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IS THE CURRENT ENVIRONMENTAL SCIENCE CURRICULUM PRACTICAL IN ENHANCING THE ENVIRONMENTAL AWARENESS OF OUR LOWER SECONDARY SCIENCE STUDENTS?*

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ABSTRACT

Government and schools are promoting environmental awareness which are targeted at mainly students. With environmental education incorporated into the science curriculum at the lower secondary, this paper reports on the knowledge and attitudes on environmental issues of these students. Three dimensions of environmental consciousness of students have been studied in this paper - the cognitive, the affective and the behavioural. The aim of this paper is to determine the effectiveness of this educational programme. Since the Secondary One students in 1993 (presently Secondary Two) were the pioneer batch to be taught environmental issues in their Science lessons, they were the obvious choice for study. The present Secondary One students who had yet to receive environmental education at the time of study were chosen as comparison. Different factors such as educational level and stream which might influence the students' extent of knowledge and attitudes were also investigated.

A total of 577 of the lower secondary Normal and Express stream students of two government schools were involved in this study. The methodology for investigation was through a survey. The results of this study have some important implications in the teaching of environmental science. These implications and some suggestions can help to improve and promote greater environmental awareness to our Singaporean children who will eventually face the environmental ramification of our action.

KEYWORDS: Environmental Education; Science Education.

INTRODUCTION

The surging advancement of the environmental movement in recent years has resulted in an unprecedented popularity of environmentalism. Due to its importance as an issue and high relevance to Science as a subject, schools have thus justifiably been a target of a number of environmental education programmes and campaigns.

With environmental education incorporated into the school curriculum and under the endless barrage of information on environmental issues by the public media, students have an unprecedented opportunity for access to information about environmental issues. However, there lies an inherent danger that environmental education might, like many subjects, become mere factual abstractions which are divorced from reality. In our meritocratic society, the paper chase highly advocates 'Rote Learning' as the easiest means to academic excellence. Environmental education if allowed to become nothing but answers to a set of examination questions would be meaningless for both our children and even more so, the environment.

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This project used a survey to investigate the knowledge and attitudes on environmental issues of Singaporean lower secondary students. It attempted to extend the study of Singaporean school children's knowledge and commitment to both global and local environmental issues undertaken by Lau (1992). It hopes to ascertain the progress made in developing students' environmental awareness since the infusion of environmental education into our school science curriculum. Three dimensions of environmental consciousness of students would be addressed in this paper - the cognitive, the affective and the behavioural and were investigated as follows :

- 1) To find out the *level of knowledge (cognitive aspect)* of students in Singapore schools towards specific environmental issue, global warming.
- 2) To find out the *level of attitude (affective and behavioural aspects)* of lower secondary students in Singapore schools towards environmental issues.
- 3) To discuss the following *factors* that might influence the level of knowledge and attitudes of these students as identified in (1) and (2):
 - i. *Educational Level*
 - ii. *Educational Stream*
- 4) To find out whether the implementation of the environmental components of the lower Secondary Science curriculum to the first batch of Secondary One students in 1993 (presently Secondary Two) had been effective in terms of their knowledge and attitudes level as compared to the current batch of secondary one students who had yet covered the topic.

METHODOLOGY

Samples

The Secondary Two students who had been taught the topic on "Clean Air is Everybody's Business" (Curriculum Development Institute of Singapore, 1993) were chosen for study. The present Secondary One students who had yet to be taught the topic at the time of study were chosen as means of comparison. Five hundreds and seventy-seven lower Secondary Normal and Express stream students from two government neighbourhood schools were involved in this study.

Though certain sections in the topic on environment were optional for the Normal stream students, all the Secondary Two students i.e. 1993 Secondary One students, under the study have been taught the topic assessed.

Instrumentation

A survey was chosen as the primary vehicle used in this study as a way of collecting information regarding the secondary students' knowledge and attitudes about environmental issues. To test the students on their knowledge and attitudes towards the environment, the survey was divided into two parts - *the knowledge subtest (Part I)* and *the attitude subtest (Part II)*.

Two popular global environmental topics were firstly considered in the design of the *knowledge subtest*. Global warming and Ozone Depletion will have devastating and direct effects on Singapore if the environmental situation worsens. Global warming will cause a rise in sea-level which may drown our island country and create frequent violent storms in our region. Ozone

depletion will cause excessive UV-radiation to enter the atmosphere and cause skin cancer and cataracts which is especially dangerous in an equatorial countries like ours where the sun is particularly relentless. Ozone depletion involves chemistry which may be too complex for the lower secondary students to fathom. Global warming, however, involves a mechanism which is analogous to the heating process found in a greenhouse which is why it is sometimes referred to as the "Greenhouse Effect". Thus Global warming may be easier for the students to understand than Ozone depletion which may require much more imagination. It was thus decided that the students' knowledge of global warming was to be tested in the first part of the survey as indication of their knowledge on the environment issues.

Table 1: The Knowledge Subtest Questions

| Question |
|---|
| 1. Describe what do you understand by "Global warming". |
| 2. Why is this process sometimes referred to as "Greenhouse Effect"? |
| 3. How do you think by creating Nature Reserves, eg. Bukit Timah, can help to reduce global warming? |
| 4. What major energy source is used by Singapore Power Plants to produce electricity? |
| 5. What kind of greenhouse gas is produced in the above process? |
| 6. How do you think by saving electricity in your home and school can help to prevent further global warming? |
| 7. What kind of fuel is used in cars? |
| 8. Name two greenhouse gases present in the exhaust fumes of cars. |
| 9. How will an uncontrolled increase in the population of cars in Singapore affect the global climate? |
| 10. How do you think the government's implementation of the whole day ALS and COE bidding has helped to reduce the amount of greenhouse gases produced? |
| 11. How will taking public transport eg. MRT, buses or car pooling help to reduce the amount of greenhouse gases produced? |
| 12. When global temperature increases, what will happen at the polar regions? |
| 12i. What is the process called? |
| 12ii. What will happen to the sea level if this happens? |
| 13. How do you think global warming will effect an equatorial island like Singapore? |

The knowledge subtest was made up of 13 open ended questions as shown in Table 1. This was to ensure that the answers were not a result of 'reckless' ticking of boxes or guessing which might occur in a multiple choice format. The questions were also designed to be inferential in nature. Answers to these questions were not simple and direct derivatives from textbooks. Some forethought and understanding of a particular environmental issue and its relevance to the context of Singapore were required to adequately answer these questions. The design of the questions was made in such a way that 'Rote Learning' without understanding on the issue by the Secondary Two students would not give them unfair advantage over Secondary One students who had yet to learn the issue but were interested enough about the environment to initiatively find out about it.

The *attitude subtest* was made up of 16 questions shown in Table 3a. It was designed in hope that it would provide the affective and behavioural dimensions of environmental consciousness. The questions explored the students' pro-environmental activities and concern for the environment. Thus unlike the knowledge subtest, the scope was chosen to be general in nature. Assessment of attitudes required a fuller range of environmental concerns and matters as environmental consciousness cannot be weighed only in a particular aspect but in all possible aspects. A combination of multiple choice and structured questions were used. Such a combination of formats could adequately explore the students' feelings and opinions on the environment.

The following were options found in the *attitude subtest* for different questions (See Table 3a for questions):

| Question No. | Options |
|--------------|--|
| Q1 to Q9i | Always; Sometimes; Never. |
| Q9ii | Newspaper/Magazine/Books; Television; Friends; Others, please specify: |
| Q10 | Government; Industry; You; All the above: Others, please specify. |
| Q11 to 12ii | Yes; No. |
| Q16 | Better than expected; Worse than expected; Same as the present. |

Procedure

The test was administered in February 1994 using a double period lesson (70 minutes). The subjects were told that the survey was part of the class lesson so as to ensure maximum effort was put into the answers of the students. Extra time was given for students who required more time to think and write their answers down to ensure that the answers truly reflected what the students thought and knew. The teacher performing the survey was there to assist any student with any problems they encountered in language and expression.

FINDINGS AND DISCUSSION

Level of Knowledge Based on Knowledge Subtest

The results of the knowledge subtest proved to be interesting but unfortunately extremely disappointing. The level of the students' knowledge on global warming was much lacking even for the Secondary Two students despite having been taught the topic. Out of 557 students, only 52, ie. 9% of the students managed to answer at least 7 out of the 15 questions.

Q's 1 and 2 were straightforward cognitive questions. Students who understood and knew what global warming was, basically would not have too much trouble answering them. As expected, the secondary two student fared better as they were taught the topic.

Q's 4, 7 and 13 were general knowledge questions which were used to find out the students' understanding of global warming in the context of Singapore. There was a surprising finding in Q4 in which the students were asked what kind of fuel was used to produce electricity in our power stations. About 17% of the students actually thought that hydroelectric power was used and another 14% thought that our electricity was begotten from solar energy. This finding sent home a message about the need for classroom instructions to be more comprehensive and relevant to the lives of the students.

Factors Influencing the Level of Knowledge

The different educational levels and streams of students were shown to be a significant influence on their ability to answer the questions. (Table 2)

Table 2: Average Score of Lower Secondary students from the Express and Normal stream who sat for the Knowledge Subtest. (Total score = 15)

| Stream \ Level | Average Score | | Total |
|----------------|---------------|---------------|-------|
| | Secondary One | Secondary Two | |
| Normal | 0.70 | 3.76 | 2.10 |
| Express | 3.41 | 4.96 | 4.31 |
| Total | 2.07 | 4.39 | - |

i) Educational Level (Secondary One Vs Secondary Two)

As shown in Table 2, the Secondary Two students scored considerably higher than their Secondary One counterparts. The average score of the Secondary Two was 4.39 compared to 2.07 of the Secondary One. Perhaps, environmental education in secondary schools had helped to elevate the level of environmental awareness and spurred some interest on the subjects. It must be reminded though this might be so, it had, however, fallen short of the environmental educators' expectations as indicated by the disappointing results of the Secondary Two.

ii) Educational Stream (Normal Vs Express)

The Secondary One Normal stream students scored dismally, answering an average of 0.70 question. The Secondary One Express stream students were able to answer an average of 3.41 questions though they were both not taught about global warming at the time of survey. It could thus be deduced that the students from the Express stream had greater exposure to environmental issues than the students from the Normal stream.

The Secondary Two students from the Normal stream though having scored less than the Secondary Two students from the Express stream, this difference in score was not as significant as that between the Secondary One of the two streams. It is also noteworthy that in Normal stream, the Secondary Two students scored 3.06 points higher than the Secondary One students while in the Express stream, the Secondary Two students scored only 1.55 points higher than the Secondary One students. The environmental education in school was more successful to the Normal stream students as it made a significant difference for them than the Express stream students. This was rather surprising as the Express stream students who were deemed to have higher learning abilities actually profited less from school teaching of environmental issues than Normal stream students.

Level of Attitude Based on Attitude Subtest

It was found that the students were more environmentally conscious despite their low level of knowledge shown earlier. This can be seen from the results of the attitude subtest in Table 3a & 3b.

Table 3a: RESULTS OF ATTITUDE SUBTEST

| No. | Questions | Options chosen by students | Number of Students in Percents | | | | |
|-----|---|-----------------------------|--------------------------------|--------------------|------------------|-------------------|---------------|
| | | | Sec. One (Normal) | Sec. One (Express) | Sec Two (Normal) | Sec Two (Express) | Overall |
| 1. | Do you use both sides of the paper when you photocopy? | Students who chose "ALWAYS" | 26 | 27 | 16 | 17 | 22 |
| 2. | Do you reuse old plastic bags or plastic bottles? | | 34 | 49 | 24 | 48 | 40 |
| 3. | Have you made use of the recycling bins found at petrol kiosks, schools and housing estates? | | 21 | 30 | 17 | 23 | 23 |
| 4. | Have you refused plastic bags when you buy small items? | | 20 | 18 | 19 | 22 | 20 |
| 5. | When buying things, is its environmental friendliness a major consideration? | | 20 | 33 | 30 | 26 | 27 |
| 6. | Do you make a conscious effort to save water and electricity in school and at home? | | 49 | 58 | 39 | 40 | 47 |
| 7. | Do you and your friends ever discuss about pollution, greenhouse effect, ozone depletion etc.? | | 7 | 8 | 4 | 7 | 7 |
| 8. | Do you worry about global warming, ozone depletion? | | 29 | 35 | 26 | 41 | 33 |
| 9i | Do you make an effort to know what is happening to our environment? | | 18 | 29 | 26 | 22 | 24 |
| ii | How do you learn what's happening through? | Majority's choice: | Books | TV & Books | TV | TV & Books | - |
| 10. | Who do you think should be responsible for taking care and saving the environment? Choices: government; industry; you; all of the above; none of the above | | All the above | All the above | All the above | All the above | All the above |
| 11. | Do you think you are doing your fair share to reduce the damage done to the environment? | Students who chose "YES" | 50 | 65 | 60 | 66 | 60 |
| 12. | Do you think the problems of global warming, ozone depletion, pollution can be solved by technology? | | 43 | 46 | 56 | 50 | 48 |
| 13. | Have you ever gone on a nature hike or gone on a bird watching trip in the bird Santuraries? | | 36 | 38 | 44 | 39 | 39 |
| 14. | If a new species of wild cockroaches is discovered at the site set for the construction of East Point in Simei and these cockroaches can only be found there in the whole entire world. Do you think that the construction of the multi-million building should be stopped to save the cockroaches? | | 36 | 56 | 44 | 55 | 48 |
| 15. | if global warming and ozone depletion can be prevented if everyone gives up modern technology, ie. no more cars or television, would you do it? | | 26 | 43 | 31 | 35 | 34 |
| 16. | In what state do you think the environment will be like in the future? | Students who chose: | | | | | |
| | | Better than expected | 48 | 45 | 35 | 30 | 40 |
| | | Worse than expected | 27 | 35 | 46 | 53 | 40 |
| | | Same as the present | 11 | 17 | 14 | 12 | 14 |

Table 3b: RESULTS OF ATTITUDE SUBTEST

| No. | Questions | Options chosen by students | Number of Students in Percents | | | | |
|---|-------------------------|----------------------------|--------------------------------|--------------------|------------------|-------------------|---------|
| | | | Sec. One (Normal) | Sec. One (Express) | Sec Two (Normal) | Sec Two (Express) | Overall |
| 1. | (See Table 3a) | Students who chose "NEVER" | 11 | 16 | 13 | 11 | 13 |
| 2. | | | 14 | 7 | 8 | 6 | 9 |
| 3. | | | 25 | 15 | 14 | 9 | 16 |
| 4. | | | 19 | 15 | 14 | 19 | 17 |
| 5. | | | 10 | 12 | 6 | 10 | 10 |
| 6. | | | 5 | 1 | 3 | 1 | 14 |
| 7. | | | 40 | 35 | 45 | 35 | 40 |
| 8. | | | 18 | 16 | 11 | 15 | 15 |
| 9i | | | 13 | 6 | 13 | 10 | 10 |
| Question 9ii and 10 (Refer to Table 3a) | | | | | | | |
| 11. | Students who chose "NO" | 38 | 30 | 31 | 28 | 32 | |
| 12. | | 41 | 51 | 41 | 45 | 45 | |
| 13. | | 44 | 61 | 53 | 59 | 54 | |
| 14. | | 49 | 39 | 47 | 41 | 44 | |
| 15. | | 52 | 52 | 60 | 59 | 55 | |

Q1 to Q6 assessed if the students took an active role in saving the environment. About 30% of all the subjects said that they were always and constantly doing environmentally friendly activities (Table 3a) while 13% did nothing to save the environment (Table 3b). While there was significantly more students who were actively pro-environment, this margin could be further improved. More environmental programmes could be targeted at the students to ensure that the students realise how their daily actions can affect the world.

Q7 to Q9 asked if environmental issues were real concerns in their daily lives and the extent to which they were willing to take responsibility for the environment. About 21% of the students constantly worried and made a conscious effort to know about the environment (Table 3a) whereas 22% admitted that the environment was not a major issue for them (Table 3b). Again, the results showed that more effort must be put into environmental education to encourage the pupils to voice their concerns about the environment and what they can do about them by discussing these issues in the classroom.

Q10 asked the pupils who they thought should be responsible for taking care and saving the environment. Fortunately, a great majority of the students agreed that industries, politicians and more importantly themselves were responsible for the job of saving our ailing world. This overwhelming majority, however, when it came to actually doing something, was reduced drastically as can be seen from the results of the first part of the subtest (Q1 to Q6).

Results from Table 3a, Q11 showed that about 60% of the students were doing a fair share to reduce the damage done to the environment. However, only 30% could muster up enough conviction to always do it as shown from Table 3a, Q1 to Q6. Thus it would be extremely helpful if our school environmental programme would explore into this area and help motivate them to do what they knew to be right.

Q12 asked the students if they thought technology could save our environment. It was the advent of technology and its overwhelming urgency to maintain its machines that had resulted in the dismal state of environment we were in. It measured how optimistic or pessimistic they were and how much they put their trust in technology. A slightly higher number of students thought that technology will indeed be the panacea to our environmental problems. This question corresponded to the results of Q16.

Results from Q16 showed that approximately equal number of students were split in their opinions as to whether they thought that the environment would be better or worse than the present. This indicated the personal outlook of the students on the future environment.

Results from Table 3b, Q13 showed that about 54% of the students had never in their lives participated in any Nature-appreciation activities which allows them to experience the wealth and knowledge Nature has to offer. Saving Nature's balance for these students may thus be seen as an abstract to them. This total lack of contact with Nature is dangerous as one must fully appreciate the wonders Nature has to offer to understand the pertinence and work up the dedication to save the environment. This is something that environmental programmes must address to allow students to appreciate Nature by organising nature hikes, bird-watching trips, etc.

Q14 asked if the students were willing to forego the luxuries of a major shopping mall to save a species of cockroaches. Despite the normal aversion to cockroaches, 48% were willing to do so as shown in Table 3a. However in Table 3b, Q15, when asked to give up cars and computers to save the environment, 55% were not willing to do so. The extent to which the students were willing to sacrifice to save the environment was definite. Sacrificing things that were essential to their normal life-style was the limit that they were not willing to cross even if the environment was worse.

Factors Influencing the Level of Attitude (See Tables 3a & b)

i) Educational Level

Based on the results shown in Q16, even though all the Secondary Two students felt that the environment was going to deteriorate (worse than expected), however, instead of playing a more active role in trying to save the environment, they did less for the environment as compared to the Secondary One students as shown from Q1 to Q6. It seems that the Secondary One students were leading a more environmentally friendly life-style than their Secondary Two counterparts, despite the Secondary Two students having been taught this topic in Secondary One (Q1 to Q6).

ii) Educational Stream

For both the Secondary One and Two levels, the Express stream students had shown a much healthier environmental attitude towards the environment as compared to the Normal stream. In almost all the questions on practical things they did to help reduce adverse environmental effects (Q1 to Q6), how much they claimed to worry about it (Q7 to Q9), to their outlook on the environment (Q16), they were significantly better than their Normal stream counterparts.

Results from Q9ii showed that majority of the Secondary One Normal students received their environmental education from books while those in the Express stream from books and television. For the Secondary Two Normal stream students, television was their source of information while

for the Express stream it included books and television as theirs. Based on the results of the knowledge subtest, having more sources of information proved to have a significant influence on their knowledge on environmentalism.

CONCLUSION

Cognitive Dimension

The knowledge of the students about the environment was very weak, much weaker than what was expected of them and what was intended when environmental education was introduced in school. Though there was improvement in the students' knowledge on the environment after they were taught environmental science in school, especially for the Normal stream students, this can be further improved across the levels. The students were in general concerned about the environment but were not aware of causes and processes of environmental destruction.

Affective and Behavioural Dimension

The students have stronger commitment to the environment than what might be suggested by the extremely superficial level of knowledge. The daily activities of a sizable part of the students did at one time or the other take its environmental effects into consideration. This should be further encouraged to ensure that it becomes in-built in their lives.

Educational Level and Stream influencing level of knowledge and attitudes

The Secondary Two students while surpassing the Secondary One students in knowledge, did less and were less concerned about the environment. The Express stream fared generally better in all areas of knowledge, actions and values than their Normal stream counterparts. Environmental education during lessons should thus help the students cultivate a more caring role in the environment to rectify the situation.

This study has shown that knowledge and attitudes towards the environment had little direct relationship. Possessing knowledge should never be an end in itself. It should be a mean to living a more environmentally life-style. This was unfortunately very much absent in the findings. However, knowledge seems to have direct relationship of proportionality with the outlook of the students. Students who were more knowledgeable had generally a more pessimistic view of the future environment, thinking that the environment of the future would be worse than the present situation. This is a dangerous trend because increased knowledge of environmental problems meant that more students become dispirited and felt helpless against these seemingly insurmountable problems. This is misplaced unconstructive pessimism. It is of paramount importance that the students learn that everyone must do their part for the environment, however insignificant they may seem to be. This problem if true should be immediately addressed to in our school's environmental programmes.

IMPLICATIONS

The teaching of environmental science in schools could be improved. Discussion with the students on how they feel about the present situation and the most important of lessons, teach them the value of collective environmental consciousness and give them a sense of hope for the future of the world. Discussions on environmental issues should be deeper and wider in scope that make their learning relevant to the students. Students should also be encouraged in schools to be exposed to more sources of information on environmental issues. Perhaps, review of both books and documentaries could be recommended as part of their assignments. Show how Singapore will be

affected by these problems and why it is imperative for them to care and actively participate in environmental preservation. It would be recommended that Nature appreciation trips to the Bird Sanctuaries, etc. be part of the curriculum to allow students to appreciate the nature.

This study could be further investigated with a bigger population from more schools. Further insights into the trends outlined in the study could be uncovered. Comparison of different faculties - Science, Arts, Technical and Commerce and the different educational streams - Gifted Programme, Special, Express, Normal and Normal Technical, should be made involved. The local universities, polytechnics, junior colleges and secondary schools can be surveyed for comparison. Age differences of these groups can also be studied. Such studies can serve to further refine the present syllabus of environmental education. It is important that our students receive a more comprehensive and practical environmental education for the future of our environment is at stake; not their examination results for its study.

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