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Measuring the environmental literacy of teachers

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The crucial role that teachers' environmental literacy plays in realising the goals of environmental education and the importance of the ability, to determine their level of environmental literacy, are argued. A measuring instrument was developed in this regard and was applied to a sample of teachers. An analysis of the results revealed that the instrument meets the necessary psychometric requirements and that it can be considered a valid and reliable instrument to measure the level of environmental literacy of teachers. The research also revealed interesting results regarding the relationship between the level of teachers' environmental literacy and their field of academic training, accompanying learning area involvement, and general environmental education training.

Introduction and background

The potential of environmental literacy as a vehicle to realise the educational agenda of sustainable development cannot be over-emphasized. According to Disinger and Roth (1992:165) environmental literacy is a prerequisite to maintaining and improving the quality of the environment and life as such. The development and fostering of environmental literacy need, therefore, to be a key objective in any general education programme (Roth, 1992:2).

Apparently, the term 'environmental literacy'does not mean the same to everyone. Since the first general reference to the concept 'environmental literacy' appeared in 1969 (Roth, 1992:ix), various researchers have made an effort to define it or to refine descriptions of it. Examples can be found in, *inter alia*, Clacherty (1992:26), Roth (1992:1) and Subbarini (1998:245). Although we are aware of the possibility of being labelled positivistic, a definition of environmental literacy was developed from the various efforts of researchers such as Leeming, Porter, Dwyer, Cobern and Oliver (1997), Loubser (1994), Smith-Sebasto and Smith (1997), Pohorille (1985) and Buethe and Smallwood (1987). Details about the development of the definition and the supporting information and literature can be found in Loubser, Swanepoel and Chacko (2001:318-319). This definition was used for the purposes of this research and it stated that:

> Environmental literacy is the ability to be aware of one's environment. It enriches one with the knowledge to realise the imbalances and threats the environment faces and enables one to form positive attitudes towards it with the aim of developing skills to resolve and prevent environmental problems and urge to protect and improve the environment for the present and future generations by active participation.

A study was also made of various models comprising concepts researchers regard as important to environmental education and environmental literacy. From these attempts by, *inter alia*, Munson (1994:31), Odum (1992:542-544), Roth (1992:37-38) and Loubser (1994:37-38), we identified ten concepts that we regard as necessary for teachers to have a grasp of before being able to really do justice to environmental education. The ten concepts are in line with the definitions, aims, objectives and guiding principles of environmental education and the preceding definition of environmental literacy. Each of the ten concepts is a cluster of related subconcepts representing aspects of environmental literacy. These ten concepts were selected mainly from major environmental areas such as ecology and interactions in the environment, participation in the identification and prevention of environmental problems, decision making on environmental issues and environmental ethics. The ten concepts are biosphere, ecological perspective, interrelationships in an ecosystem, environmental changes, basic human needs, resources, maintaining environmental quality, the ability to make choices, decision-making on environmental issues, as well as environmental ethics. Loubser, Swanepoel and Chacko (2001:319-322) can be consulted for more details on the identification and justification of the concepts.

In most of these concepts there is a close link between knowledge, affect, skills and behaviour. Environmental literacy, therefore, is considered to be a continuum of competencies ranging from zero competency to very high competency. There is a broad spectrum of environmental literacy, from complete unawareness to deep, thorough understanding and concern. For the purposes of this research a few distinguishable, but not separable, disposition levels on this continuum were identified, namely awareness, knowledge, attitude and participation.

Teachers — more than any other professional group — can probably promote environmental literacy, by virtue of their interaction with society (more specifically learners, parents and colleagues). Teachers at all levels and subject areas have a role to play in this regard, i.e. contribute to the development of citizens who possess the basic understanding and skills to make informed decisions in matters affecting the environment and whose personal lifestyles support sustainable development. Teachers can, however, hardly assist learners to become environmentally literate if they themselves lack environmental literacy. Despite the important role teachers play in educating students, research into teachers' level of environmental literacy has been extremely limited. The few studies that were reported indicated a relatively low level of environmental literacy. An example is a study by Beuthe and Smallwood (1987:40) which stated that the environmental literacy of Indiana teachers is far from optimal. In addition several researchers, for example, Schreuder (1995:2), Braus (1995:46) and Papadimitriou (1995:88-89), mentioned that most teachers are not trained to do justice to environmental education. It seems, therefore, imperative to be able to determine the state of affairs regarding the environmental literacy of the teacher corps.

Formulation of research problems

The following research problems were formulated with reference to the preceding exposition:

- Is it possible to develop an instrument to measure the level of environmental literacy of teachers?
- What is the relationship between both pre-service academic teacher training and general environmental education training and the level of environmental literacy of teachers?

Hypotheses

The following hypotheses, which follow on the research problems, were formulated:

1. A reliable measuring instrument can be developed to measure the level of teachers' environmental literacy.
2. The nature of pre-service professional teacher training, accompanying field of tuition and general environmental education

training, relate to the level of environmental literacy of teachers and have, therefore, an influence on their disposition towards environmental education.

Research design

Measuring instrument

Different data gathering techniques, which could possibly be utilised to determine the level of environmental literacy of teachers, such as interviews, observations and questionnaires, were considered. After investigating the merits and deficiencies of the various techniques, the questionnaire was identified as the most suitable instrument to be used in this regard.

The questionnaire developed in this study consisted of two sections — section A which comprised 12 items on background information and section B which comprised 135 items dealing with the various aspects of environmental literacy. Section B initially consisted of 370 items which were reduced to 135 in the process of content validity determination. The items were developed according to a matrix with the ten central concepts representing environmental literacy (see introductory paragraph) on one axis and the disposition level of the respondent (see introductory paragraph) on the other axis. A 4-point scale ranging from 'strongly agree' to 'strongly disagree' was used as a response-measuring scale.

Sampling

The sample area selected for this study comprised the Northern province, North West province and Mpumalanga province of South Africa. This area covers 26.2% of the total area of South Africa with a population which constitutes 25.9% of the total population of the country (Luüs & Oberholzer, 1994; Republic of South Africa, 1997). Of the 53 schools randomly selected from the three provinces, 420 teachers were selected to represent teachers teaching in the foundation phase, intermediate phase, senior phase, and further education and training phase. Questionnaires were adequately completed by 352 teachers. These respondents were representative of gender, age, learning area taught and qualifications obtained. The majority of respondents were from rural areas.

Analysing techniques

The data obtained from the questionnaire, was analysed using the Statistical Analysis System (SAS) version 6.1.2. In order to test the first hypothesis, it was necessary to determine whether the questionnaire met certain psychometric requirements. To accomplish this, the homogeneity of each of the four disposition level (dl) fields of the questionnaire (Awareness, Knowledge, Attitude and Participation) was scrutinised and the reliability and the construct validity of the questionnaire determined. This was done by means of an item analysis (item field total correlation and alpha coefficient for each item), a Cronbach alpha coefficient for each dl field, as well as the questionnaire as a whole, inter-correlations between the four dl fields and between each dl field and the total of the questionnaire. Testing of hypothesis two was done by stating corresponding null hypotheses and testing these by using analysis of variance (F tests and t tests).

Results and discussion

Hypothesis 1

The aim with the item analysis was to obtain clarity on the homogeneity of each dl field. In this regard, it was determined whether each item contributes to the total of the field it belongs to. If an item does not show a considerable correlation with the total of the particular field, or contributes negatively to the alpha reliability coefficient of the field, it should be omitted.

The item analysis revealed that only one item of the Awareness dl field, two of the Knowledge dl field, one of the Attitude dl field and three of the Participation dl field should be omitted. The Cronbach alpha coefficients, obtained for the four dl fields after the above items had been omitted, were 0.793 (Awareness), 0.839 (Knowledge), 0.867 (Attitude) and 0.861 (Participation). These coefficients served as further confirmation of the internal consistency of the four dl fields of the questionnaire, since the Cronbach alpha coefficient algebraic equals the mean of the bisection reliability coefficients which are calculated on every possible bisection of the instrument.

The reliability coefficient calculated for the questionnaire as a whole was 0.945. This is quite acceptable and the questionnaire could, therefore, be considered a reliable instrument.

Content validation of the questionnaire was done by submitting it to eight specialists in environmental education, ecology and sustainable development. (Refer also to the second paragraph of 'Measuring instrument').

Although the questionnaire consists of four different dl fields, these were related to one another and to the total construct of the questionnaire, since they all dealt with the disposition of teachers towards environmental education. One would, therefore, expect to find significant positive correlations between the dl fields. To be construct valid each dl field should display — on the one hand — a high correlation with the questionnaire as a whole and on the other hand a relative independence regarding the other fields. The inter-field correlations are indicated in Table 1.

Table 1 Inter-field correlations for the questionnaire

Disposition level field	Aw	K	At	P	Q
Awareness (AW)	1.000				
Knowledge (K)	0.799	1.000			
Attitude (At)	0.727	0.673	1.000		
Participation (P)	0.705	0.694	0.701	1.000	
Questionnaire as a whole (Q)	0.895	0.882	0.885	0.877	1.000

All coefficients were highly significant ($p \leq 0.01$)

It is evident from Table 1 that there was a high correlation between each dl field and the questionnaire as a whole. The lowest coefficient was ± 0.88. As far as the questionnaire's relative independence of dl fields was concerned, Table 1 reveals that the highest inter-field correlation between individual dl fields was 0.799. This implies that the biggest collectivity between any two dl fields was approximately 64%, which indicates that the questionnaire displays the necessary internal independence of dl fields. It could, therefore, be considered construct valid.

From the preceding discussion of results, the conclusion can be made that the questionnaire met the necessary psychometric requirements and that it can be considered a valid and reliable instrument to measure the level of environmental literacy of teachers. Norms were subsequently determined by converting the raw scores into stanines.

Hypothesis 2

In order to test the second hypothesis, three null hypotheses were formulated. The first to be verified was:

'*There is no significant difference between the level of environmental literacy of teachers with different academic qualifications*'.

The respondents were divided into five categories based on highest academic qualification as indicated in Table 2. In order to compare the mean scores of the five groups an analysis of variance (F test) was carried out.

The results of the F test, which appear in Table 2, revealed that the null hypothesis could not be rejected ($p > 0.05$). It can, therefore, be concluded that there is no significant difference between the average environmental literacy of teachers with different academic quali-

fications. It appears that this result contradicts research results reported by Buethe and Smallwood (1987), if one assumes that almost all secondary school science teachers in the USA have a BSc degree. According to them, science teachers had higher levels of environmental literacy than other teachers.

Table 2 Level of environmental literacy of teachers with different qualifications

Qualification group	N	Mean	SD
Standard 10	103	416.31	35.71
B A	64	418.88	37.62
B Sc	24	417.50	51.44
B Com	12	446.00	41.59
Other	149	422.58	40.48

$F(4.347) = 1.70$; $p > 0.05$

The second null hypothesis stated that:

'*There is no significant difference between the level of environmental literacy of teachers if they are divided according to learning area in which they offer tuition'.*

In order to test this null hypothesis, the respondents were divided into eight categories (refer to Table 3 for the categories). According to an analysis of variance (F test), the null hypothesis cannot be rejected when the means of the total score obtained for the questionnaire are compared [$F(7.344) = 1.81$; $p > 0.05$]. This result is in line with a finding from a study by Abraham and Chacko (1999), according to which teacher training college lecturers have average environmental literacy, irrespective of the subjects they teach. An analysis of the mean scores (F test) obtained for the four dl fields in the eight categories revealed, however, an interesting picture. The results for the Knowledge dl field are indicated in Table 3.

Table 3 Knowledge dl field scores of teachers in different learning areas

Learning area	N	Mean	SD
Language, literacy and communication	133	98.62	11.09
Human and socio sciences	47	100.49	9.60
Mathematics, maths literacy and maths sciences	66	99.36	8.69
Natural sciences	76	103.66	10.89
Arts and culture	12	100.42	4.40
Economic and management sciences	9	103.33	16.12
Life orientation	7	90.43	5.06
Technology	2	100.00	2.83

$F(7.344) = 2.74$; $p < 0.01$

According to the data included in Table 3, the null hypothesis can be rejected as far as knowledge, as an aspect of environmental literacy, is concerned ($p < 0.01$). A further analysis of the data by means of applying a t test for independent groups, showed a significant difference between the mean scores of teachers teaching in the learning area 'Natural sciences' and both those teaching in the "Language, literacy and communication" and "Life orientation"($t > 3.14$; $p < 0.05$) learning areas. In the other three dl fields (Awareness, Attitude and Participation), no significant difference was found between the mean scores obtained for teachers involved in the eight learning areas.

The third null hypothesis stated that:

'There is no significant difference in the level of environmental literacy between teachers who received training in environmental education and those who did not receive any training'.

A t test for independent groups was utilised for each dl field, as well as for the questionnaire as a whole to test the null hypothesis. The results are indicated in Table 4.

Table 4 Environmental training and environmental literacy

DL Field	Group	N	Mean	SD	t value	Df	P
Awareness	1*	114	82.71	9.81	2.23	350	$p < 0.05$
	2	238	80.44	8.47			
Knowledge	1	114	101.65	11.80	1.89	350	$p < 0.05$
	2	238	99.39	9.77			
Attitude	1	114	114.44	12.66	2.77	350	$p < 0.01$
	2	238	110.45	12.64			
Participation	1	114	112.25	12.24	3.30	350	$p < 0.01$
	2	238	107.85	11.47			
Questionnaire as a whole	1	114	429.14	42.11	2.85	350	$p < 0.01$
	2	238	429.14	37.84			

* 1 = Received training; 2 = Did not receive training

According to Table 4, the null hypothesis can be rejected on at least the 0.05 level of confidence for the questionnaire as a whole, as well as all the dl fields, except the Knowledge dl field. It appears, therefore, that the environmental training teachers received did not contribute significantly to the 'knowledge level' of teachers, but definitely to their level of awareness, attitude and willingness to participate in environmental actions.

Concluding remarks

Developing environmental literacy is a major challenge for our school system. It is the disposition of teachers towards the environment and environmental education which determines to a large extent whether learners are educated to become adults who take the responsibility to maintain the environment and improve quality of life. A measuring instrument to determine whether teachers themselves demonstrate the necessary environmental literacy, was developed by this research. It was established that the instrument is indeed a valid and reliable instrument to measure the level of environmental literacy of teachers and that is could be utilised in further research for this purpose. Norms were subsequently determined for future use.

The results of this investigation have also revealed a tendency regarding the impact of training of teachers on their environmental literacy. It seems that the field of academic training, as well as the field of tuition involvement do not make a significant difference in the environmental literacy of teachers in general. Teachers involved in the teaching of the Natural sciences appear, however, more 'environmentally knowledgeable' than teachers involved in some of the other learning areas, but do not have a significantly more positive attitude towards or intention to participate in environmental actions. On the other hand, those teachers who received training in environmental education do demonstrate a significantly higher level of awareness, attitude and participation intention than those teachers who did not receive such training. These findings reiterate the recommendations of a number of researchers such as Shongwe (1992:18), Simmons (1993: 8) and Papadimitriou (1995:85-86) regarding the need for pre-service as well as in-service environmental education training of teachers.

References

Abraham NP & Chacko CC 1999. Levels of environmental literacy among college lecturers. Paper presented at the 19th Seminar of the *International Society for Teacher Education*, University of Kent, Canterbury, England.

Braus J 1995. Environmental education: Where we've been and where we're going. *Bioscience*, Supplement:845-851.

Buethe C & Smallwood J 1987. Teachers' Environmental Literacy. Check and recheck, 1975 and 1985. *Journal of Environmental Education*, 18:39-42.

Clacherty AJ 1992. Environmental literacy: Implications for environmental teacher education. *South African Journal of Education*, 12:25-30.

Disinger JF & Roth CE 1992. Environmental education research news. *The Environmentalist*, 12:165-168.

Leeming FC, Porter BE, Dwyer WO, Cobern MK & Oliver DP 1997. Effects of participation in class activities of children's environmental attitudes and knowledge. *Journal of Environmental Education*, 28:33-42.

Loubser CP 1994. *Environmental Education in Primary Schools in South Africa*. Pretoria: University of South Africa.

Loubser CP, Swanepoel CH & Chacko CPC 2001. Concept formulation for

environmental literacy. *South African Journal of Education*, 21:317-323.
Luüs C & Oberholzer R 1994. *Provincial characteristics of South Africa*. Halfway House: Southern Book Publishers.
Munson B 1994. Ecological misconceptions. *Journal of Environmental Education*, 25:30-34.
Odum EP 1992. Great ideas in ecology for the 1990s. *Bioscience*, 42:542-545.
Papadimitriou V 1995. Professional development of in-service primary teachers in environmental education: an action research approach. *Environmental Education Research*, 1:85-97.
Pohorille RL 1985. Derivation of a test for measuring degrees of environmental education. MA dissertation. Rondebosch: University of Cape Town.
Republic of South Africa 1997. *RSA Statistics in brief*. Pretoria: Government Printer.
Roth CE 1992. *Environmental Literacy*: *Its roots, evolution and directions in the 1990s*. Columbus: The Ohio State University.
Schreuder DR 1995. Environmental Education at the crossroads: Rhetoric and reality in educational reconstruction in South Africa. Paper presented at the *NAAEE Conference*, Portland, Maine, USA.
Shongwe DP 1992. Environmental education in primary schools in Bophuthatswana: A case study in curriculum implementation. MEd dissertation, Grahamstown: Rhodes University.
Simmons D 1993. Facilitating teachers' use of natural areas: Perceptions of environmental education opportunities. *Journal of Environmental Education*, 24:8-16.
Smith-Sebasto NJ & Smith TL 1997. Environmental education in Illinois and Wisconsin: A tale of two states. *Journal of Environmental Education*, 28:26-36.
Subbarini MS 1998. Philosophical, epistemological, doctrinal and structural basis for an international environmental education curriculum. *Proceedings of the International Best of Both Worlds Conference*, Pretoria, South Africa: 242-246.