A Research Tool for Analysing and Monitoring the Extent to which Environmental Issues are Integrated into Teachers' Lessons

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Abstract

South Africa enjoys strong policy support for the integration of environmental issues into school curricula. However, much doubt exists over the extent to which this has been converted into appropriate classroom practice at the majority of under-resourced rural schools in the country. This article reports on a study which piloted a research tool which can be used to analyse teachers' lessons, with the aim of gaining insight into the extent to which they integrate natural resource management issues. The research tool was based on Bernstein's concept of classification and consisted of five indicators of natural resource management integration into Life Sciences lessons. The study contributes to the design of research tools that can be used to analyse and monitor the integration of environmental issues into teachers' lessons. It also provides some insight into the environmental content of a sample of Grade 10 Life Sciences lessons at four rural under-resourced schools in the Eastern Cape.

Introduction

South Africa's post-apartheid school policy gives recognition to the importance of environmental education as a means of creating environmental awareness and equipping South Africans with the right skills, attitudes, values and knowledge that are necessary to ensure environmental sustainability and human wellbeing. This view was highlighted in the country's White Paper on Education and Training (DoE, 1995:342), where it is stated that:

> Environmental education … must be a vital element of all levels and programmes of the education and training system, in order to create environmentally literate and active citizens and ensure that all South Africans, present and future, enjoy a decent quality of life through the sustainable use of resources.

One feature which characterises environmental education policy in South Africa is its integrated and multi-disciplinary approach to teaching and learning. Under this approach, rather than being treated as a separate subject, environmental education processes are incorporated into all subjects across the school curricula and in all grades. This holistic approach to environmental education is promoted as the best educational strategy to deal with the multi-faceted and complex nature of environmental issues and risks (Janse van Rensburg & Lotz, 1998). It is also in accordance with the principle of knowledge integration, which underpinned South

Africa's first two major post-apartheid curriculum frameworks, Curriculum 2005 (C2005), and its revised and streamlined version called the Revised National Curriculum Statement (RNCS). This approach to environmental education has remained intact in South Africa's latest curriculum framework, called the Curriculum and Assessment Policy Statement (CAPS), which is to be introduced in schools from 2012 (Motshekga, 2009).

Status of environmental learning in rural schools

Little is known about the status of environmental education processes at the majority of rural under-resourced schools in South Africa. This is not surprising given their isolation from major urban centres and South Africa's poor record on research into teachers' classroom practice (Taylor, 2000). However, some of the insight into environmental education practices at some of these schools was generated by the 'Learning for Sustainability' project (Janse van Rensburg & Lotz-Sisitka, 2000), the 'National Environment Project for General Education and Training' (NEEP-GET) (Lotz-Sistika, 2004) and the evaluation of the Eco-Schools programme in South Africa (Rosenberg, 2008). Additional data has come by way of case study investigations that have been conducted by post-graduate scholars into environmental education practices at various rural schools in South Africa, for example Nduna (2003), Ruhinda (2004), Mvula-Jamela (2006) and Jenkins (2007). However, much remains unknown about the extent to which the teachers in the Eastern Cape's rural under-resourced schools integrate environmental issues into their lessons.

Taylor (2000:8) notes that a lack of information on classroom practice 'severely constrains the design of curricula which are appropriate to local conditions … and renders impossible any effort … to track any improvement or deterioration over time'. Ellis and Fouts (2001) observe that there is a general lack of carefully crafted studies on curriculum integration, and that decisions regarding this curriculum approach seem to be based on rhetoric rather than on research. They identified the lack of suitable research methods as one of the factors which impede empirical research on curriculum integration. It is out of these concerns that this study was conducted.

Study Context

The study took place in the Eastern Cape, one of South Africa's poorest provinces. Education challenges in this province are immense and include a high proportion of rural under-resourced schools, lack of effective curriculum support to teachers at provincial and district levels, large numbers of untrained or under-trained teachers, over-crowded classes, low attainment levels among learners and an irrelevant curriculum (NMF, 2005).

Natural resource management (NRM) education is a form of environmental education that focuses on the protection and wise use of natural resources, to ensure present and future environmental sustainability and human wellbeing. Effective integration of NRM issues into the curricula of rural schools in the Eastern Cape (and elsewhere in southern Africa), can enhance the quality and relevance of rural education, and at the same time contribute to environmental sustainability in these areas (Lotz-Sistika *et al.*, 2005). This is especially relevant

given the government's interest in economic growth and sustainable livelihoods in rural areas of the country (ANC, 2009), and the growing interest in environmental education initiatives that are based on the needs and strengths of local communities (Vandenbosch, 2007; Namafe, 2008; Hogan, 2008).

Research Goal

The study was carried out with two main objectives in mind. The first objective was to design and pilot a research tool for analysing teachers' lessons in order to find out the extent to which they integrate environmental issues. The second aim of the study was to provide insight into the extent to which NRM issues are integrated into a sample of Grade 10 Life Sciences (Biology) lessons at four rural under-resourced schools in the Eastern Cape.

Theoretical Framework

The design of the research tool that was piloted during the study was based on the concept of 'classification'. Bernstein (1971, 1996) coined the term 'classification' to conceptualise and describe relationships between different categories in pedagogic contexts, for example, between subjects in a given curriculum. According to Bernstein (1996), if there is strong insulation between subjects in a curriculum, it implies the existence of a strong principle of classification, which creates specialised, distinct subjects. Weak classification, on the other hand, is associated with weak insulation between subjects, which allows cross exchanges to take place between them, resulting in more integrated and less specialised subjects.

Bernstein proposed a four-point scale of classification levels for describing different extents of integration between subjects in a curriculum:

- C+ +: very strong classification (very strong insulation)
- C +: strong classification (strong insulation)
- C-: weak classification (weak insulation)
- C - -: very weak classification (very weak insulation) (Bernstein, 1990:51).

The research tool that was piloted in this study used the notion of classification as a theoretical 'lens' through which the boundary between NRM and Life Sciences knowledge in a sample of Grade 10 Life Science lessons was analysed in order to gain insight into the extent to which they were integrated. Bernstein's four-point scale of classification levels provided the theoretical language with which the nature of the boundary between NRM and Life Sciences knowledge in the lessons was described and illustrated.

Research Design

Four schools were purposely selected to take part in the study, the major selection criteria being that they were rural, under-resourced in terms of physical structures and educational resources and had at least one Grade 10 Life Sciences class. For reasons of maintaining confidentiality, the

schools are referred to as Schools A, B, C and D. The study adopted a constructivist approach to research, in which reality is believed to exist in the form of respondents' beliefs, attitudes, experiences and actions (Cohen *et al.*, 2007). Data were generated using classroom observation of Grade 10 Life Sciences lessons, content analysis of texts that were produced during these lessons and semi-structured interviews with Grade 10 Life Sciences teachers.

The research tool

The research tool that was piloted during the study consisted of five procedural steps:

1. Construction of an analytical framework from key criteria of Grade 10 Life Sciences lessons;
2. Selection of suitable key indicators of NRM integration for each criterion;
3. Generation of data on the selected indicators regarding the extent of NRM integration in each criterion;
4. Grading the performance of each indicator with regard to the extent of NRM integration according to Bernstein's classification scale; and
5. Illustration of the results with the aid of radar diagrams.

The details of each step are discussed in the following sections.

Step 1: Construction of an analytical framework

The analytical framework consisted of what were judged to be key criteria of Grade 10 Life Sciences lessons, and that have the potential to integrate NRM. This step facilitated the analysis of the lessons by breaking them into smaller manageable parts. The selection of the criteria was done after observing two initial Grade 10 Life Sciences lessons at School A. It was important that the selected criteria were representative of a Grade 10 Life Sciences lesson at these schools, and that they were easy to identify and analyse in a lesson. The selection of lesson criteria was also guided by the pedagogical principles which underpin the national curriculum policy for Grade 10 Life Sciences (DoE, 2003). The five criteria which were selected to structure the analysis of the lessons are listed in Table 1.

Step 2: Selection of indicators of NRM integration

In the context of this study, the term indicator referred to a 'variable' which was used to show the status of a given lesson criterion with regard to the integration of NRM. Each identified lesson criterion was linked to one such indicator. The list of indicators that were used to analyse the lessons is shown in Table 1.

A table was compiled to distinguish between concepts which are specific to Life Sciences (for example, cell division and animal physiology), those which are general to both Life Sciences and NRM (for example, ecosystem structure and soil types), those which contained implicit reference to NRM (for example, climate change, water pollution) and those which explicitly refer to NRM (for example, biodiversity loss and game reserves). The assumption made was that the more explicit the references to NRM are during a Life Sciences lesson, the stronger the integration of NRM into that lesson.

Table 1. The criteria and indicators used to analyse the extent of NRM integration in the Grade 10 Life Sciences lessons

Criteria	Indicator
1. Lesson content	a. Nature of reference to NRM in the lesson topic
2. Oral questions	b. Nature of reference to NRM in the questions asked during the lesson
3. Educational resources	c. Types of educational resources used during the lesson
4. Written notes	d. Nature of reference to NRM in the notes written on the board during lesson
5. Assessment tasks	e. Nature of reference to NRM in the assessment tasks

Step 3: Generation of data on the extent of NRM integration
Classroom observations were conducted at each of the four schools. The class visits were made after making prior arrangement with the teachers concerned and involved only Grade 10 Life Sciences lessons. The lessons were spread across two school terms to help ensure that different areas of the Grade 10 Life Sciences curriculum were sampled, and observations were conducted with the aid of an observation schedule. All the observed lessons were audio-taped and field notes were taken. The second source of data was the pedagogic texts that were produced or used during the observed lessons. These included teachers' and learners' note books, teaching and learning materials and the notes written on the blackboard during the lessons. Semi-structured interviews with the Grade 10 Life Sciences teachers were also conducted mainly to obtain more clarity over issues which had arisen during the classroom observations.

Step 4: Grading the performance of each indicator with regard to the extent of NRM integration
This step was necessary in order to convert field data regarding the extent of NRM integration in the observed lessons to Bernstein's four classification levels of C+ +; C+; C- and C- -. The conversion of field data to classification levels was carried out with the help of scaling grids. A scaling grid is a research aid that was constructed during the study to ensure that the conversion was conducted in a systematic, rigorous, open and transparent manner. Each indicator had its own scaling grid, which showed which indicator descriptions from the field (in relation to the extent of NRM integration) corresponded with which classification level (see Table 2). An extra classification category (C°) was added to cater for those lessons in which the necessary data on the extent of NRM integration was either absent or insufficient.

Table 2. The scaling grids used to grade the performance of the indicators that were used to analyse the lessons

Indicator	C + + (very weak integration)	C+ (weak integration)	C- (strong integration)	C- - (very strong integration)	C° (necessary data absent/ insufficient
a. Nature of reference to NRM in the lesson topics	All specific to Life Sciences. No reference to NRM at all	Are general to both Life Sciences and NRM	Only implicit references made to NRM	Explicit references made to NRM	Lessons lacked focus, topic was unclear. Indicator performance could not be analysed.
b. Nature of reference to NRM in the questions asked during the lesson	Majority of questions specific to Life Sciences	Majority of questions general to both Life Sciences and NRM	Majority of questions made implicit reference to NRM	Majority of questions made explicit reference to NRM	No questions asked at all during lesson. Indicator performance could not be analysed.
c. Types of educational resources used during the lesson	All were specific to Life Sciences	Included those that are general to both Life Sciences and NRM	Included those that contain implicit reference to NRM	Included those that contain explicit reference to NRM	No teaching and learning materials used.
d. Nature of reference to NRM in the notes written during the lesson	Most notes are specific to Life Sciences	Contain numerous themes common to both Life Sciences and NRM	Contain numerous themes with implicit references to NRM	Contain numerous themes with explicit reference to NRM	No notes written down at all. Indicator performance could not be analysed.
e. Nature of reference to NRM in the assessment tasks	All assessment tasks set were specific to Life Sciences	Assessment tasks general to both Life Sciences and NRM	Assessment tasks with implicit reference to NRM	Assessment tasks with explicit reference to NRM	No/few assignment tasks given out. Indicator could not be analysed.

Results

A total of 15 Grade 10 Life Sciences lessons were analysed: four lessons each at School A, C and D, and three at School B. Since the lessons were observed after prior arrangement with the teachers, they were treated as representing the teachers' best classroom practices. The results are presented per indicator per school.

Indicator a: Nature of reference to NRM in the lesson topics

This indicator analysed the extent of NRM integration based on the teachers' inclusion of NRM concepts or themes into the lesson that was being taught. Of the four lessons which were observed at School A, one lesson (Lesson 1) contained explicit reference to NRM. This lesson involved listing the various natural resources and their uses by humans and other species. The rest of the observed lessons at School A consisted of topics which are specific to Life Sciences. At School B, all the observed lessons were based on topics which are specific to Life Sciences and contained no reference at all to NRM. At School C, Lesson 2, which was based on 'Biosphere Reserves', contained explicit reference to NRM, while Lesson 1 and 3 were based on topics which are general to both Life Sciences and NRM. Of the four lessons which were observed at School D, one contained topics which were general to both Life Sciences and NRM (Lesson 1), and the remaining three lessons were based exclusively on Life Sciences.

Based on the scaling grid of this indicator (see Table 2), the overall extent of NRM integration in the lesson topics that were taught to learners during the class visits at School A and School C was judged to be very strong and allocated a classification level of C- -. For School D the overall extent of integration in the topics that were taught during the observed lessons was judged to be weak and was given a classification score of C+. The extent of NRM integration at all the three observed lessons at School B was judged to be very weak, and allocated a score of C+ +.

Indicator b: Nature of reference to NRM in the questions asked during the lesson

This indicator analysed the extent of NRM integration in a lesson depending on the nature of questions that were asked during the lesson, the assumption being that the more the questions explicitly referred to NRM, the stronger the extent of NRM integration into the lesson.

The majority of the questions that were asked during all the observed lessons at all four schools were specific to Life Sciences. Based on the scaling grid of this indicator (see Table 2), the overall extent of NRM integration in the questions which were asked during the observed lessons at all the four schools was judged to be very weak, and given a classification score of C+ +.

Indicator c: Types of educational resources used during the lesson

This indicator analysed the extent of NRM integration in the lessons based on availability and use of different types of NRM-based educational resources during the lessons. The assumption made is that use by teachers or learners of various types of teaching and learning materials that specifically focus on NRM reflect very strong NRM integration, while the lack of use of such educational materials point to very weak NRM integration into the lesson.

The blackboard, teachers' notes and learners' notebooks were the most commonly used educational resources during the observed lessons at all four schools. In only one lesson (Lesson 1 of School C) did the teacher make use of a tool kit during the lesson. The tool kit was used to demonstrate the composition of soil, which is a topic that is common to both Life Sciences and NRM. Using the scaling grid of this indicator (see Table 2), the overall extent of NRM integration in the educational resources that were used during the observed Grade 10 Life Sciences at Schools A, B and D was judged to be very weak (C+ +). At School C, the overall extent of NRM integration in the learning materials that were used during the observed lessons was judged to be weak and allocated a score of C+.

Indicator d: Nature of reference to NRM in the notes written during the lesson

This indicator analysed the extent of the integration of NRM in the lessons depending on the nature of reference made to NRM in the notes that were written on the blackboard by the teacher. If most sets of notes contain themes with explicit references to NRM, it is interpreted as representing very strong NRM integration into the lesson, while the absence of themes that are specific to NRM in the notes points to very weak NRM integration.

The only notes that contained themes that are specific to NRM were written during Lesson 1 at School A (types of natural resources), and at School C during Lesson 2 (biosphere reserves). The rest of the notes that were written on the blackboard during the rest of the observed lessons at Schools A and C, and during all the observed lessons at Schools B and D were on themes that were specific to Life Sciences. Using the scaling grid for this indicator (see Table 2), the overall extent of NRM integration in the notes that were written on the blackboard during the observed lessons at all four schools was judged to be very weak (C + +).

Indicator e: Nature of reference to NRM in the assessment tasks

This indicator analysed the extent of NRM integration in the Grade 10 Life Sciences lessons depending on the themes of the assignment tasks that were assigned to the learners during the observed lessons. The assumption made is that explicit reference to NRM in the assignment tasks that were set during the observed lessons implies very strong NRM integration, while the absence of any reference to NRM counts as very weak NRM integration.

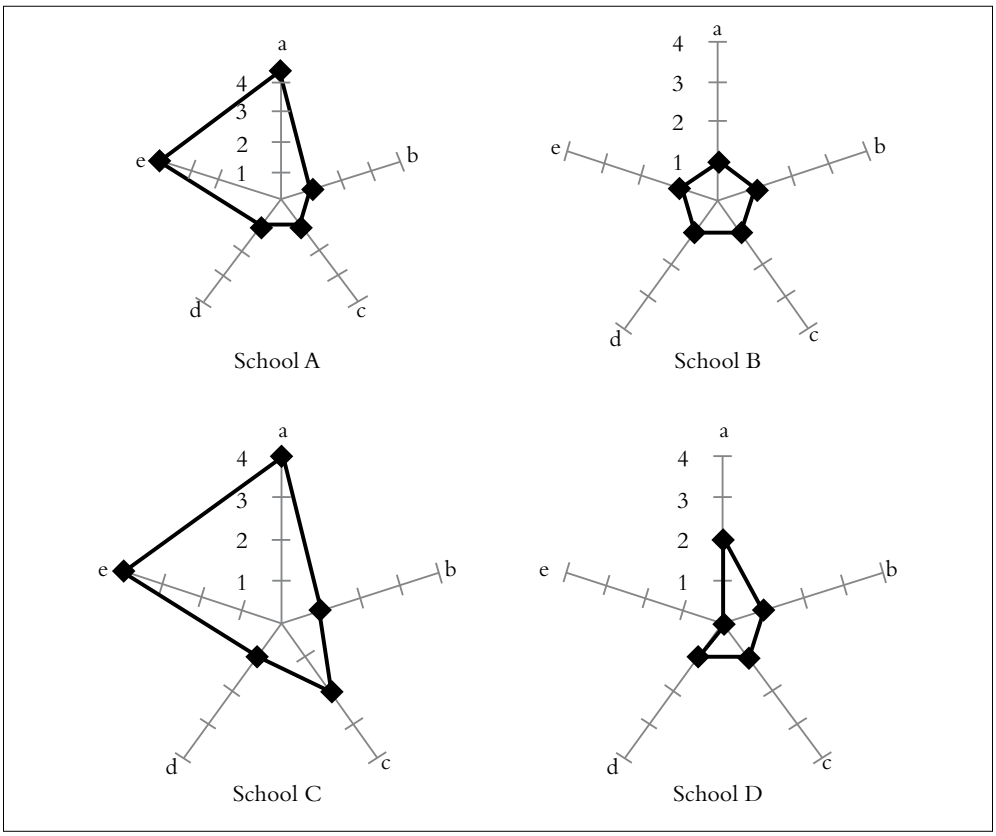
The only assessment tasks that contained explicit reference to NRM were in Lesson 1 of School A (although learners were merely required to list various natural resources and their uses) and Lesson 2 at School C (where learners were asked questions based on a diagram of biosphere reserves). The remaining assessment tasks at School A and School C, and all the assessment tasks which were set during the observed lessons at School B, were specific to Life Sciences.

Using the scaling grid of this indicator (see Table 2), the overall extent of NRM integration in the assessment tasks at Schools A and C was judged be very strong (C- -), while that at School B corresponded to a classification score of C+ +. At School D, no assessment tasks were set during the observed lessons, and this indictor was given a classification score of C^{o}.

Illustration of overall results

Overall, at all four schools, there was little or no integration of NRM into the Grade 10 Life Sciences lessons that were observed during the study. The overall extent of NRM integration into the observed lessons was strongest at Schools A and C, where two of the five indicators that were used to analyse the lessons showed very strong NRM integration. School B showed the least overall NRM integration, with all five indicators registering very weak NRM integration. There was no indicator that consistently showed very strong NRM integration across all the four different schools. The integration of NRM into the questions that were asked during the lessons was particularly weak at all the four schools. These results are illustrated in Figure 1 with the aid of radar diagrams.

Figure 1. The overall extent of NRM integration in the Grade 10 Life Sciences lessons at the four case study schools



Key to classification levels: 0: insufficient data for analysis; 1: C + + (very weak NRM integration); 2: C+ (weak NRM integration); 3: C- (strong NRM integration); 4: C- - (very strong NRM integration)

Key to indicators: a: Nature of reference to NRM in the lesson topics; b: Nature of reference to NRM in the questions asked during the lesson; c: Types of educational resources used during the lesson; d: Nature of reference to NRM in the notes written during the lesson; e: Nature of reference to NRM in the assessment tasks set during the lesson.

Discussion

One of the study's objectives was to design and to test the efficacy of a research tool for analysing and monitoring the extent to which NRM issues are integrated into lessons. The research tool that was piloted during the study proved to be very effective in analysing and describing the extent to which NRM issues were integrated into a sample of Grade 10 Life Sciences lessons. Bernstein's theory of classification, which formed the theoretical basis of the research tool, provided the 'lens' through which the relationship between NRM and Life Sciences knowledge was analysed, while his classification scale was used to differentiate between different extents of NRM integration. The use of qualitative indicators of NRM integration during the analysis resulted in a more comprehensive and interpretive analysis of the lessons. The radar diagrams that were used to illustrate the findings proved to be very strong and effective visual communicating tools of the overall extent to which NRM was integrated into the different lessons. In addition, the radar diagrams are relatively easy to draw and interpret as compared to linear or bar graphs. They also facilitated rapid comparisons of the extent of NRM integration between the different schools, different lessons in a given school and different criteria in a given lesson. Lastly, each of the five steps which constituted the analysis procedure has ample opportunity for the inclusion of teachers' and other stakeholders' input. This has the potential to democratise the lesson analysis process, which ensures that the decisions taken during the process are sensitive to the school and classroom contexts.

However, the piloted research tool also had a number of limitations. Firstly, with five different steps involved, the lesson analysis procedure became overly long before a final decision regarding the extent of NRM integration within each lesson criterion could be made. Secondly, the use of qualitative indicators of NRM integration to analyse the lessons could have resulted in researcher bias (hence the need to clearly show how major decisions during the lesson analysis were made). Thirdly, although the research tool made it possible to identify and describe different extents of NRM integration, it did not facilitate analysis of the quality of the NRM knowledge that was integrated into the lessons. This led to a situation where lessons were allocated the highest level of integration (C- -), although the quality of the NRM that was integrated was of questionable quality. This limitation on the part of Bernstein's theory of classification has been noted by Hugo *et al.* (2006), who recommend that it be used simultaneously with Bloom's Revised Taxonomy (for those studies where the quality of pedagogic [integrated] knowledge is also under investigation). Lastly, the conversion of data into classification levels (Step 4) led to the loss of rich descriptions of NRM integration that had been obtained from the field. Despite these limitations, the research tool proved to be an effective and robust alternative to the sole use of frequency counts of words when analysing the environmental content of teachers' lessons.

Although the study was mainly exploratory, it provided some insight into the extent to which NRM issues are integrated into Grade 10 Life Sciences lessons at a sample of rural under-resourced schools in the Eastern Cape. Overall, the study showed that at the four schools that took part in the study, there was little or no integration of NRM issues into the observed Grade 10 Life Sciences lessons. These results are in spite of the strong NRM discourse in the

official Grade 10 Life Sciences documents (Nsubuga, 2008). The results point to the possible existence of a disparity between official environmental education policy and its enactment at classroom level at the four schools. The existence of a wide gap between official curriculum policy and actual classroom practice at South Africa's rural under-resourced schools has been highlighted in numerous studies (Jansen, 2001; Cross *et al.*, 2002).

According to Bernstein (1996), the interpretation of official curriculum policy at school level is greatly influenced by a school's context, and the degree of autonomy that the school enjoys from external control. This view is supported by Neves and Morais (2001), who state that the implementation of official curriculum policy in schools depends on teachers' ideology and whether they understand what is stated in the curriculum documents. They further note that a lack of effective school monitoring mechanisms also creates opportunities for teachers to effect change to official discourse if they do not identify with the principles that underpin that discourse.

Working in a South African context, Maila (2004) identified numerous challenges to effective environmental learning in South Africa's schools, which included lack of teacher training in environmental education; poor curriculum support for teachers; lack of skills and experience with the development and use of teaching and learning materials that are relevant to environmental education; negative perceptions accorded environmental learning; unclear job descriptions for educators regarding their role in environmental learning and historical and structural factors. Which of the above named factors were at play at the four case study schools is an issue that demands further investigation.

Conclusions

Although there have been numerous changes made to the formal school curricula in South Africa since the end of apartheid, an integrated approach to environmental learning remains one of the country's cornerstone education policies. Effective implementation of this key environmental education principle in South Africa's rural under-resourced schools hinges inter alia on feedback information about teachers' environmental education practices at classroom level. The thousands of teachers in the Eastern Cape's rural under-resourced schools are a potential rich source of information on the status of environmental teaching and learning at these schools. Such research would be useful in two major ways. First, it would help create opportunities for teachers to reflect and improve on their classroom practice with regard to environmental learning. Secondly, it has the potential to inform future environmental education policies and implementation strategies that address the specific needs of the Eastern Cape's under-resourced rural schools. However, for these objectives to be realised, it is important that the teachers are supported in their capacity to integrate environmental issues into their lessons. A research tool for analysing the extent to which environmental issues are integrated into teachers' lessons represents one form of such teacher support.

Note on the Contributor

This article was written while the author was a post-doctoral student at Nelson Mandela Metropolitan University, Port Elizabeth. Dr Yvonne Nsubuga is currently a researcher in the Department of Education, Rhodes University. Email: ynsbga@yahoo.com

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