GLOBAL TRENDS IN TEACHER EDUCATION: A STUDY OF CONTRIBUTION OF SCIENTIFIC APTITUDE AND SCIENTIFIC ATTITUDE TO DEVELOP ENVIRONMENTALLY SENSITIVE PRACTICES

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Abstract

This research paper attempts to explore the extent of which scientific attitude and scientific aptitude help in improving environmentally sensitive behavior among students. In this paper environmental practices pertaining to conservation of nature, control of noise pollution water conservation health and hygiene, energy conservation and limiting use of poly products have been taken into consideration. The sample consisted of 480 students who are studying in IX and X standards. It is found that scientific attitude is influencing environmental practices of children whereas scientific aptitude is not/ Curiosity and open – mindedness components of scientific attitudes do contribute in developing environment sensitive of behavior among secondary school students. Environmental practices that could be developed through scientific attitude are conservation of nature control of horse pollution and limited use of poly products.

Keywords: *Scientific Attitude, Environmental Practices, Secondary School Students*

INTRODUCTION

Developments in science and technology have not only made human living more comfortable but created several problems also to ecological balance and to the environment. Hence, science education should equip children to transform scientific knowledge into optimum utilization of science without affecting the environment. This could be achieved when inter and intra disciplinary approaches are practiced in science. Progress and development have become synonymous with the introduction of new technologies and products, aimed at making life better, safe and more viable. But there have been instances where apparently useful products and technologies have turned out to be capable of inflicting extremely detritus impact on environment and development in the long run. Many of the problems related to environment are largely 'due to lack of environmentally friendly application of science and technology. The interaction of humanity with its environment has grown over the last few decades with the exploitations of nature "on an' increasingly large scale causing detrimental effect on the ecological balance. Man has been the vital cause for this state of environment. Man being a single unit in the vast and complex eco-system is the only organism so totally committed in shaping his environment according to his selfish needs rather than adopting himself to the natural setting of the environment. The problem is that man's propensity to make development decisions is far more advanced than his ability to

understand his environment. Environmental problems like pollution, depletion of natural resources, erosion of top soil, deforestation and loss of bio-diversity are all the results of selfish attitude of man along with over and misuse of limited resources by increasing population. Man has created the situation for self-destruction.

Noll (1935) opined that the scientific attitude includes the following habits of thinking, viz. habit of accuracy in all operations, including accuracy in calculation, observation and report; habit of intellectual honesty: habit of open mindedness: habit of suspended judgement habit of looking for true causes and effect relationship and habit of criticalness including that of self-criticism. Caldwell and Curits (1943) suggested a list of scientific attitudes. They are curiosities to know about one's environment; the belief that nothing can happen without a cause and those occurrences that seem strange and mysterious can always be explained by natural causes. Sinha and Sinha (1982) arrived at fourteen areas that constituted scientific aptitude. They are experimental bent; clarity of definition; perception of causal relation: ability to reason and solve problems; detection of inconsistencies or intellectual conclusion; ability to reason and solve problems; detection of fallacies or misleading apparent plausibility's caution and thoroughness; accuracy of interpretation: accuracy of conversation; ability to generalize: ability to deduce conclusion from data provided: ability to differentiate the relevant and irrelevant data: capacity for independent thinking and capacity to detect new relationship. An environmental behaviour is “a behaviour adopted by an individual consciously attempting to minimise his or her negative impacts on natural and constructed environments (Kollmuss & Agyeman. 2002). This type of behavior, however although desired and researched by environmental educators is hard to develop because of the difficulty inherent in the behavioral change process. Several models have been proposed to try to identify the various factors of influence and describe the interrelationship among those factors. One of the first suggested models is of Ramsey and Rickson (as cited in Hungerford & Volk. 1990). It was based on the theory that, if people were well informed, they would become more aware of environmental problems and consequently. would be more motivated to act responsibly towards environment. However, the validity of this linear model was not recognized or supported for long (Burgess, Horison & Filuhs 1998; Hungerford & Volk). Hwong. Kim and Jeng (2000) classified the factor affecting environmental behaviours into three categories, cognitive, affective and situational factors. According to Pruneau (2006) cognitive, affective and situational factors influence an individual's pro environmental behavior. Cognitive factors correspond to an individual as degree of awareness and knowledge of the environmental and major ecological concepts, including the individuals own abilities and knowledge action strategies. Affective factors mostly involve emotions and feelings with environmental issues and ecological phenomena and generally include attitudes and personality traits. Situational factors are linked to an individual's (groups) situation and notably include economic and demographic constraints (e.g. social norms. education level. Prior action opportunities, gender).

NEED OF THE STUDY

The need of the study is to explore the contribution of scientific attitude and scientific aptitude in developing sensitivity towards environment among students of secondary schools, focusing on the current trends of global education within an aim to promote inquisitive mind though constructivist approach.

OBJECTIVES OF THE STUDY

1. To examine the components of scientific aptitudes among secondary school students.
2. To analyze the components of scientific attitude among secondary school students.
3. To find out the influence of scientific aptitude and scientific attitude on environmental practices among secondary school students.

SAMPLE

The Bhopal district is divided in 2 blocks. Total 455 secondary schools are situated in Bhopal district. Out of 455 secondary schools, 54 are situated in rural areas and 401 are situated in urban areas. In 455 secondary schools, 69 are government schools and 386 are private schools. Total 52,075 students are studying in Classes IX and X of secondary schools of Bhopal district. There are two blocks in Bhopal district, they are Berlsia and Phanda and both blocks were selected for the study. Out of these two blocks, the sample was selected using stratified random sampling technique. Researcher has taken three as strata into consideration for selecting sample. They are locality, type of school and sex. The sample consists of total 480 secondary school students drawn from both rural and urban areas and from private and government schools.

TOOLS

Three tools were used to measure Scientific Attitude. Scientific, Aptitude and Environmental Practices. Scientific Aptitude Test Battery: Scientific aptitude test battery developed by Agarwal .K.(1986] was used to measure scientific attitude of secondary school students. The test consists of four subtests. viz. reasoning, numerical ability test, science information test, science vocabulary test.

Scientific Attitude Scale: Scientific Attitude Scale was administered to secondary school students to know their levels of scientific attitude. This scale constituted six components namely, Rationality, Curiosity, Open mindedness, Aversion to superstitions, Objectivity of intellectual beliefs and Suspended judgments. Environmental Practices Scale: In order to measure environmental practices of secondary school students' environmental practices scale has been developed. The present tool as Environmental Practices Scale' purports to measure the environmental friendly practices of students in their daily life. There are six components in environmental practices scale. They are conservation of nature, control of noise pollution, conservation of water, human health and hygiene, conservation of energy and limiting use of poly products.

RESULTS AND DISCUSSION

In order to find out the influence of scientific aptitude and scientific attitude on environmental practices, secondary school students were divided into five categories of very high, high, Moderate, low and very low on the basis of their scores on scientific aptitude test battery and scientific attitude scale. The classification was made on the basis of sigma units M ±1.50σ, M ±0.5σ. The sigma interval were 1.5 σ to ∞; 0.5 σ to 0.5 σ - 0.5 σ , -1.5 σ to -0.5 σ; and - ∞ to -1.5 σ for very high; high; moderate; low; and very low categories of scientific attitude Respectively. Similar classification was carried out for components of scientific aptitude and scientific attitude. Analysis variance was carried out to know the influence of scientific aptitude and scientific attitude and their components on environmental practices.

SCIENTIFIC APTITUDE AND ENVIRONMENTAL PRACTICES

On the basis of analysis of variance carried out, no significant effect of scientific aptitude on environmental practice's of secondary school children ($F = 0.86$. $P > 0.05$) was evident. Hence it can be said that there was no significant difference betweenstudents belonging to different categories of scientific aptitude in respect of environmental practices. It may be inferred that scientific aptitude of students does not help to sensitize environment friendly behaviour through their daily practices.

COMPONENTS OF SCIENTIFIC APTITUDE AND ENVIRONMENTAL PRACTICES

Students belonging to different categories of reasoning ($F=0.44$, $p>0.5$), numerical ability ($F=1.89$. $p>0.05$); science information (F:1.91, $p>0.05$) and science Vocabulary ($F=2.22$, $p>0.05$) do not differ significantly in respect of their environmental practices; From this it was evident that students' logical thinking, reasoning ability, ability to solve mathematical problems and knowledge in science do no help in improving their environmental friendly practices.

SCIENTIFIC APTITUDE AND COMPONENTS OF ENVIRONMENTAL PRACTICES

The results of analysis of variance indicated that the contribution of scientific aptitude was evident only in limiting the use of poly products ($F=2.69$. $p<0.05$). The contribution of scientific aptitude was not evident for other components of an environmental practices, namely conservation of nature ($F=2.02$, $p>0.05$), control of noise pollution ($F=I.78$. $p>0.05$), water conservation ($F=l.11$. $p>0.05$), health and hygiene ($F=1.09$, $p>0.05$) and conservation of energy (If;2.03, $p>0.05$).

ISSN : 2394 - 9430

Table 1
Values of 't' between different Categories of Scientific Aptitude in respect of limiting use of Poly Product

	High	Moderate	Low	Very Low
Very High	0.68	0.60	1.25	0.18
High		0.17	2.35*	1.68
Moderate			2.64**	1.62
Low				0.92

**p<0.01 p< 0.05

Students with low scientific aptitude do differ significantly with their counterparts belonging to high and moderate categories in respect of environmental practices in limiting use of poly products. On examining the means it is found that mean of students belonging to low scientific aptitude (AM=5.46) is less than their counterparts belonging to high (AM=:5.86) and moderate (AM=5.83) in respect of limiting use of poly products. It may be inferred that students of all categories of scientific aptitude are having higher level of practices in limiting use of poly products. Hence students with high and moderate scientific aptitude were better in limiting the use of poly products than their counterparts with low scientific aptitude.

SCIENTIFIC ATTITUDE AND ENVIRONMENTAL PRACTICES

Analysis of variance indicated a significant effect of scientific attitude on their environmental practices ($F=3.52$, $p < 0.01$). This indicates that there was a significant difference between students belonging to different, categories of scientific attitude in respect of their environmental practices. Variations in students' curiosity, Rationality, judgement, open-mindedness and objectivity may likely to explain the variations in their environmental sensitive behaviour. Students environmental friendly practices in their daily life vary how scientifically they obtain evidences in accepting phenomena and these obtained evidences may be seen in terms of curiosity, rationality, judgement, open -mindedness and objectivity.

Table 2
Values 'of 't' between Categories of Scientific Attitude in respect of Environmental Practices

	High	Moderate	Low	Very Low
Very High	2.71**	2.66**	3.28**	3.13**
High		0.26	0.83	1.61
Moderate			1.15	1.76
Low				0.44

0.44**p<0.01

It was evident that students with very high scientific attitude do differ from their counterparts belonging to high, moderate, low and very low categories in respect of environmental practices. Whereas there is significant difference between high, moderate, low and very low categories of scientific attitude in respect of environmental practices. Further, it is found that these differences were in favour of students with very high scientific attitude as its mean (AM=59.55) was higher than the mean values of students belonging to other category, namely, high (AM=55.28). moderate (AM=55.56) low (AM=54.29) and very low (AM=51.54). On examining the means, it is noticed that environmental practices of students have been in a descending trend from very high through moderate to very low categories of scientific attitude. This may be due to the reason that higher level of scientific attitude sensitises students to imbibe environmental friendly practices in their day-to-day life.

Components of Scientific Attitude and Environmental Practices

A significant difference between students belonging to different categories of curiosity ($F=2.82$. $p<0.05$) and open mindedness ($F=2.93$, $p<0.05$) was found in respect of their environmental practices.

Further, there was no significant difference between students belonging to different categories of rationality ($F=2.23$, $p>0.05$) aversion to superstitions ($F=l.48$, $p>0.05$), objectivity to intellectual beliefs ($F=l.01$, $p>0.05$) and suspended judgement ($F=1.93$. $p>0.05$) in respect of their environmental practices.

Probable explanation to variations between students belonging to different levels of curiosity in respect of their environmental practices might be that students with different levels of characteristics like desire for completeness of knowledge and understanding new situation have different types of environmental friendly practices in the field of control of noise pollution, health and hygiene, conservation of nature, water conservation and emery conservation. This means that students' environmental friendly practices vary how much they are curious in accepting evidences. Variations among students belonging to different level of open mindedness in respect of their environmental practices might be attributable to their willingness to revise opinions and conclusions and having rejection of rigid approaches have different levels of practices to save our environment. It means that environmental practices of students depend on how much open-minded they are to change their opinions.

As regards curiosity, it was found that students with very low curiosity do differ from their counterparts belonging to very high, high, moderate and low categories in respect of environmental practices. Further, it was found that these differences were not in favour of students with very low curiosity as their mean was less (AM=51.39) compared to their counterparts with very high (AM=56.96), high [AM=56.46), moderate (AM=55.04) and low (AM=55.41) curiosity. From this, it was evident that the students with very low curiosity were having less environmental friendly practices. Further. As

regards open- mindedness, all the values of "t" were found to be not significant except between very high and low; very high and very low and moderate and low categories. On examining the means it is noticed that means were in descending order from very high (AM=58.37), high (AM=55.14) through moderate (56.10), low (AM=53.88) to very low (AM=52.29) categories of open-mindedness in respect of environmental practices. Students with very, high level of open-mindedness do posses high level of environmental practices.

Table 3

Values of 't' between different Categories of Curiosity in respect of Environmental

Components	Open-mindedness					
	Category	Very High	High	Moderate	Low	Very Low
Curiosity	Very High		1.90	1.36	2.63**	2.41*
	High	0.25		0.92	1.14	1.31
	Moderate	0.96	1.42		2.09*	1.75
	Low	0.73	0.85	0.30		0.73
	Very Low	2.37*	3.14**	2.28*	2.31*	

**p<0.01 *p<0.05

So it may be inferred that open-mindedness of students do help in improving environmental practices. On the whole we can say that curiosity and open-mindedness components of scientific attitude do influence environmental practices. Whereas the other components of scientific attitude like rationality, free from superstitions, objectivity to intellectual beliefs and judgement do not influence environmental practices. It means that students have high desire for understanding new things and ideas and willingness to revise opinions and conclusion were better in environmental friendly practices.

SCIENTIFIC ATTITUDE AND COMPONENTS OF ENVIRONMENTAL PRACTICES

A significant difference between students belonging to different categories of scientific attitude was observed from the analysis of variance in respect of conservation of nature (F=3.60, P<0.01), control of noise pollution (F=3.75, p<0.01) and limiting the use of poly products (F=4.18, p<0.01). Influence of scientific attitude was not evident in respect of environmental practices such as water conservation (F=1. 12 p>0. 05) health and hygiene (F=1.28, p>0. 05) and energy conservation (F=2. 18, p>0.05). As values of 'F' were significant for three components of environmental practices [conservation of nature control of noise pollution and limiting the use of poly products), t-test is carried

out to know the significance of difference of means between the categories of scientific attitude.

Table 4

Values of 't' between different Categories of Scientific Attitude in respect of Conservation of Nature Control of Pollution and Limiting use of Poly Products

Components	Control of Noise Pollution Limiting use of Poly Products (Values in parentheses)					
	Categories	Very High	High Low	Moderate	Low	Very Low
Curiosity	Very High	2.88** (0.70)	1 (0.70)	2.90** (1.00)	3.37** (2.30)	2.51*
	High	1.40		0.42 (0.00)	0.45 (3.07**)	0.08 (3.57**)
	Moderate	2.83**	1.63		1.08 (2.82**)	0.39 (3.57**)
	Low	3.23**	2.23*	0.50		0.23 (1.99**)
	Very Low	3.07**	2.40*	1.59*	1.38	

**p<0.01 *p < O .05

With regard to conservation of nature it was found that students with very high, scientific attitude do differ significantly from their counterparts belonging to moderate, low and very low categories.

Further students with high scientific attitude do differ significantly from their counterparts belonging to low and very low categories. On examining the means a descending trend was noticed among students belonging to very high (AM:14.29) high(AM:13.66) moderate (AM=13. 0'7), low (AM=12.90) and Ivory low (AM=11.92) Categories of scientific attitude.

As regards control of noise pollution, it was found that students with very high scientific attitude do differ from their counterparts belonging to high, moderate, low and very low categories. Further. It was found that students with very high (AM=8.89) scientific attitude exhibited better practices in controlling noise pollution compared to their counterparts belonging to high (AM=7.58), moderate (AM=7.70), low (AM=7.44) and very low (AM=7.54) categories.

As regards limiting the use of poly products, it was found that students with very low

scientific attitude do differ significantly from their counterparts belonging to very high, high, moderate and low categories. Further students with low scientific attitude do differ significantly from their counterparts belonging to high and moderate categories. 0n examining the means it was found that students with very low (AM=4.92) scientific attitude were not sensitive to minimize the use of poly products compared to their counterparts belonging to very high (AM=5.68). High (AM=5.85), moderate (AM=5.85) and low (AM=5.44) categories.

FINDINGS

It was found that neither scientific aptitude nor its components significantly influence environmental practices of secondary school students. With regard to influence of scientific aptitude on components of environmental practices scientific aptitude had significant influence on limiting use of poly products. Further students with higher scientific aptitude were found to be better in minimizing the use of poly products when compared to their counterparts belonging to other categories.

There was a significant influence of scientific attitude on environmental practice of student. Values of means of environmental practices are in a descending trend from very high to very low categories of scientific attitude. The environmental practices of students with higher levels of scientific attitude were more environment friendly compared to students with lower levels.

With regard to components of scientific attitude, curiosity and open-mindedness were significantly influencing environmental practices of secondary school students. Students with higher levels of curiosity and open-mindedness were found to be more sensitive to environment in their practices.

Further, contribution of scientific attitude was evident on three components of environmental practices namely conservation of nature control of noise pollution and limiting use of poly products. Students with higher levels of scientific attitude were found to be more environmentally sensitive in conservation of nature, controlling noise pollution and in limiting poly product usage.

CONCLUSIONS

In these days of enormous ecological imbalance caused due to social and scientific factors, there is a danger for environment.

This research paper examines the contribution of scientific attitude and scientific aptitude in developing environmentally sensitive practice. On the basis of findings of the study following conclusions may be drawn.

Scientific attitude of secondary school students does facilitates improving environmental practices. Only two components of scientific attitude (curiosity and

open- mindedness do help in increasing environmental practices among secondary school students. Environmental practices of secondary school students may be more among these students who have willingness to revise opinions and conclusions and have a desire for completeness of knowledge and new ideas. Students" environmental friendly practices in the field of nature conservation controlling noise pollution and limiting use of poly products may be more among those secondary students who have better scientific attitude. From the finding of study, it may be concluded that only curiosity, one of the component of scientific attitude do predict environmental practices. Though open-mindedness is influencing the environmental practices, it is not acting as a predictor of environmental practices of secondary school students. This indicates that students belonging to different levels of open mindedness (very high to very low) have different levels of environmental practices and this difference is in favors of students with very high level of open-mindedness. However, these differences are not contributing to consider open-mindedness as a predictor of environmental practices.

EDUCATIONAL IMPLICATIONS

Realizing the importance of preparing younger generations to protect environment and maintain ecological balance for harmonious and healthy living free from hazards of natural calamities. School science curriculum from time to time emphasizing the need for promoting environmental awareness as well as attempting to develop environment friendly behavior. Findings of this paper focus on certain pertinent indicators that could help in cherishing the objectives of science curriculum in sensitizing children to environmental issues and in turn manifesting these sensitivities to practice. As it was found that scientific attitude curiosity and open-mindedness seem to have significant influence on environmental practices (conservation of nature, control of noise pollution and limiting use of poly products), this paper ventilates some pertinent implications to school science curriculum.

1. Establishing Linkage between Science and Environment

This can be achieved if school science curriculum is feasible to provide adequate opportunities to children in applying science to environment. School curriculum should help children in recognizing the consequences. both positive and negative, of science to environment and probable ways of preventing the negative effects. Recent school curriculum documents emphasized the need for cultivation of curiosity and focused on linking science curriculum to environmental issues. National Curriculum Framework (2005) has aptly pointed out that child should be engaged in joyful exploration of the world around and harmonize with it at primary stage.

2. Development of Scientific Attitude:

There should be an inbuilt provision in school science curriculum where children could change their opinions basing on evidences arrive at judgment basing on facts, be free from superstitious beliefs, cultivate habits of thinking so on that would help in developing scientific attitude. With a view to make science education time to child, true

to life and true to science, NCF (2005) evolved six criteria of validity of a science curriculum among which environmental validity is one, that places science in the wider context of the learners environment enabling them to appreciate the issues at the interface of science technology and society.

3. Providing Learning Situations to develop Curiosity and Open-mindedness:
Gone are the days where science is viewed as a routine curricular subject that helps in achieving professional excellence and career growth. Ulterior purpose of learning science is to develop curiosity and open-mindedness, two important components of scientific attitude. Science teaches should not leave any opportunity that could activate curiosity and open-mindedness while transacting science curriculum. NCF (2005) envisaged that objectives of science curriculum at primary stage as nurturing curiosity of the child about the world (natural environment, artifacts and people), engaging child in exploration for developing cognitive skills through observation, classification, inference etc.

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