

Students' and Teachers' Awareness of and Attitude towards Environmental Pollution: A Multivariate Analysis Using Biographical Variables

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ABSTRACT The purpose was through a multivariate analysis, to examine students' and teachers' environmental *Awareness* and *Attitude* in relation to selected biographical data. Participants were Grade 8 to Grade 12 students with ages ranging between 13 years and 23 years ($M = 16.5$ years, $SD = 1.8$) as well as their teachers with ages ranging between 23 and 57 ($M = 40.6$ years, $SD = 9.8$). All were from schools within a precinct of coal mines and electricity generating power stations; this being industry that characteristically releases large amounts of carbon dioxide into the air. The basis of this investigation was the researchers' argument that it is important for students in their teenage years to know and be aware of environmental matters because they will grow to be conscious and responsible adults who will take care of their environment. The researchers therefore determined the participants' biographical factors that had an effect on environmental *Awareness* and *Attitude*. An *Awareness* and *Attitude* scale comprising 24 - items on a 5 point Likert type format was administered to students and teachers in the first quarter of 2012. Among students, no gender effects were found however, significant effects with respect to age and *Attitude*, as well as grade level and *Awareness* were established. For teachers, on the other hand, no significant effects were established for all the biographical variables tested. More pleasing was that teachers had higher scores with respect to environmental *Awareness* and *Attitude* compared with their students. The researchers argue that these findings are important because it is the teachers who will hopefully pass the proverbial baton to their students, for them to embrace environmental issues in the air polluted area whence they reside.

INTRODUCTION

The 21st century has seen major developments in terms of industrialisation throughout the world. A resultant effect of this has been the movement of communities from rural areas to urban centres. The influx and concentration of people in certain parts of the world has meant that increased amounts of resources are consumed. Also, this influx has brought strain that has impacted negatively on the environment. For instance, all over the world fossil fuels such as coal and crude oil are still the main sources of energy. These movements of large numbers of people have impacted negatively on the environment. For instance, the demand for fossil fuels has meant that the world is producing unsustainable levels of carbon emissions that are affecting the environment. The negative impact on the environment has resulted in concerns

about climate change due to gaseous emissions as well as the effect pollution will have on water. Regarding the former, it is indicated that significant climate change may be expected due to the increase in the atmospheric concentration of carbon dioxide (Houghton et al. 1996). In respect of the latter meanwhile, water pollution is reportedly the second most affected environmental issue after air pollution (Gambhir et al. 2012)

Global warming and climate change issues have necessitated that leaders of major nations in the world take action that would address these problems. 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

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was held in Durban, South Africa. This high profile conference on pollution and environmental matters was the main motivation for the research study reported here. The motivation was from the fact that world leaders and interested parties were to visit South Africa. Specifically, the researchers felt it was opportune to establish students' and teachers' *Awareness* of and *Attitude* towards environmental pollution especially as they were from a coal mining area.

Awareness and Attitude

To provide a perspective of the importance of *Awareness* of and *Attitude* towards environmental pollution, some literature on these aspects is outlined. Researchers such as Hines et al. (1986/87) have reported that it is not known which variable or variables is most influential in motivating individuals into taking responsible environmental action. The theoretical basis for this paper was therefore gleaned from these authors, where the researchers wanted to determine the effect of environmental *Awareness* and *Attitude* on students and their teachers. Environmental awareness relates to the consciousness that individuals have and display toward what is happening around them. In fact it is pointed out that environmental awareness leads to individuals responding positively and taking better care of their environment (Laroche et al. 2001). On the other hand, environmental attitude is described as related to feelings toward aspects of the environment that individuals may have (Holahan 1982). Such feelings may be in favour of what is happening to the environment or they may be negative feelings based on what may not be happening to the environment. In a similar vein, attitude towards the environment is described as a combination of individuals' beliefs; affect related feelings as well as behaviour people display in respect of environmental issues (Newhouse 1990; Schultz et al. 2004).

In conducting this study the researchers were guided by literature reporting on teachers and how they handle environmental matters in their classrooms. For instance it has been reported that sometimes teachers fail to implement environmental related education or are not confident of developing creative programs and activities in their classrooms (Pudin et al. 2005). In a related manner it is indicated that some teachers only teach what they are comfortable with and avoid or give less attention to environmental matters they do not know (Krantz 2002).

The basis of this investigation was the researchers' argument that it is important for students in their teenage years to know and be aware of environmental matters. The researchers argue in fact that with awareness and positive attitudes, teenagers will grow to be conscious and responsible adults who will take care of their environment. It is actually reasoned that awareness, knowledge, and attitudes, are not only important for students' classroom experiences but are likely to have a positive impact throughout their lives (de la Vega 2004). The researchers included teachers here because they further argued that if they were not aware about or held negative attitudes toward environmental issues then students would probably hold similar views. The purpose therefore was to determine which biographical factors had an effect on environmental *Awareness* and *Attitude*. In doing this, the study's objectives were three-fold. Firstly, it involved determining whether the adapted questionnaire's results were reliable and valid. Establishing the reliability and validity was important because if these were not acceptable, any further analysis would not make sense. Secondly, to determine whether biographical variables had any effect on *Awareness* and *Attitude*. Here there were six questions relating to students and eight relating to teachers. The questions were:

1. Students

- a.* Is there a statistically significant difference between males and females with respect to *Awareness* of environmental pollution?
- b.* Is there a statistically significant difference between males and females with respect to *Attitude* towards environmental pollution?
- c.* Are there statistically significant differences among students' ages with respect to *Awareness* towards environmental pollution?
- d.* Are there statistically significant differences among students' ages with respect to *Attitude* towards environmental pollution?
- e. Are there statistically significant differences among students' grade levels with respect to *Awareness* towards environmental pollution?
- f. Are there statistically significant differences among students' grade levels with

respect to *Attitude* towards environmental pollution?

- * - The questions for teachers were the similar with regards to these biographical variables.

2. Teachers

- Are there statistically significant differences among teachers' teaching experience with respect to *Awareness* towards environmental pollution?
- Are there statistically significant differences among teachers' teaching experience with respect to *Attitude* towards environmental pollution?
- Is there a statistically significant difference between teachers' qualification specialisation with respect to *Awareness* towards environmental pollution?
- Is there a statistically significant difference between teachers' qualification specialisation with respect to *Attitude* towards environmental pollution?

Thirdly, to establish whether differences between students' scores and teachers' scores were different. In this regard, the two questions investigated were:

- Is there a statistically significant difference between students' scores and teachers' scores with respect to *Awareness* towards environmental pollution?
- Is there a statistically significant difference between students' scores and teachers' scores with respect to *Attitude* towards environmental pollution?

METHOD

Participants

The population comprised Grade 8 to Grade 12 students and teachers from nine public schools. This population equates to approximately 36000 students and 500 teachers. The rationale for choosing this population was the study site which was a coal mining area with associated industry that burns this fossil fuel for energy. Typical examples of the associated industry were foundries and coal fired electricity generation power stations. Importantly all the schools were in the vicinity of the industrial sites. The researchers randomly selected three schools

and within these the resulting sample of 250 students and 31 teachers was chosen. Random selection involved writing each school on a piece of paper and placing these on a box. The first author without looking inside then selected a school. This process was carried out three times in order to pick each of the schools finally in the sample. In selecting the students, in all 100 questionnaires were prepared for each school. As there were five grade levels (Grade 8 – Grade 12) per school, each was allocated 20 questionnaires. The schools allowed the researchers to administer the questionnaires in each grade level. Randomisation in this instance was achieved by giving the questionnaire to students who were about six or more desks from each other in a classroom. The process of selecting the teachers was similar to that of the students in that we gave the questionnaire to every third teacher in each school. This was possible because all teachers are expected to include issues relating to the environmental education in all subjects they teach.

Instrument and Procedure

To collect data, an *Awareness and Attitude Questionnaire* was used. The questionnaire solicited the same information from both groups. This questionnaire had two parts. The first part requested participants to provide demographic data such as age, gender, grade level for learners and teaching experience for teachers. The second part comprised 24 - items on a 5 point Likert type format measuring participants' levels of *Awareness* of (12 items) and *Attitude* towards (12 items) environmental pollution. The questionnaire was adapted from others exploring environmental awareness, knowledge and attitudes (Yilmaz et al. 2004); environmental attitudes (Bas et al. 2011); and environmental concerns (Hines et al. 1986/87). In developing the questionnaire 12-items related to environmental pollution *Awareness* and 12-items on *Attitude* towards environmental pollution were selected from instruments developed by the authors referred to earlier. In selecting the items the researchers first inspected the school curriculum for Grade 8 to Grade 12. This was because in South Africa environmental education is not a stand-alone subject but concepts related to environmental issues are mentioned in different subjects such as, geography, biology and life-orientation.

A typical *Awareness* item for example was: 'Human beings are severely abusing the environment.' On the other hand, an item on *Attitude* was: 'To protect our environment, renewable resources should be used to generate electricity instead of fossil fuels.' Participants registered their views on a five point scale anchored by 1 = Strongly Disagree and 5 = Strongly Disagree. The questionnaire included a section on demographic data such as age, gender, grade level. Additionally, teachers had to indicate their qualifications and teaching experience for instance.

Data Analysis

To analyse data, statistics including frequencies, percentages, means, modes, medians, standard deviations and percentiles were computed. Reliability was determined by computing the internal coefficient value of alpha (Cronbach 1951) including their confidence intervals (Barchard 2007; Feldt 1965). Also, statistical significant differences were computed between variables by using the t-test and analysis of variance (ANOVA) as well as among variable through multivariate analysis of variance (MANOVA). It should be pointed out that hypotheses related to these computations such as tests of equality of error variance and homogeneity of variance were determined.

RESULTS AND DISCUSSION

Biographical Data

A total of 300 questionnaires on *Awareness* of and *Attitude* towards pollution related issues were distributed among students while 60 were distributed to their teachers in three public schools in a coal mining town in Mpumalanga Province, South Africa. Two hundred and fifty (83.3%) were returned by students and 31 (51.6%) by teachers. A majority 135 (54.3%) of the students were females. All were in Grades 8 to 12 with ages ranging between 13 years and 23 years ($M = 16.5$ years, $SD = 1.8$). Among teachers on the other hand 18 (58.1%) were females with ages ranging between 23 and 57 ($M = 40.6$ years, $SD = 9.8$). Table 1 shows a more comprehensive biographical data of both learners and teachers.

Reliability and Validity of Scale Scores

For both students' scores and teachers' scores reliability was assessed by computing Cronbach's (1951) alpha (see Table 2). Alpha is a measure of internal consistency that is actually "...a function of the interrelatedness of the items in a test..." (Schmitt 1996: 350). The alpha value for students' scores for the *Awareness* and *Attitude* scale was .82 [95 % CI: $\alpha = .79$ to $\alpha = .85$] while that of teachers was .81 [95 % CI: $\alpha = .70$ to

Table 1: Biographical data of students (n = 250) and teachers (n = 31)

	<i>Students</i>			<i>Teachers</i>	
	<i>N</i>	<i>%</i>		<i>N</i>	<i>%</i>
<i>Gender</i>			<i>Gender</i>		
Male	115	46.0	Male	13	41.9
Female	135	54.0	Female	18	58.1
<i>Age in Years</i>			<i>Age in Years</i>		
13 - 15	73	29.2	20 - 35	10	32.3
16 - 17	112	44.8	36 - 51	14	45.1
18 +	65	26.0	52 +	7	22.6
<i>Grade</i>			<i>Qualification</i>		
8	71	28.4	Diploma	8	25.8
9	60	24.0	Bachelor degree	20	64.5
10	54	21.6	Honours degree or higher	3	9.7
11	47	18.8	<i>Teaching Experience</i>		
12	18	7.2	3 - 12	13	41.9
			13 - 22	11	35.5
			23 +	7	22.6
			<i>Specialisation</i>		
			Science	14	45.2
			Social science	17	54.8

Table 2: Alpha values and 95% confidence intervals for the Awareness and Attitude questionnaire as well as for the two subscales for students and teachers

	Students		Teachers	
	<i>á</i>	95% CI	<i>á</i>	95% CI
Awareness	.75	.70-.79	.79	.75-.83
Attitude	.74	.70-.79	.69	.64-.75
Total	.82	.79-.85	.81	.70-.89

$\alpha = .89$] (Barchard 2007; Feldt 1965). These two alpha values were good based on the rule of thumb “... $> .9$ – Excellent, $> .8$ – Good, $> .7$ – Acceptable, $> .6$ – Questionable, $> .5$ – Poor, and $< .5$ – Unacceptable” (George and Mallery 2003: 231).

To establish face validity, the questionnaire was given to two senior university academics, in the field of Environmental Education. The academics were briefed about its adaptation and its intended use. Each academic indicated that in their opinion the scale should measure what it was intended to, so we accepted its face validity.

Descriptive Statistics

Awareness and Attitude scores were determined from 12 items each. This means that scores ranged from a maximum of 60 to a minimum of 12. Table 3 shows the measures of central tendency including the 25th and 75th percentiles in respect of *Awareness and Attitude* (see Table 3). *Awareness* scores for students ranged from 24 to 59 ($M = 47.2, SD = 6.5$) while those of teachers range between 44 and 60 ($M = 53.4, SD = 4.3$). *Attitude* scores ranged from 24 to 60 ($M = 46.5, SD = 7.2$) while those of teachers ranged between 43 and 60 ($M = 53.2, SD = 4.8$).

Table 3: Measures of central tendency including the 25th and 75th percentiles in respect of the Awareness and Attitude for both students and teachers

		Mean	Median	Mode	SD	Percentiles	
						25	75
Students	Awareness	47.2	48.0	46	6.5	44.0	52.0
	Attitude	46.5	47.0	42	7.2	42.0	52.0
Teachers	Awareness	53.4	54.0	53	4.3	51.0	56.0
	Attitude	53.2	55.0	56	4.8	49.0	56.0

Biographical Effects on Awareness and Attitude

Students

Here, the researchers explored student differences in respect of *Awareness* and *Attitude* as against the biographical variables. This means that differences were determined in terms of levels of *Awareness* and *Attitude* against gender, age and grade level.

Student Differences by Gender

Initially the researchers tested the null hypothesis that group variances are significantly different. This null hypothesis was rejected because Levene’s test of equality of error variance was not statistically significant for *Awareness*, $F(1, 248) = 1.03, p = 0.311$ and *Attitude*, $F(1, 248) = 0.13, p = 0.91$. That is, the variances are not significantly different. Analysis of variance (ANOVA) computed to determine differences between each of *Awareness* and *Attitude* against students’ gender revealed that these were not statistically significantly different. This was in spite of the fact that females had higher *Awareness* and *Attitude* mean scores than their male counterparts (see Table 4).

Student Differences by Age

To determine differences between *Awareness* and *Attitude* against students’ age a one-way multivariate analysis of variance (MANOVA) was computed. A statistically significant multivariate main effect for age was established, Wilks’ $\lambda = 0.932, F(2, 494) = 4.394, p < 0.05, \text{Partial } \eta^2 = 0.03$ and the Power to detect the effect was 0.93. Given the significance of the overall test, the univariate main effects were examined. Here, as

$\gamma\lambda$

Table 4: Student gender distribution showing the mean and standard deviation, and F test in terms of Awareness and Attitude

Variables	Gender	M	SD	F	p	Partial ζ^2	Power
Awareness	Males	46.6	6.7	1.79	.182	.007	.266
	Females	47.7	6.2				
Attitudes	Males	45.6	7.4	2.83	.094	.011	.388
	Females	47.2	7.0				

* p < .05

the test involved the age and the two dependent variables, the significance level was set at $p < 0.025$ ($0.05 / 2$). Significant univariate main effects for age were obtained for *Attitude*, $F(2, 247) = 7.39$, $p < 0.001$, Partial $\eta^2 = 0.06$, Power = .94 (see Table 5). Levene's test of equality of error variance indicated that the variance was not significantly different, $F(2, 247) = 1.573$, $p = 0.210$. Based on this result Scheffe's *post hoc* was computed. This test indicated significant age pairwise differences in *Attitude* between 18+ years and both 13 – 15 years and 16 - 17 years. The mean *Attitude* scores were 48.5 (13 – 15 years), 46.7 (16 - 17 years), and 43.9 (18+ years).

Student Differences by Grade Level

Here the one-way MANOVA indicated a statistically significant multivariate main effect for grade level, Wilks' $\lambda = 0.9344$, $F(8, 488) = 2.11$, $p < 0.05$, Partial $\eta^2 = 0.03$, Power to detect the effect was 0.85. Once again the significance level was set at $p < 0.025$ ($0.05 / 2$). Significant univariate main effects for grade level were obtained for *Awareness*, $F(4, 245) = 3.09$, $p < .025$, Partial $\eta^2 = .05$, Power = .81 (see Table 6). Levene's test of equality of error variance indicated that the variance was not significantly different,

$F(4, 245) = 1.31$, $p = 0.265$ (*Awareness*). Scheffe's *post hoc* indicated significant grade level pairwise differences in *Awareness* between Grade 8 and Grade 12. The mean *Awareness* score for Grade 8 was 45.3 while that of Grade 12 was 50.6.

Teachers

A similar multivariate analysis to that of students was carried out here. Specifically differences were determined between the *Awareness and Attitude* and the teachers' gender, age, qualification, teaching experience and specialisation.

Teacher Differences by Gender

For each of *Awareness* and *Attitude*, Levene's test of equality of error variance was not statistically significant, $F(1, 29) = 0.006$, $p = 0.939$ (*Awareness*); $F(1, 29) = 1.979$, $p = 0.170$ (*Attitude*). Analysis of variance (ANOVA) revealed that there was no statistically significant difference between the teachers' gender and *Awareness*. However, a statistically significant gender difference was established with *Attitude* [$F(1, 29) = 6.60$, $p < .05$, Partial $\eta^2 = .18$, Power = .70]. It

Table 5: Summary of tests of between subject effects

Source	Dependent variable	F	p	Partial ζ^2	Power
Age	Awareness	3.081	.048	.024	.59
	Attitude	7.388	.001*	.056	.93

* p < .025

Table 6: Summary of tests of between subject effects

Source	Dependent variable	F	p	Partial ζ^2	Power
Grade Level	Awareness	3.09	.016*	.048	.81
	Attitude	0.119	.976	.002	.07

* p < .025

is noteworthy from Figure 1 that males had higher *Attitude* scores than their female counterparts.

Teacher Differences by Age

Here the multivariate main effect for age was not statistically significant Wilks' $\lambda = .90$, $F(6, 52) = .486$, $p = .816$, $\text{Partial } \eta^2 = .05$ and the Power to detect the effect was .18. Given the non-significance of the overall test, the univariate main effects were not examined. It was concluded therefore that age had no effect on the teachers' *Awareness* and *Attitude*.

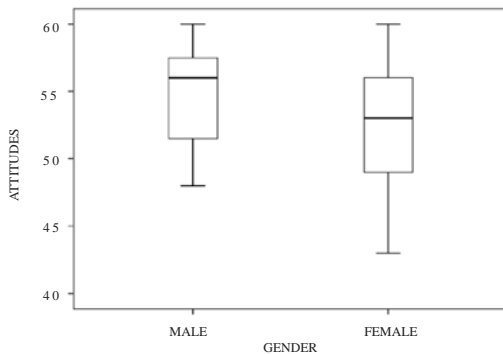


Fig. 1. Score distribution of *Attitude* in respect of gender

Teacher Differences by Qualification

Analysis of variance (ANOVA) revealed no statistically significant difference between the teachers' qualification with *Awareness* and *Attitude*.

Differences by Teaching Experience

Here the multivariate main effect for teaching experience was not statistically significant, Wilks' $\lambda = .919$, $F(6, 52) = .37$, $p = .893$, $\text{Partial } \eta^2 = .04$ and the Power to detect the effect was .15. Given the non-significance of the overall test, the univariate main effects were not examined. It was concluded therefore that teaching experience had no effect on the teachers' and *Attitude*.

Teacher Differences by Specialisation

Analysis of variance (ANOVA) computed to determine differences between *Awareness* and *Attitude* against teachers' specialisation re-

vealed that these were not statistically significantly different.

Differences between Students' Scores and Teachers' Scores

Differences were established between the students' *Awareness* and *Attitude* scores against those of their teachers' scores. The teachers had higher mean scores compared to their students. Paired samples t-test indicated that the mean differences were statistically significant (see Table 7).

Table 7: Paired samples test in terms of *Awareness* and *Attitude* including means and standard deviations for students and teachers

		<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
<i>Awareness</i>	Male	50.5	4.6	3.130	.003*
	Female	53.3	4.1		
<i>Attitude</i>	Male	49.1	6.3	3.227	.002*
	Female	53.3	4.4		

* $p < .05$

DISCUSSION

An important aspect about the scale used in this study is that scores from it were internally consistent and valid. This suggests that the findings in a sense should not be attributed to chance. The importance of these the findings with respect to *Awareness* and *Attitude* was that students' and teachers' gender was not a factor. This is consistent with that reported by Shobeiri et al. (2007). On the other hand, it was in variance with studies reporting females with higher levels than males (see Davidson and Freudenburg 1996; Shahnawaj 1990) and those reporting males with higher levels than females (see Tripathi 2000). With respect to age the researchers found that older students revealed lower levels of attitude compared to their younger counterparts. In a similar manner this was reported elsewhere (see Ma and Bateson 1999; Musser and Diamond 1999) while on the other hand it was found that it was older children who reported higher levels of environmental attitude than younger children (see Aminrad et al. 2010; Strong 1998). In terms of grade level it was found that students in Grade 12 had more awareness than those in Grade 8. A variety of findings have been reported with regards to grade level (see

Alp et al. 2006; Ma and Bateson 1999; Malkus and Musser 1997; Musser and Diamond 1999).

A pleasing aspect here is that teachers had higher scores with respect to environmental *Awareness* and *Attitude*. So teachers had better *Awareness* and *Attitude* compared to their students. Also, no differences were found irrespective of the teacher biographical variables. These findings are important because it is the teachers who will hopefully pass on the proverbial baton to their students, for them to embrace environmental issues in a coal mining area. Good awareness and positive attitude about environmental pollution are extremely important. This is because if people understand their environment in terms of how it works, then they will know when there are problems and what is required to fix these (Cook 1978/79). It is extremely important therefore that children especially should be aware of the great harm we are causing to the environment. When they have proper awareness and understanding of their environment it will go a long way in shaping their attitude. On the contrary if they are not aware and knowledgeable they will worsen the situation. An advantage of the awareness of and positive attitude towards the environment is that these will be passed on from generation to generation.

CONCLUSION

In this study, it is reported that the adapted questionnaire's results were reliable and valid. This, the researchers felt was an important aspect to determine because without being reliable and valid, the results would not be meaningful. In terms of the effects of biographical factors on *Awareness* and *Attitude*, the study reveals no statistically significant differences with respect to the gender of the students. Statistically significant differences were however established with respect to age and the grade students were in. For teachers on the other hand, it was found that the males had positive *Attitude* compared to the females. However, in terms of the teachers' age, teaching experience, and specialisation no statistically significant effects were established. Furthermore, it is reported that teachers' scores were statistically significantly higher than those of their students. Based on this study's findings it is concluded that teachers remain the key role players in advancing is-

ues related to awareness and positive attitude about the environment. The key role stems from the fact that teachers pass on environmental issues to the young who in future may turn up to be environmentally responsible adults.

Further, the world over, environmental issues are taking centre stage. It is important therefore that future generations should not inherit environments that are polluted or completely destroyed. It was reported here that younger learners had better scores than their older counterparts. It is recommended that investment in environmental education should be as early as possible in children's schooling. Such an investment is envisaged to have good long term spinoffs. Early education will ensure that children have a proper understanding and knowledge about the environment around them. The knowledge should be useful in changing perceptions of what affects the environment. Furthermore, investing in such knowledge as early as possible is critical, because it will take a lifetime of consciousness about caring for the environment.

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