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Environmental Pollution-Specific Science Concepts Among The School Students of West Bengal

KEYWORDS: Conjunctive concepts, Environnemental pollution, Environment-specific Science concepts, Polluted zones & Non polluted zones.

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ABSTRACT *The explanation of the causes of pollution in environment and their minimization mainly depend on science. To enable the students to give such explanation, learning of concepts common to both environment and science is important at the school stage. To investigate whether such concept learning differs significantly according to the characteristics of students (sex) and the location (polluted and non polluted zones) of the schools they study in, the researchers have designed the present study. Since enactive stage (as per J. Bruner) of environmental education almost ends in the upper primary level, the class VIII students have been considered as the population of the study. A sample of 1063 students of both sexes and schools located in polluted and non polluted zones of length and breadth of West Bengal has been considered. Findings: Locations of the schools whether in polluted or non polluted zones make no difference in the concepts scores of the students. However, boys and girls significantly differ in the concept scores. The interaction(as obtained from ANOVA) between sex and location is significant showing that boys and girls of different locations of their schools also differ in environment-specific science concepts.*

After the Belgrade Charter (1975), effort was taken worldwide to include environmental education at school level. Environmental Education at school level in India became an integral component of education for all ages and levels in the National policy on Education in1986. School curriculum included teaching of Environmental Studies for the primary stage of schooling. At the upper primary stage Environmental Studies was merged with teaching of science and social studies(Saxena, d.n.f.).According to NPE(1986), in primary education 'environmental education(EE)'involved observations and classification of surroundings. EE covered a study of major composition or structure of environment along with some notes on environmental pollution in connection with maintaining and development of health. In upper primary and secondary stages there was no exclusive discussion on environmental education but there were some plug points in science and social science to transact Environmental Education in National and State levels particularly in West Bengal (WB). This process continued till 2005 in WB. At the time of revision of Curriculum in 2005 under WBBSE, some chapters of environmental education were included in both physical science and life science in more comprehensive, relevant and integrated way. Social part of the environment was included in the social science. Thereafter, under the orders of Supreme Court in 2003, NCERT developed curriculum for compulsory Environmental Education for all stages of school Education. EE thus introduced as a separate discipline burdened the already loaded school curriculum. National Curriculum Framework(NCF)-2005 recommended integration of natural part of Environment with science curriculum. Recently (2011) under WBBSE the disciplines: physical science, life science and environmental education have been replaced by a single interdisciplinary subject 'Science and environment'. The corresponding text books have been developed with constructivist approach. In whichever way science and environment are presented in schools, knowledge of one cannot be completed without other. As science in the primary education is based on observation and classification of immediate surroundings, the children at this stage get knowledge about biotic and abiotic environment with a particular emphasis on understanding of the surroundings, symbiosis operating among them and their relation with the children themselves.

At Upper Primary level the students have to learn science through environment by performing observation, experiment, group activities and co-curricular activities (NCF-2005,p48). Students learn abstract concepts in science in a concrete way by using different processes and structures of environment through an approach which is called 'infusion approach'(Sasikala; 2014) or integration approach. In turn, through science teaching, they understand the nature of the environment, its harmony or ecosystem and causes of imbalance resulting in pollution.

Environmental Education is basically an interdisciplinary subject comprising natural and social sciences. Explanation of causes of pollution largely depends upon science. For meaningful learning of both Environment and its pollution a cognitive consonance or coherence is necessary between the concepts of both environment and science. Concept reveals the salient features of different terms used in both science and EE. Gagne(1979, as reported in Mangal & Mangal ; 2009, p183) in his hierarchical theory of instruction placed concept learning at an important position. On understanding the features of concepts connecting science and environment, a student can easily find the correspondence between environment and science, their relationship, environmental pollution and its minimization etc. The students, therefore, become able to find the plug- points of environment embedded in science and vice versa. Concepts included in the curriculum up to upper primary level in science and EE, mostly comprise some joint characteristics or features. Such concepts were denoted by Bruner (1956) as conjunctive concepts. This type of concepts is easier for the school students to learn (Tom Ciborowski & Michael Cole, 1973). These common concepts help to in-

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tegrate science and environmental studies together which may help downsize the curricular load of science and education in schools (NCTE, New Delhi: 2005, pp-20&31).

Emergence of the Problem:

Science at upper primary level should be learnt through environment. If science is properly correlated with environment at the time of teaching and learning, both science and environment might be understood more clearly. The salient features of science concepts related to environment could be more easily identified by the students. In Environmental Education what concerns the most Indian pupils is pollution: pollution of air, water and soil. Pollution is a relevant component of Environmental issues and often having its root in poverty, ignorance & superstitions of people of a country. NCERT in its National Curriculum for Elementary and Secondary education: A Framework (1988) observed, "The school curriculum should highlight the measures for protection and care of environment, prevention of pollution and conservation of energy". Concept of pollution ranges from dust and mud to the nuclear fallout from atomic wastes. India, due to her large population and poverty has easily been vulnerable to pollution. The best way to control pollution is to make the students aware of pollution and their harmful consequences in public life while they learn science. Such concepts of pollution may concern: sources of pollution, causes of pollution, prevention of pollution, removal of pollution & development of environment. These concepts, if suitably presented before students, might help them correlate science and environment, and hence integrate the two subjects in a meaningful way(Reddy & Reddy:2002,p228). Such correlation and subsequent integration may not be identical for all schools or at all places or for all groups of pupils. It may so happen that the students living in the polluted zones could like to learn some concepts which may not be same with those living in no polluted zones. A plenty of researches on environmental studies for different levels of education have been reported, but very few on the concepts of environmental pollution. Senapati & Sahoo (2009) studied the knowledge of environment and environmental pollution –their understanding, causes and consequences. Saxena (2009) made a study on the concepts of pollution of the primary grade students. The students of polluted zones(or location) have to suffer due to pollution and as such their awareness, concepts and reaction to their environment might be different from the students of pollution free regions. Saxena's study was mainly related to primary institutions. Moreover pollution-related works on school education are not adequately available at this point of time in West Bengal. No study seems to have been reported as yet in this direction particularly for secondary /upper primary school students. So some questions as yet remain unanswered: (1) Do the Boys and Girls of West Bengal Schools differ in concepts related to environmental pollution? (2)Do the students of West Bengal schools located in polluted and non polluted zones differ in Science concepts related to environmental pollution?

In this perspective present authors like to undertake a study on the concepts bridging science and environmental pollution to see whether the school students of West Bengal differ in concept scores due to difference in sex and difference of locations of schools as regards environmental pollution. A study have been, therefore, considered on 'Environmental Pollution-Specific Science Concepts among the School Students of West Bengal'

Statement of the Problem: Generally people are more sensitive to their local problems. The same is expected from the school kids also. Environmental pollution is a great hazard now -a -days. The school children learn it from their daily experience as well as from their study of science. Further habits and activities of the girls and boys do not always match. So in this problem the investigators intend to find the difference, if any, among (i) the boys and girls and (ii) the students of polluted and pollution free zones as regards pollution-specific science concepts. In this problem, therefore, the variables are: gender, locations of schools& concept scores.

DEFINITION OF TERMS:

Polluted and non-polluted zones (locations):

The area having high density of population and polluting industries with low density of number of trees and plants are generally treated as polluting zones. Moreover the absence of lichens and moss on trees or old buildings has been taken as another indicator of such zones. Industrial areas of WB generally come under this zone.

Nonpolluting zone means zones where pollution is far below the danger level and where the lichens and moss are visible at larger extent (Santra, 2001). North Bengal districts and the rural belts of South Bengal mostly belong to such zones.

OBJECTIVES:

1. To compare the students of secondary schools (upper primary) gender-wise on the environmental pollution – specific science concepts
2. To compare the environmental pollution -specific science concepts of the students of secondary schools(upper primary) located in polluted and non-polluted zones of WB

NULL HYPOTHESES:

H_{01}: The boys and girls do not differ in mean scores in environmental pollution-specific science concepts

H_{02}:The students of polluted and non-polluted zones do not differ in mean scores in environmental pollution-specific science concepts

H_{03}: The boys and girls of polluted zones do not differ in mean scores in environmental pollution-specific science concepts

H_{04}:The boys and girls of non-polluted zones do not differ in mean scores in environmental pollution-specific science concepts

H_{05}:The boys of polluted& non polluted zones do not differ in mean scores in environmental pollution-specific science concepts

H_{06}:The girls of polluted & non-polluted zones do not differ in mean scores in environmental pollution-specific science concepts

METHODOLOGY:

Population of the study: Students of class VIII passed under WBBSE in Bengali medium schools are considered for this study. Class VIII is the terminal stage of upper primary stage up to which students mostly learn about environment through activity and observation and up to this stage science and environment are interwoven.

Sample of the study:

Sampling:

As Polluted Zones (P zones) of West Bengal containing large densities of industries were identified as Kolkata, Howrah, South 24 Parganas, North 24 Parganas, Hooghly, East Midnapur and Burdwan of which three districts have

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been randomly chosen for the study. As non-polluted (NP) zones three districts of North Bengal have been randomly considered. The schools of the concerned districts were selected randomly (Table-1) with the following restrictions: Schools were selected from polluted& non polluted zones, whose % of passes in first division in Secondary Final examinations was between50 to 75% for the last three years.

In all 1063 students were selected from these schools (Table-2).The cell-wise distribution of students of polluted and non-polluted zones is shown below.

Table-1: Zones vs. Schools

Zones of Schools	Boys' schools	Girls' schools	Total No. of schools
P zone	3	3	6
NPzone	3	3	6
Total No. of schools	6	6	12

Table-2: Zones vs. Students

Zones of Schools	No. of Boys	Girls	Total No of students
P zone	301	243	544
NPzone	180	339	519
Total No.of Students	481	582	1063

Variables of study:
Independent variables:
Two categorical variables: Gender and Zones(Locations)of the schools

Dependent variables:
Environnemental Pollution-specific science concepts

Tools:
Test developed by Bhat, De& Sen (2013) on Environmental Pollution-specific Science Concepts was used.

The test contains –dimensions as noted in Table-3:

Table-3: Dimensions of concept test (as per WBBSE, Curriculum, 2005)

Types of science (Dimensions)	Topics	No of Items
Physical Science	Solution/mixture	1
	Structure of matter	1
	Separation of mixture	1
	Combustion	2
	Acid Base	3
	Motion	1
	Chemical Reaction	3
Life Science	Concept of pollution	7
	Waste materials	2
Total		21

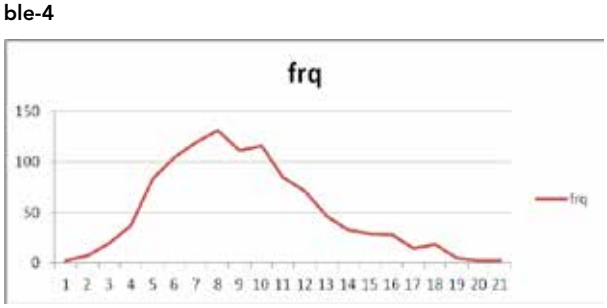
Bruner's conjunctive concept was used to frame the test items. In all 106 concepts common to science and environment up to upper primary stage were identified. Some of which are noted below:

Drinking water, Waste materials, Purification, Jaundice, Deforestation, Lungs, Lungs diseases,Domestic waste, Recycling, Ecosystem, Refrigerant,, Carbon dioxide, fly ash, Arsenicosis, Fluoride, DDT, Fungus, Plastic, Dysentery, Diarrhea, Temperature, Photosynthesis, Nonconventional energy, Ozone, Natural gas, Fossil fuel, Photo synthesis,, Sound, Noise, Carbon, Waste Materials, Bio-Degradable, Biogas, Combustion, Minamata, Acid Rain, Dust, CFC, Aerosol, Greenhouse Gas, Filter, Lead Particles, Element, Mixture, Compound, Heterogeneous Mixture, Filtration, Chemical Combination, Combustion, Depletion of Ozone, Oxidising Agent, Reducing Agent, Respiration, Acids, Base, Alkali, Out of these concepts 25 were selected for concept test of which only 21 were considered in the final draft of the concept test. Only two salient but joint features of each of the concepts were used for the preparation of each item of the test. A respondent has to respond to each item by selecting two salient features out of four given. The validity of the test was determined by content validity. After finding the discriminating values of the items of the test, only 21 out of 25 items were finally retained. The reliability of the test was found by test –retest method where reliability coefficient is r=0.7264 for df=132.The internal consistency of the items were found by Bunch-total correlation. Marking Scheme used for scoring is 1 for right answer & 0 for wrong or incomplete answer.

Presentation of Data:
TABLE-4: Frequency distribution of concept scores of the students of the total sample

Scores	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
Freq	2	7	19	37	83	105	119	131	111	116	85	71	46	33	29	28	14	18	05	02	02	1063

Fig:1 Frequency Polygon representing the frequency distribution of the concept scores of the students shown in Table-4



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freq Scores→
The fig -1 shows that the frequency of scores distribution is almost normal

TABLE-5: Descriptive statistics of the sample and its different strata

		Ctot	Cp	Cb	Cnpb	Cnpg	Cpg	Cg	Cpb	Cnp
N		1063	544	481	180	339	243	582	301	519
Mean		8.1957	8.4982	8.7713	7.6389	8.0059	7.3210	7.7199	9.4485	7.8786
Median		8.0000	8.0000	9.0000	8.0000	7.0000	7.0000	7.0000	9.0000	7.0000
Std. Deviation		3.54887	3.57194	3.67164	2.91167	3.77315	2.67755	3.37383	3.90916	3.49996
Variance		12.594	12.759	13.481	8.478	14.237	7.169	11.383	15.282	12.250
Skewness		.587	.512	.406	.299	.714	.325	.739	.243	.676
Kurtosis		.098	-.016	-.169	.064	.078	-.018	.501	-.462	.289

Abbreviations:
Ctot- Concept scores for total sample, Cp-concept scores of the students of polluted zones ,Cnpb-concept scores of the boys of non-polluted zones ,Cnpg-concept scores of girls of non polluted zones, Cb-concept scores of boys etc.

Analysis and Interpretation
To find the main effects of 'sex' and 'location of schools' and their interaction ANOVA was designed for 50 scores selected randomly from each of the cells :Boys, Girls, Polluted and Non polluted locations of schools.

Table-6: ANOVA of 2x2 factorial designs of Sex and Location

Source	Sum of Squares	df	Mean Square	F	p
Sex	58.320	1	58.320	4.613	.033
Location of schools	13.520	1	13.520	1.069	.302
Sex * Location	208.080	1	208.080	16.460	.000
Error	2477.760	196	12.642		

Interpretation of Table 6:
Difference of Boys and Girls in concept scores is significant($p<0.05$).Difference of concepts of students of the schools in Polluted and Non polluted zones(locations) is not significant($p>0.05$).Interaction between sex &locations of the schools is significant ($p<0.05$) indicating that boys and girls might differ in concept for schools at different zones(locations).Hence t-tests are essential for testing those differences (if any).

Table-7: Results of testing of Null hypotheses by t-tests

Levels	t-values	df	Significance
Boys and Girls: P Zones	4.199	198	S($p<0.05$)
Boys and Girls: NP Zones	0.150	198	NS($p>0.05$)
Boys of P &NP Zones	03.376	198	S($p<0.05$)
Girls of P &NP Zones	2.302	198	S($p<0.05$)

Interpretation of Table-7: Boys of the two zones differ significantly in concept scores. This is also for girls. Again Boys and Girls differ significantly in concept scores in polluted zones but not in non polluted zones (locations).

Therefore at 0.05 level of significance, the retained null hypotheses are two:H_{02}&$H_{04}$and rejected null hypotheses are four:H_{01}, H_{03},H_{05}&H_{06}

Results:
1. Boys and girls differ significantly in the environmental pollution-specific science concepts.

   This particularly happens for the schools located only in polluted zones.
2. Students of the two locations (polluted and non-polluted (zones) do not significantly differ in concept scores; but the boys of the two locations differ significantly and so also the girls.

Limitations of the study:
1. By very nature, a conjunctive concept involves two or more features. In the concept test two salient features of a concept were tagged with two incorrect features. Most of the students in the sample are not accustomed to answering Multiple Choice (MC) type questions by identifying two correct answers from a list of four. This has created some problem in collection of data.
2. Adequate studies were not available through books, journals and internet regarding studies on Environmental Education related to problems of environmental pollutions.
3. There is no single indicator which can detect all types of environmental pollution in a locality. As such moss and lichens were considered for identifying air pollution only.

Discussion:
1. The mean concept scores of the students were low in comparison to Maximum Marks allotted for the concept test.
2 The mean scores of the students of different sex and zones remained very close to one another.
3. Items were set on the Environment concepts drawn from science text books and the common observations of the students.

The students very sparingly came out of their text books to collect data on the environment. So the width and depth of knowledge of the students remained almost same whether the students are hailed from polluted or non-polluted zones. The pedagogy forwarded by NCF (2005) is "Group activities, discussions with peers and teachers, surveys, organization of data and their display through exhibitions, etc., in the schools and the neighborhood should be important components of pedagogy". The schools have rarely gone to maintain the style and content of environmental education. However some NGOs under the guidance of NCSTC(National Council of Science and

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Technology Communication), Delhi, conduct NCSC (National Children's Science Congress) every year in different parts of India. In doing so the NGOs undertake different scientific activities to be done by the students on different parameters of environments –cleanliness, air soil, water, nutrition, energy conservation, atmosphere ,pollution, contamination etc. Some self-supported organizations like All India Science Teachers' Association do in this line. But in most of the schools these are still dreams. This might be one of the reasons for almost no difference between students of pollution and non-pollution zones in concept scores.

Suggestions for further studies:

At the time of learning of science in schools the students should be encouraged to keep the school and the home environment clean and to visit the problems and hazards of the environment. Teacher should also give liberal explanations of different scientific concepts through environment. If the present design of study is executed after such teaching and learning the results of the study might be more valid and reliable.

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