking clarity of focus and for a loss of history (i.e. it loses its historical trajectory in the changing of terminology). Environmental education has also been strongly conceptualised within an environment–economy–politics–society nexus in South Africa.
6. The 'Training of Trainers' (ToT) component of this initiative will be used to provide training to those teacher educators and teacher education organisations that will run the Teacher Education Programme. It therefore requires broader orientation than what is in the teacher education materials. The ToT programme is being supported by GIZ; while the South African TED programme is being supported by a range of South African partners and institutions (see partnership discussion below).
7. Hedegaard (2007, pp. 251–2) provides the following framework for explaining modern tendencies to differentiate between different forms of knowledge, which appears to be foundational to the DHET policy framework for Teacher Education Qualifications. She differentiates between:
 - Empirical knowledge: reflected in abstract concepts that are attained through observation, description, classification, and quantification (Bruner *et al.*, 1956). This form of knowledge circulates in everyday life, and in many western classrooms.
 - Narrative knowledge: characterised by changeableness in intentions; mutual goals and perspectives which interact; involvement of feelings and emotions (Bruner 1986). Also described as 'folk theories' about daily life events.
 - Theoretical-dialectical knowledge: related to forms of systematic knowledge. Found in theories and models that can be used to understand events and situations, and to organise and experiment with actions (concrete life activities).
8. The DHET (2011:7) note that integrated and applied knowledge should be understood as being both the condition for, and the effect of, scrutinising, fusing together and expressing different types of knowing in the moment of practice. They explain further that, '[t]eaching is a complex activity that is premised upon the acquisition, integration and application of different types of knowledge practices or learning'; and differentiate the following types of learning/knowledge mix as underpinning teacher education qualifications in South Africa:

- Disciplinary learning: disciplinary or subject matter knowledge (study of education and educational foundations and specific specialised subject matter relevant to the subject or discipline e.g. Professional Ethics);
- Pedagogical learning: general pedagogical knowledge (knowledge of learners, learning, curriculum, assessment, etc.) and specialised pedagogical content knowledge (how to teach concepts, methods, etc. of a subject);
- Practical learning: learning in and from practice. Learning from practice = study of practice; Learning in practice = teaching practice experience (work-integrated learning);
- Fundamental learning: learning second language; use ICTs, academic literacy; and
- Situational learning: knowledge of contexts; situations; environments; policies; challenges (e.g. HIV/AIDS, environmental issues).

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Appendix A. CAPS analysis to show cross-cutting environment and sustainability (ESD) content (sample only)

EXTRACT FROM GEOGRAPHY FET PHASE ANALYSIS (GRADE 10-12)				
GEOGRAPHY GRADE 10		GEOGRAPHY GRADE 11		
Term 2	Term 3	Term 4	Term 1	Term 2
<p>Natural Disasters (4 hrs) Earthquakes - 4 hrs Volcanoes - 4 hrs (both focus on the impact on people and the environment)</p> <p>ASSESSMENT Assessment Task 2 Exam</p>	<p>Population Growth World pop growth Managing pop growth</p> <p>Population Movements Impact of movements Understanding causes Refugees/Migrants</p> <p>HIV/AIDS Impact of HIV/AIDS (South African examples)</p> <p>GIS/Map Reading/photos, graphs, models</p> <p>ASSESSMENT Test</p>	<p>Water Resources: World and SA</p> <p>Water Management in South Africa Water sources in SA Factors influencing water availability Challenges of free basic water Role of gov't in water security Role of municipalities Water purification Strategies for sustainable water management Gov't and individuals</p>	<p>Africa's Weather La Nina and El Nino - effect</p> <p>Vulnerability of Africa to drought and desertification (Climate Change Risks for Africa) Management strategies</p> <p>Satellite images/GIS Orthophotos/aerial</p>	<p>Mass Movement e.g. impact on people and environment strategies to minimise mass movement in SA</p>
			<p>Concept of Development Economic, Social Sustainability Examples of development global, regional, local</p> <p>Frameworks for dev. Factors influencing Natural resources Environmental degradation Sustainability models Community development Rural – Urban Globalisation – impact on development</p> <p>Development Issues Effect of development on environment Role of State and business Development aid (types and impact)</p>	<p>Resources and Sustainability</p> <p>Using Resources Sustainability, exploitation and depletion Sustainable resource management</p> <p>Soil and Soil Erosion Formation, erosion, effect, management</p> <p>Conventional Energy Sources thermal, nuclear, hydro</p> <p>Impact of conventional sources – acid rain, waste environmental degradation Nuclear Case Study</p> <p>Potential to meet needs through conventional sources</p> <p>Non-conventional sources Solar, wind sources Effects – economy & environ</p> <p>Energy Management South Africa's needs Green economy Energy management</p>

EXTRACT FROM LIFE ORIENTATION ANALYSIS: FET PHASE (GRADE 10-12)											
LIFE ORIENTATION (FET)											
GRADE 10					GRADE 11						
Term 1	Term 2	Term 3	Term 4	Term 1	Term 2	Term 3	Term 4	Term 1	Term 2		
<p>Self in Society (3hrs): confidence, participation in projects, gender, inequalities.</p> <p>Careers (3hrs)</p> <p>Democracy & Human Rights (4hrs): women's rights, discrimination.</p>	<p>Social & Environmental Responsibilities (4hrs): impacts on local & global communities, social & environmental issues (poverty, justice, social food security, etc.), social responsibility, youth service and development, participation in projects</p>	<p>Careers (5hrs)</p>	<p>Careers (3hrs)</p> <p>Democracy & Human Rights (3hrs): Religion and indigenous belief systems</p>	<p>Self in Society (3hrs): goal-setting, well-being.</p> <p>Career (3hrs)</p> <p>Democracy & Human Rights (4hrs): democratic participation, structures, principles & practices</p>	<p>Social & Environmental Responsibility (3hrs): health, inhumane farming methods, degradation of society & environment, fishing stocks, firewood & land, climate change, participation in community service.</p>	<p>Self in Society (5hrs): role of nutrition, role models, etc.</p> <p>Careers (5hrs)</p>	<p>Self in Society (3hrs): gender roles on health & well-being.</p> <p>Democracy & Human Rights (3hrs): diversity of belief systems, cultural practices & traditions</p>	<p>Self in Society (5hrs): healthy lifestyle choices, quality of life, environmental factors, personal plan</p> <p>Careers (3hrs)</p>	<p>Democracy & Human Rights (4hrs): responsible citizenship</p> <p>Social & Environmental Responsibility (3hrs): community, government responsibility, intervention programmes, personal mission statement and impact</p>	<p>Self in Society (4hrs): poverty, gender, develop action plan.</p> <p>Careers (3hrs)</p>	<p>Careers (2hrs)</p>

EXTRACT FROM LIFE ORIENTATION ANALYSIS: FET PHASE (GRADE 10–12)							
LIFE SCIENCES (FET)			LIFE SCIENCES (FET)				
GRADE 10			GRADE 11				
Term 1	Term 2	Term 3	Term 4	Term 1	Term 2	Term 3	Term 4
<p>Life at a cellular, molecular level</p> <p>10 hours Nutrition- minerals and importance in diet. Link to eutrophication, food labelling, loss of arable land</p> <p>12 hours – plant and animal cells. Possible link with ecology/ biomimimry</p> <p>8 hours – cell division – causes of cancer – can link to pollution, nuclear radiation</p>	<p>Life at a cellular, molecular level</p> <p>8 hours – traditional medical knowledge systems, biotechnology/ cloning – link to IKS/indigenous medicine and biomimimry</p>	<p>Environmental Studies</p> <p>24 hours – biosphere: Biomes, human and community impact on the env. Ecosystems, trophic pyramids, energy flow, biotic and abiotic factors. Introduction to human influences on the environment which will be expanded on in grade 11</p>	<p>Diversity, change and continuity</p> <p>4 hours – biodiversity, indigenous and endemic species. Classification (taxonomy)</p> <p>20 hours – history of life on earth, geological history, SA fossil records, mass extinctions, radiometric testing, key event's in life's history in SA linked to non-renewable energy biodiversity and the environment. Fossil tourism.</p>	<p>Diversity, change and continuity</p> <p>12 hours – biodiversity as related to micro-organisms, symbiosis (e.g. given of ecoli in human intestine, however, other examples can be given, e.g. symbiosis and decomposition in a natural forest.</p> <p>12 hours – biodiversity of plants, asexual and sexual reproduction, pollination of flowers (SA examples of birds and insects), significance of seeds and seed banks – link to plant extinction</p> <p>8 hours – biodiversity of animals, phyla</p>	<p>Life processes in plants and animals</p> <p>12 hours – photosynthesis, importance of carbon dioxide in photosynthesis</p> <p>8 hours – biodiversity of animals, phyla</p> <p>16 hours – animal nutrition and ecology – link to food chains, animal nutrition – homeostasis and blood sugar control – diabetes. Link to fast foods and nutrition – loss of indige-nous/ healthier ways of eating. Diets and religious diets e.g. kosher/halaal and vegetarian diets.</p>	<p>Environmental Studies</p> <p>24 hours – population ecology – population size, interactions in the env. e.g. parasitism, social organisation, human population growth</p>	<p>Environmental Studies</p> <p>28 hours – human impact on the environment. The atmosphere and climate change, water and availability/ quality, biodiversity, food security, acid mine drainage, solid waste disposal (practical observation and local research project)</p>

Appendix B: Principles and Guidelines for Design of Materials and Course Processes

Environment, Science, Society and Sustainability (E3S) Teacher Education Programme: Transformational curriculum leadership for the future

ORIENTATION TO THE COURSE

- **Subject knowledge:** The course focuses on the relationships that exist between environment, science, society and sustainability in specific subjects, e.g. Water Resources Management in Geography; Climate Change in Geography; Biodiversity in the Natural Sciences; Healthy Living in Life Skills; Responsible Citizenship in Life Orientation etc. (See CAPS analysis for environmental content). It offers teachers contemporary understandings of core concepts and core issues relevant to the knowledge that they are required to teach in the CAPS. The course will bring out or bring forward the key themes that are relevant to environment, science, society and sustainability in the specific subjects.
- **Open, critical approach to knowledge:** The course helps teachers to understand knowledge and how it is constructed, framed, contested, validated and how it can change. It also helps teachers to understand how knowledge is selected and represented in curriculum documents and in textbooks, giving teachers the capability to become critical users and interpreters of curricula. It also supports teachers to select materials and make reasoned choices about how and why they use materials and what learning support materials they use.
- **Pedagogical content knowledge and quality assessment practice:** The course provides direct support to teachers to develop their pedagogical content knowledge, as required by the different subjects and the different disciplines, and support for the specific assessment practices required in the CAPS for the different subjects and phases. Besides the specifics relevant to the CAPS requirements, teachers also learn foundational knowledge of assessment and pedagogical content knowledge. The course will focus on Quality Assessment Practice, and foreground this as ‘very important’ and even as the ‘starting point’ for development of transformational curriculum leadership (particularly since it has been so neglected).
- **Transformational curriculum leadership:** The course supports teachers to think about their practice as ‘transformational curriculum leadership’ and is based on a ‘3S’ pedagogy, which deepens Subject Knowledge, Self Development as a teacher; and Social Learning (the relevance of knowledge and quality teaching practice to society).
- **A wide view including systems, heritage, society and self:** The course supports teachers to understand knowledge within a systems, cultural heritage, social relevance, personal meaning-making, practices and future perspective, so that they can develop wider perspective on the issues (not just a technical perspective). This is informed by the broader purpose of the subject/area of study.

- **Transformative reflexive scholars and citizens that can participate in social transformations:** The course works towards supporting teaching practices that enable reflexive scholars (scholars that can think, do, review and reflect on actions in society) and citizens that can participate in social transformations in schools and communities using subject knowledge.

GUIDELINES FOR COURSE PROCESSES

The course will be oriented towards supporting teachers to ‘develop, implement and evaluate a learning programme/sequence of lessons’ relevant to the CAPS. It will be an accredited programme, and will use a workplace-based assignment (including pre-course, on-course and off-course tasks) to meet the unit standards requirements, and a portfolio of evidence that will reflect the ‘knowledge mix’ of the Teacher Education Qualifications (a mix of discipline-specific knowledge, pedagogical knowledge, educational knowledge, situational knowledge and practice knowledge). The focus will be on expanding existing knowledge through review of existing practice.

On-line formats, as well as pre-service and in-service applications of the programme will be investigated.

ACCREDITATION OF THE COURSE

The course will be accredited by the ETDP SETA and universities through CHE-accredited short-course programmes that wish to offer the programme. It will also be endorsed by SACE, and providers will be required to a) either be accredited by the ETDP SETA to offer the unit standard; b) affiliated to a HEI that offers the course; or c) SACE endorsed. The focus will be on assessment of subject coherence.

The course can also be integrated (as modules/elements of subject teaching modules or part of EdStuds/situational learning, etc.) into formally accredited qualifications that fall within the framework of the HEQF and the new Teacher Education Qualifications.

GUIDELINES FOR DEVELOPMENT OF CORE TEXTS

Assessment: CORE TEXT

- Ground discussions of assessment in local realities and contexts
- Importance of Assessment Practice ‘Starting with Assessment’; working ‘outwards’ from assessment
- How to establish and recognise Quality Assessment Practice (QAP)
- Assessment of sustainability knowledge and projects
- Inclusion of different ways of assessment and different learning pathways

Knowledge: CORE TEXT

- Ground knowledge in local realities and contexts
- Introduce strategies for being critically reflective of knowledge and how to work critically with knowledge

- Develop understanding of ‘knowledge trajectories’, progression, increased sophistication, etc.
- Strategies for updating knowledge and working with contemporary knowledge changes

Methods: CORE TEXT

- Ground the discussion of methods in local contexts and realities
- Provide the rationale for different methods and show how methods thinking has changed over time
- Different categories of methods and how and when they are best used (for different learning purposes)
- Make visible the learning theories embedded in methods
- Relationships between pedagogical processes, purposes and methods combinations
- Layered methods
- Learning environments and use of methods (e.g. large classes)

GUIDELINES FOR DEVELOPMENT OF SUBJECT SPECIFIC EXEMPLARS**Assessment Resources: SPECIFIC ASSESSMENT PRACTICE TEXTS FOR SUBJECTS**

- Assessment as starting point. Cover the basics well (what needs to be done in the subject/phase/grade), and grow from there
- Provide the rationale for the assessment and type of assessment
- Show clearly what are we assessing for (conceptual understanding; application, knowing, etc.)
- Show the disciplinary specifics in terms of assessment (disciplinary requirements in the subject)
- Cover the range of assessment approaches needed and develop ways for teachers to apply this differently to their own contexts/learner groups, etc.

Knowledge Resources: SPECIFIC SUBJECT KNOWLEDGE EXEMPLARS

- Ground knowledge in specific local realities and contexts
- Focus on the core concepts
- Include an overview of the ‘knowledge trajectory’ across the phase and provide perspective ‘backwards’ to phase below; and ‘forwards’ to show how the knowledge is developing
- Work with an approach that shares ‘core background knowledge’ that provides teachers with access to find more (where to extend the knowledge introduced)
- Cover core themes including:
 - Shaping patterns (how things have come to be the way they are)

- What the current knowledge is (what we know now)
- What the current and projected impacts are (what we don't yet know)
- What is being done and what more can be done, by whom etc. (responses and action trajectories)
- Ask the interesting and important questions
- Include strategies to keep knowledge contemporary, and maintain a 'knowledge seeking' tone

Methods Resources: SPECIFIC METHODS TEXTS FOR SUBJECTS

- Ground the discussion of methods in local contexts and realities
- Give attention to the integrity of methods in relation to the disciplinary 'fabric' and purposes of the subject; and how methods change as the ESD influence becomes integrated into mainstream disciplinary methods ('e.g. borrowing methods'); sustainability also brings orientations to the way that methods are used (e.g. the concept of strong sustainability)
- Demonstrate or show how 'methods can be used in combination' within a learning process framework

BOUNDARIES OF AN EXEMPLAR

Each exemplar is to be constructed according to the principle of 'conceptual and logical coherence' in relation to what is required in the **phase** (not grade); but should point out **grade specifics/possible applications to grade specific requirements**. It is possible to produce only one exemplar for the E3S focus of each phase, but it may be *necessary* (according to the principle of 'conceptual and logical coherence' to produce more than one exemplar per phase.

Each exemplar should cover the most important concepts/knowledge orientations; pedagogical content knowledge/methods; and **quality assessment practices** (three parts that can be used inter-changeably, but must cohere). They should be easy to access, and should provide 'leads and links' to extension materials that can be obtained 'online' or elsewhere.

Each exemplar should take note of, but extend what is offered in textbooks and should support teachers to do the same (i.e. extend or work critically with textbooks). Exemplars are not textbooks to match the requirements of the CAPS, but extended knowledge and pedagogical content knowledge resource platforms for teachers and learners. They should not be based on the CAPS minimum, but should develop the CAPS approaches (knowledgeable, competent and confident teachers, able to teach their subjects successfully and with 'artistry').