

Exploring environmental pollution awareness among high school students from a coal mining town

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Abstract

This study explored environmental pollution awareness of high school students from a coal mining town of eMalahleni, Mpumalanga province of South Africa. About 423 students from grades 8 to 12 from five schools (250 students from 3 public and 173 students from 2 private schools) participated in this study. There were 189 males and 234 females with ages ranging between 13 years and 23 years ($M = 16.0$ years, $SD = 1.8$). A 12 – item five point Likert type scale anchored by 1 = Strongly disagree and 5 = Strongly agree was used to determine students' awareness about environmental pollution. In this study, we determined students' level of environmental awareness with respect to their gender, age, grade level and school type. Further students ranked their sources of information about environmental pollution in the order of importance to them. Finally students' views about introducing environmental education as a standalone subject in South African Schools were determined. Results revealed (a) no gender differences; (b) younger students indicated higher level of awareness compared with 18 years and older; (c) differences were established between Grade 8 and Grade 10 (d) compared to public schools, students in private schools reported higher level of environmental awareness. About one-in-four students ranked newspapers as their main source of information about environmental pollution. Majority of the students were of the view that environmental education should be introduced as a separate subject. It is recommended that authorities should consider introducing environmental education as a subject at schools in South Africa.

Keywords: Awareness, Environmental pollution, Coal mining, Demographic variables, Sources of environmental information

Introduction

Leaders of major nations the world over have been looking at finding solutions that would address issues relating to climate change and global warming. Globally, the United Nations through the Climate Change Conference (UNFCCC) has hosted a number of conferences aimed at addressing these issues. For instance in December 1997 the Kyoto Protocol was adopted in Japan with the detailed rules for its implementation adopted at COP 7 in Marrakesh in 2001 (UNFCCC, 1997). The process continued to Cancun in Mexico where it is reported "... far-reaching international response to climate change the world had ever seen to reduce carbon emissions and build a system which made all countries accountable to each other for those reductions" were reached (UNFCCC, 2010). In December 2011 the United Nations Climate Change Conference was held in Durban, South Africa. This high profile conference on pollution and environmental matters was the main motivation for us

conducting this study. Also, it is reported that In South Africa children are major victims of pollution and this invariably happens within their homes and schools (Mathee, 2003). We felt it was opportune to establish how aware students from a coal mining town were about pollution in their environment.

It has been argued that “Despite the wealth of information which exists concerning environmental behavior, it is not known which variable or variables appear to be most influential in motivating individuals to take responsible environmental action” (Hines, Hungerford, & Tomera, 1986/87: 1). Studies have indeed been carried out with the aim of determining the influence of factors such as knowledge of, awareness as well as attitudes towards environmental issues (e.g., Lasso de la Vega, 2006). Most studies have found that among children these factors tend to be favourable. For instance it is reported that in UK schools levels of environmental understanding amongst children are high (Strong, 1998). Similarly, in Ethiopia secondary school students were reported to hold moderate levels of environmental awareness and attitude while they had intentions to contribute for environmental improvement (Feleke, 2010).

UNESCO has described environmental awareness as relating to individuals’ concern about and being sensitive to the environment including the factors impacting on it (UNESCO, 1979). In terms of awareness, what is critical is that human beings should ensure the sustainability of the environment they are in. In this regard, it is argued that what is needed is “... a holistic, lifelong process of becoming aware or, appreciating, valuing and contributing to the creation and development of the kind of environment that is healthy and sustainable.” (Little, 1998: 3) An investigation exploring environmental awareness is important because it has been shown that awareness is necessary to achieve environmental protection and restoration (Fisman, 2005; Madsen, 1996). Similarly, it is pointed out that making children aware of their environment would build their sense of caring and protecting it.

In exploring students’ environmental pollution awareness we determined whether we could establish differences with respect to (a) gender (b) age (c) grade level and (d) school type. Further, we wanted to determine what students’ sources of information about environmental pollution were. In conducting this investigation we were of the view that it is important for students in their teenage years to know and be aware of environmental matters. We felt that if teenagers were aware and conscious of environmental issues, then the likelihood of being responsible adults who will take good care of their environment was high.

Method

Study Area

The research site for the study was the town of eMalahleni, in Mpumalanga province of South Africa. eMalahleni is a coal mining town that also supplies the coal to adjacent power stations for electricity generation. Also there are a number of smelting companies around the mines who use the coal in the foundries. The effect of the mining, electricity generation and industry in the area is the release of

coal related gasses. In fact, conversations the researchers had with a number of the town's residents revealed that almost every evening one would notice smog emanating from the mines. Further, a conversation with one high school principals revealed that there were approximately 15 mines in the general vicinity of her school (personal communication, March, 2011).

Participants and Sampling procedures

Participants selected for this study were male and female high school students from grades 8 to 12 who were between ages 13 and 23 years from public and private schools. We selected schools that were within the coal mining and power generating plants' precinct. In this general area there were about twelve schools comprising nine public schools and three private schools. We randomly selected three public schools and two private schools. Each school's name was given a unique number written in a piece of paper. The papers were put in a hat and three schools representing the public schools were drawn. A similar process was followed for the private schools. We distributed 100 questionnaires to each of the five schools. The questionnaires were given to students at each grade level selected by their teachers who assisted in the administering the questionnaires. The teachers were selected by the various school principals.

Instrument and procedure

The questionnaire we used had three parts. The first part of the questionnaire invited the participants to provide biographic information such as their age, gender, and grade level. The second part was a 12 - item Likert type scale on environmental awareness adapted from other studies (Yilmaz, Boone, & Anderson, 2004; Bas, Tuncer, & Ertepinar, 2011). In South Africa students do not take environmental education as a subject. So in choosing 12 items we looked into the secondary school curriculum for Grades 8 – 12 in subjects where environmental concepts are taught. These concepts are mentioned in subjects such as Life orientation as well as in Life and Natural Sciences. *Two typical Awareness items for example were (i) Environmental pollution causes serious illnesses.'* (ii) *Schools must offer environmental education as a subject.* Participants were requested to register their views on a five point scale anchored by 1 = Strongly Disagree and 5 = Strongly Agree. In the third part, participants were provided with ten sources of environmental information adapted from (Hausbeck, Milbrath, & Enright, 1992). Here we requested the participants to rank the sources in order of importance to them.

Reliability and validity

Reliability of students' scores for the Awareness variable was determined by computing Cronbach's (1951) alpha. Alpha is a measure of internal consistency that is actually "...a function of the interrelatedness of the items in a test ..." (Schmitt, 1996, p. 350). The internal consistency alpha value of the Awareness variable was found to be .72 [95 % CI: $\alpha = .67$ to $\alpha = .76$] (Barchard, 2007; Feldt, 1965). This value of alpha was seen to be acceptable based on the rule of thumb "... $\alpha > .9$ – Excellent, $\alpha > .8$ – Good, $\alpha > .7$ – Acceptable, $\alpha > .6$ – Questionable, $\alpha > .5$ – Poor, and $\alpha < .5$ – Unacceptable" (George & Mallery, 2003, p. 231). To ascertain face validity, the questionnaire was given to two senior academics in a university's Education department. The academics were briefed

about the adaptation of and the intention of the questionnaire. Their brief was to study the Awareness items and advise on any changes. The academics were happy with the content so, no changes were made. They however recommended some technical changes. For instance we had the biographical section at the end of the questionnaire and they suggested that this be at the beginning. Also, the original font was 10 points with single spacing and they suggested that this be changed to 12 points with double spacing for the ease of reading by participants. Having effected all the suggested changes, face validity of the questionnaires was accepted

Results

Rate of return

A total of 500 questionnaires on awareness of pollution issues were distributed to participants in three public schools and two private schools in eMalahleni, Mpumalanga Province. Out of the 500 questionnaires 423 (85%) copies were returned.

Biographical data

Participants were 189 (44.7%) males and 234 (55.3%) females who were from Grade 8 to Grade 12. Their ages ranged between 13 years and 23 years ($M = 16.0$ years, $SD = 1.8$). Table 1 shows a more comprehensive biographical data of students.

Table 1: Biographical data of students (N = 423)

	n	%
Gender		
Male	189	44.7
Female	234	55.3
Age in years		
13- 15	160	37.8
16 - 17	184	43.5
18 +	79	18.7
Grade		
8	127	30.0
9	95	22.5
10	94	22.2
11	89	21.0
12	18	4.3
School type		
Public	250	59.1
Private	173	40.9

Awareness scores

The 12 Awareness item scores ranged between a maximum of 60 and a minimum of 12. Table 2 shows the measures of central tendency including the 25th and 75th percentiles. Awareness scores

ranged from 24 to 59 ($M = 48.0, SD = 5.9$). In terms of the percentiles it may be seen for instance that 75% of the participants obtained scores below 52

Table 2: Measures of central tendency including the 25th and 75th percentile

Mean		48.0
Median		49.0
Mode		49.0
Std. Deviation		5.9
Percentile	25	45.0
	75	52.0

Establishing learner differences by gender

To establish differences between students' awareness and gender, independent samples t-test with equal variances assumed (Levene's test for equality of variances) was computed. The test for equality of variances was accepted [$F(1,421) = 1.81, p = .18$]. Independent samples t-test indicated that the difference between the males and females was not statistically significantly different (see Table 3).

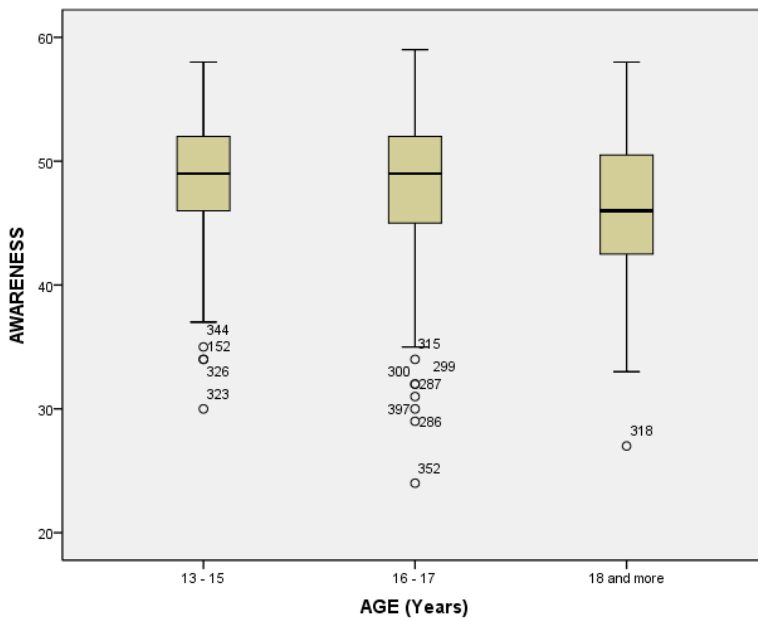
Table 3: Means, standard deviations and t-test results of Awareness against gender

Awareness	Gender	N	M	SD	df	t	p
	Male	189	47.4	6.2	421	1.92	0.055
	Female	234	48.5	5.7			

Establishing students differences by age

Univariate analysis of variance (UNIANOVA) was computed to determine differences between the students' *Awareness* against age. The null hypothesis that the error variance of the dependent variable is equal across groups (Levene's test of equality of error variance) was rejected for *Awareness* [$F(2, 420) = 3.36, p = .036$]. The test of between subjects - effects revealed that there was a statistically significant difference between students' age and *Awareness* [$F(2, 420) = 3.15, p < .05$; partial $\epsilon^2 = .01, Power = .60$]. The *post hoc* analysis using Scheffe indicated that the difference was between students in the age range 13 years – 17 years and those who were 18 years and older (see Figure 1). It may be inferred from the figure that the distribution of students whose ages were 13 years to 15 years was not different to that of students with the age range 16 years to 17 years but the distribution of those who were 18 years and older was lower.

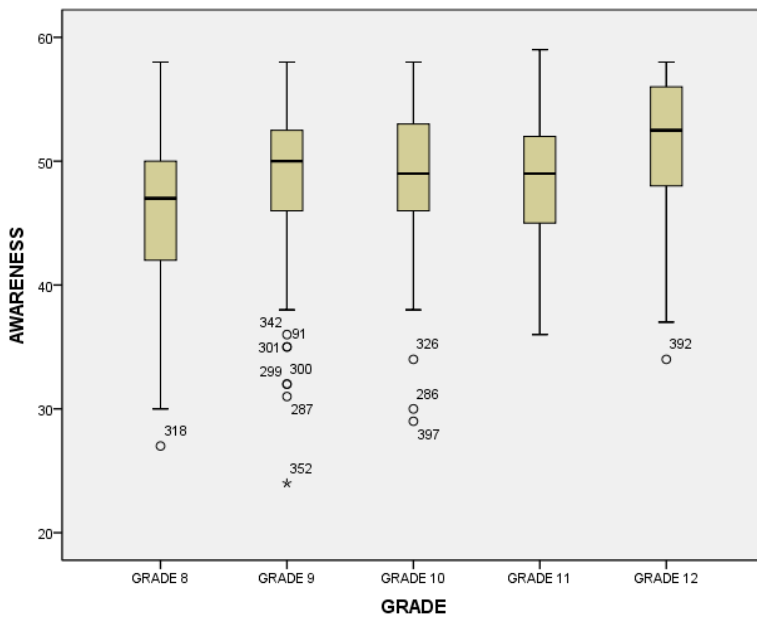
Figure 1: Distribution of students' age and *Awareness*



Establishing students differences by grade level

To determine differences between *Awareness* against the students' grade level, UNIANOVA was computed. The null hypothesis that the error variance of the dependent variable is equal across groups (Levene's test of equality of error variance) was accepted for *Awareness* [$F(4, 418) = 1.48, p = .208$]. The test of between subjects - effects revealed that there was a statistically significant difference between students' grade level and *Awareness* [$F(4, 418) = 4.82, p < .05$; partial $\epsilon^2 = .04$, Power = .95]. The *post hoc* analysis using Scheffe indicated that the difference was between students in Grade 8 and students in Grade 10 (see Figure 2).

Figure 2: Distribution of students' grade level against *Awareness*



Establishing students differences by grade level

To establish school type differences, independent samples t-test with equal variances assumed (Levene's test for equality of variances) was computed. The test for equality of variances was rejected [$F(1, 421) = 14.1, p < .05$]. Independent samples t-test indicated that the difference was statistically significant (see Table 4).

Table 4: Means, standard deviations and t-test results of Awareness against School type

Awareness	School	N	M	SD	df	t	p
	Public	250	47.2	6.5	421	3.51	0.000*
	Private	173	49.1	4.9			

* $p < 0.05$

Students' sources of information

Students were asked to rank different sources of information about pollution issues in the order that they preferred. Newspapers (24.5%) were reported to be the highest source of information, followed by school lessons (19.9%). At the other end, books (6.2%) as well as friends (6.3%) were the least sources of information (see Table 5).

Table 5: Students' rankings and percentages of their sources of information

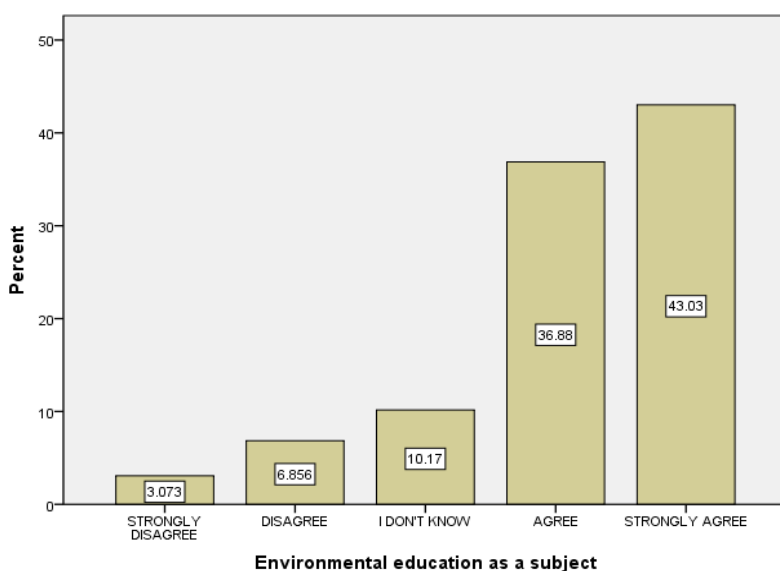
Sources	Ranking	%
Newspapers	1	24.5
School lessons	2	19.9
Internet	3	7.9
Television	4	7.7
Magazines	5	7.6
Radio	6	7.1
Parents	7	6.4

Extracurricular		
activities	7	6.4
Friends	9	6.3
Books	10	6.2

Environmental education as a standalone subject

Students were asked to express their views about introducing environmental education as a standalone subject in South African Schools. Majority (79.9%) of the students were of the view that environmental education should be introduced as a separate subject (see Fig 3)

Figure 3: Introducing environmental education as a subject



Discussion

There are four important aspects of the findings presented here. The first relates to the fact that no gender differences were established. This finding is in support of a study reported in India and Iran among high school students where there were no significant differences between males and females (Shobeiri, Omidvar, & Prahallada, 2007). This suggests that with children still at school, environmental awareness is important to both males and females. The second aspect relates to the fact that younger children seem to embrace and are more aware of environmental issues. This finding is consistent with a study conducted in Hong Kong reported that younger students expressed higher levels than older students (Yiu, 2004) Another important aspect of this finding is that private school students had higher levels of environmental awareness than the public school students. This finding is perhaps supported by the fact that a number of studies conducted elsewhere have reported similar findings (Hausbeck, Milbrath, & Enright 1992; Smith, Rechenberg, Cruvey, Magness, & Sandman, 1997; Tuncer , Ertepinar, Tekkaya, & Sungur, 2005).This could be because private

] schools by virtue of the finances they collect tend to have a lot of resources compared to public schools, which could be a mitigating factor for the findings reported here. In a sense this finding may be a socio-economic indicator of sorts because it revealed variance that could be attributed to financial matters.

Students were asked to rank their sources of information about environmental pollution in the order of importance. We reported that one-in-four revealed that newspapers were the main source. Further, we found that one-in-five students also indicated that school lessons were responsible for their environmental awareness. Students were also asked to express their views about introducing environmental education as a standalone subject in South African Schools. Our findings reported that majority (79.9%) of the students were of the view that environmental education should be introduced as a separate subject. This finding is comparable to a New York study's finding where 56% of students reported that they would like environmental education to be offered in schools (Hausbeck *et al.*, 1992). Similarly in Ireland where it was reported that environmental education should be taught as a separate, compulsory subject area in the secondary curriculum (Murphy, 2000). Considering that environmental concepts are only embedded in other subjects we argue that if these were to be put together and taught directly as a single subject then levels of awareness would be even higher. Further, the concepts as taught in other subjects should still remain however.

The implication of the results reported here should be of interest to education authorities. It is reported in this study that the younger students tend to be environmentally aware. Perhaps following more comprehensive studies the department of education may consider introducing environmental education as a subject as early as possible in South African schools. In fact it is argued that "Curricular and instructional strategies which effectively lead to the development of environmentally responsible individuals have not been implemented in our school systems" (Hines, Hungerford, & Tomera, 1986/87: 1). Further, it is opined that a solution to environmental problems will require environmental education, proper understanding and knowledge of it which has to be deeply incorporated in the education system at all levels of education (Shukla, 2001 as cited by Shobeiri, Omidvar, & Prahallada, 2007). We feel that this is extremely important because if children today are educated and aware of the impact environmental pollution has on plants, animals, the atmosphere, water and the soil then that would be the best legacy we can bestow on them. Also, by the time they are parents themselves it would be easier to inculcate environmental consciousness and responsibility on their children. We are encouraged however because there has been consultation from the government's side "... on how to strengthen the integration of environment and sustainability education into the teacher education programmes ..." (Department of Environmental Affairs, 2012). We feel that if environmental education is introduced in the training of teachers then in the near future young people in South African will have the prospect of caring for and protecting the environment around them.

In considering the findings reported here, it is worth acknowledging that one limitation of the study was the few schools and children that participated. The students were selected by their teachers. It

could be that they were selected because the teachers felt they would be more expressive on the matters investigated than their counterparts. This suggests that it would not be correct to generalise the awareness findings on all students from the coal mining town. The findings nonetheless provide baseline information that may be used as a basis for follow up studies on environmental issues affecting students in the coal mining environment.

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