C H A P T E R - V

ANALYSIS, INTERPRETATION AND DISCUSSION

The results obtained from the study have been analysed and interpreted with reference to the stated objectives under the following heads :

- Analysis of Environmental Knowledge
- Analysis of Environmental Attitude
- Analysis of the relationship between Environmental Knowledge and Environmental Attitude
- Analysis of the relationship between Environmental Knowledge and Selected Variables
- Analysis of the relationship between Environmental Attitude and Selected Variables
- Analysis of Perception regarding Environmental Education

Analysis of Environmental Knowledge

Objective - I

The first objective was to study the environmental knowledge of pre-service and in-service secondary school teachers.

More specifically this objective can be stated as :

i) To find out the level of factual, conceptual and total environmental knowledge of pre-service and in-service secondary school teachers,

ii) To compare the factual, conceptual and total environmental knowledge of pre-service and in-service secondary school teachers,

iii) To analyse item-wise the factual environmental knowledge of pre-service and in-service secondary school teachers in eight areas of environment,

iv) To analyse item-wise the conceptual environmental knowledge of pre-service and in-service secondary school teachers in eight areas of environment, and

v) To identify the deficiencies in factual and conceptual environmental knowledge among pre-service and in-service secondary school teachers,

Level of Environmental Knowledge

A statistical summary of factual, conceptual and total environmental knowledge possessed by teachers in terms of mean and standard deviation with reference to maximum possible score is given in Table 5.1.

Table - 5.1

Environmental Knowledge Score of Teachers

Categories of Teachers	Indices of Environmental Knowledge	Maximum possible score	Mean	S.D.
Pre-service (N=297)	Factual	55	22.58	5.76
	Conceptual	40	21.62	4.48
	Total	95	44.20	8.41
In-service (N=220)	Factual	55	26.92	6.03
	Conceptual	40	21.42	5.74
	Total	95	48.34	8.94

From Table 5.1. it is observed that the mean score on factual knowledge of both the pre-service and in-service teachers is less than 27.5 i.e., 50 per cent of the maximum possible factual score. This means that, on the average, both the groups of teachers, know less than 50 per cent of the facts about environment and its associated problems in their perspective. Hence, their level of factual environmental knowledge is 'low'.

The mean score on conceptual environmental knowledge of both the groups of teachers is just a little higher than 20, the 50 per cent of maximum possible score. Hence, the level of conceptual environmental knowledge of these teachers is 'moderate'. Similarly, taking into account the overall performance as indicated by their total environmental knowledge, the mean score of 44.20 for pre-service teachers indicates that their average level of total environmental knowledge is 'low', as this score (44.20) is less than 47.5, i.e. 50 per cent of the maximum possible score. On the otherhand, in-service teachers possess 'moderate' level of total environmental knowledge. This is indicated from their average score which lies between 50-75 per cent of the maximum possible total score on environmental knowledge.

To get a better picture of the level of factual, conceptual and total environmental knowledge of the teachers, the frequency distribution of factual, conceptual and total scores of these groups has been represented graphically in the form of ogives in Figures 5.1, 5.2 and 5.3 respectively. An analysis of these figures reveals the following :

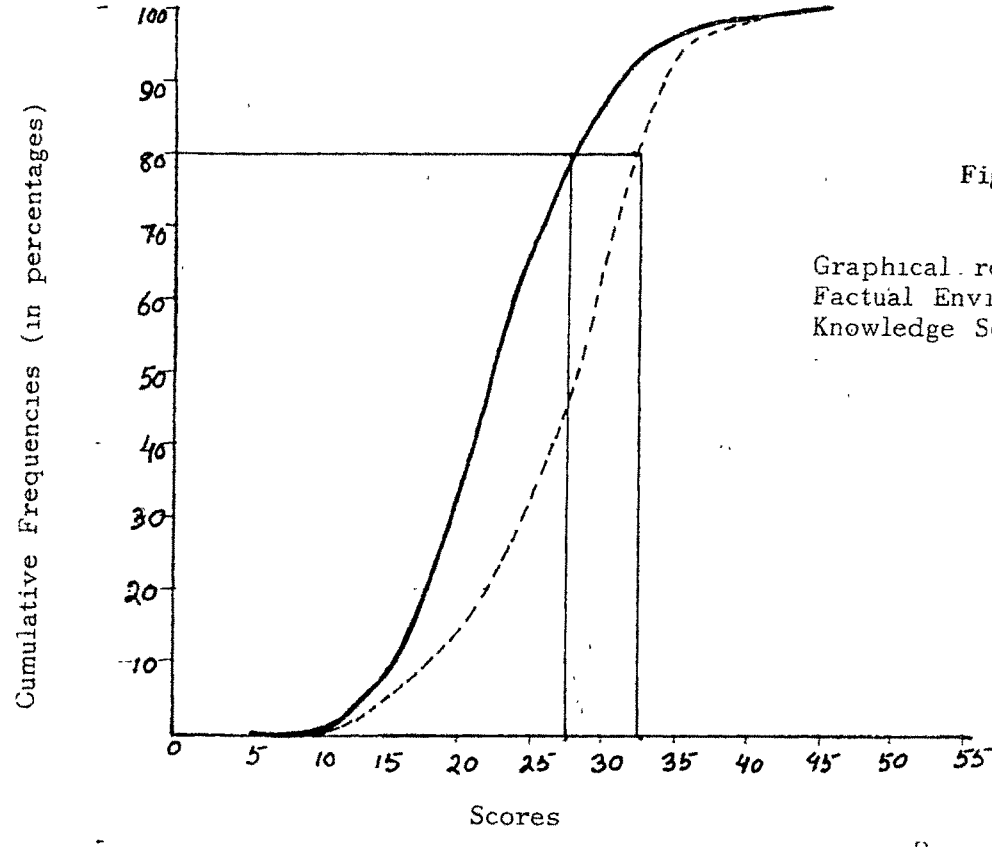

Figure 5.1

Graphical representation of Factual Environmental Knowledge Scores

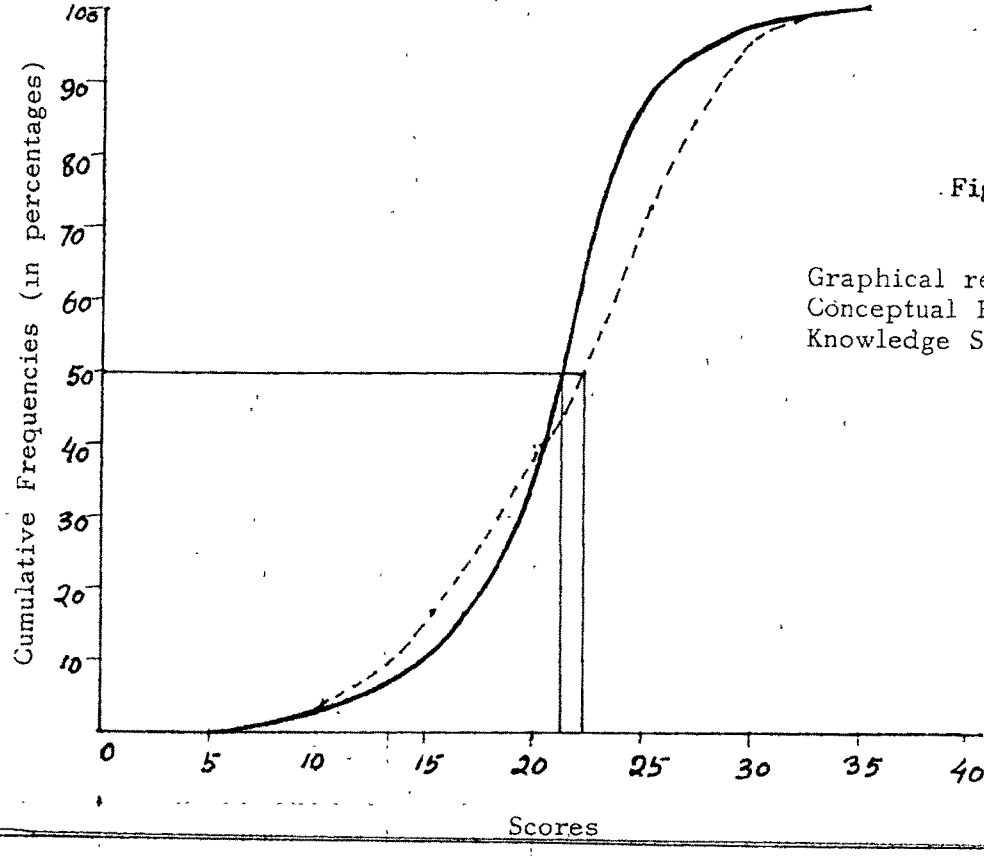

Figure 5.2

Graphical representation of Conceptual Environmental Knowledge Scores

Figure 5.3

Graphical representation of Total Environmental Knowledge Scores

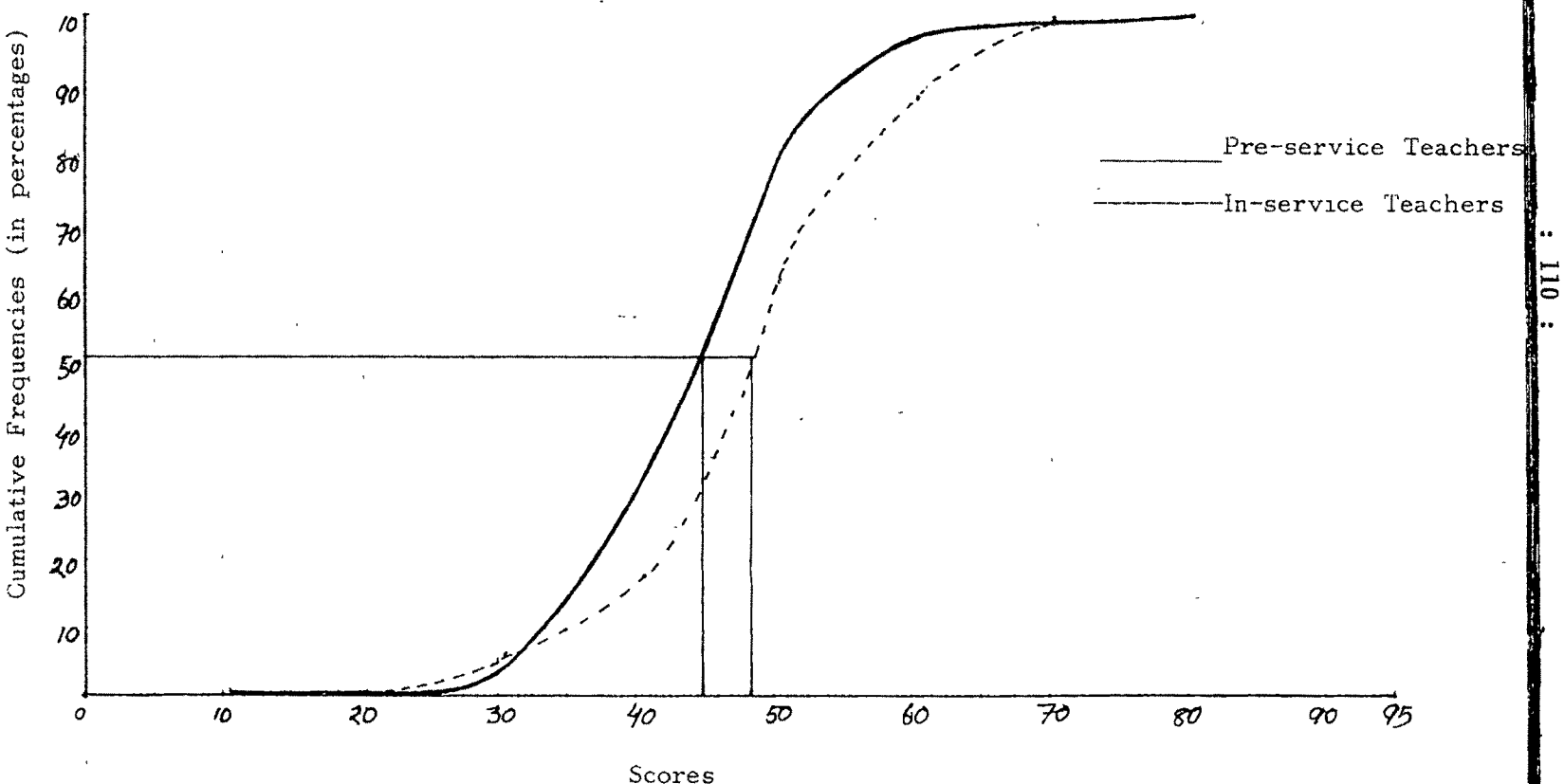

Figure-5.1

Eighty per cent of pre-service teachers have factual environmental knowledge score below 27.5 which is 50 percent of the maximum possible score. A similar percentage of in-service teachers have scores below 32.5 i.e. 59 per cent of the maximum possible score. The in-service teachers possess relatively better factual environmental knowledge than pre-service teachers.

Figure 5.2

Median score of both the groups of teachers is above 20 i.e. 50 per cent of the maximum possible score on conceptual environmental knowledge, indicating a 'moderate' level of conceptual knowledge. Further, the figure indicates apparently marginal difference in level of conceptual environmental knowledge between both the groups.

Figure 5.3

None of the pre-service and in-service teachers has scored more than 80 i.e., 84 per cent of the maximum possible total score on environmental knowledge. The median score for the pre-service teachers is less than half of the maximum possible total score i.e. 47.5. However, in case of in-service teachers, the median score is 54 per cent of the maximum possible total score on environmental knowledge. The total environmental knowledge possessed by the in-service teachers, in general, is better than that of pre-service teachers.

Comparison of Environmental Knowledge

To compare the factual, conceptual and total environmental knowledge of pre-service secondary school teachers with these indices for in-service teachers, the mean scores of these groups were computed and analysed by applying 't' test. The results are shown in Table 5.2.

Table - 5.2

Mean Score on Environmental Knowledge of Teachers.

Characteristics being compared	Groups of Teachers	Mean	S.D.	't'
Factual Environmental Knowledge.	Pre-service	22.58	5.76	8.24**
	In-service	26.92	6.03	
Conceptual Environmental Knowledge	Pre-service	21.62	4.48	0.43
	In-service	21.42	5.74	
Total Environmental Knowledge	Pre-service	44.20	8.41	5.34**
	In-service	48.34	8.94	

Pre-service Teachers, N = 297 ** Significant at 0.01 level
In-service Teachers, N = 220

The analysis of data presented in Table 5.2 shows that there is significant difference between in-service and pre-service teachers in their factual and total environmental knowledge. These two groups of teachers do not differ significantly in their conceptual environmental knowledge.

The in-service teachers possess higher factual and total environmental knowledge compared to the pre-service teachers. The above conclusion leads to the rejection of the null hypotheses that in-service and pre-service secondary school teachers do not differ significantly in their factual and total environmental knowledge. However, the null hypothesis concerning the difference in their conceptual environmental knowledge is retained.

Item-wise Analysis of Factual Environmental Knowledge

In order to get a better insight into the factual environmental knowledge of teachers, the frequency of responses to each alternative of factual item expressed in terms of precentage have been presented in Table 5.3. The correct response from among the alternatives has been indicated by an asterisk.

Table 5.3

Frequency of Responses (in percentages) to Factual Environmental Knowledge Items

Item	Pre-service Teachers Alternatives				In-service Teachers Alternatives			
	1	2	3	4	1	2	3	4
(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
1.	42	7	9	42*	41	11	16	32*
2.	13	31	40*	16	16	26	44*	14
3.	9	32	45	14*	16	23	35	26*
4.	70	21	6*	3	68	23	6*	3
5.	51	2	2	45*	42	3	2	53*

(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
6.	6	4	8	82*	7	1	5	87*
7.	41*	7	19	33	67*	4	11	18
8.	31	14*	33	22	50	16*	16	18
9.	17	21	12	50*	8	18	9	65*
10.	24	58*	7	11	22	57*	4	17
11.	35*	34	11	20	38*	44	3	15
12.	16	42*	27	15	13	36*	27	24
13.	28	16	10	46*	14	25	4	57*
14.	35*	18	40	7	57*	11	28	4
15.	15	54*	9	22	26	60*	1	13
16.	44	23	30*	3	51	18	26*	5
17.	27*	21	16	36	27*	17	10	46
18.	11	1	87*	1	3	1	94*	2
19.	30	6	60*	4	26	8	64*	2
20.	14	8	66*	12	9	5	80*	6
21.	8	31*	38	23	11	17*	52	20
22.	19*	29	30	22	30*	14	39	17
23.	16*	32	19	33	25*	12	12	51
24.	41*	48	5	6	71*	21	1	7
25.	22	9	11	58*	12	4	6	78*
26.	17	17	36*	30	30	4	20*	46
27.	6	26	33	35*	10	9	46	35*
28.	20*	34	8	38	30*	28	4	38
29.	8	7	44*	41	5	4	62*	29
30.	16	44*	10	30	8	61*	22	9
31.	48*	20	28	4	52*	13	32	3
32.	8	32*	4	56	6	56*	4	34
33.	56	6	6	32*	64	5	8	23*
34.	12	53*	19	16	11	46*	27	16
35.	9	18	37*	36	7	22	33*	38
36.	7	57*	24	12	12	69*	9	10

(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
37.	13	69*	11	7	12	75*	6	7
38.	8	56*	25	11	10	63*	14	13
39.	16	48*	16	20	21	39*	17	23
40.	27*	37	18	18	29*	48	11	12
41.	13*	20	46	21	16*	27	42	15
42.	38*	15	13	34	59*	10	11	20
43.	27	42*	17	14	26	61*	3	10
44.	53*	12	20	15	66*	9	14	11
45.	10	25	55*	10	12	11	63*	14
46.	7	9	74*	10	7	7	82*	4
47.	29*	32	26	13	41*	41	13	5
48.	34*	10	22	34	56*	9	17	18
49.	26	30*	30	14	21	15*	56	8
50.	34*	28	17	21	65*	13	5	17
51.	9	71*	11	9	4	88*	3	5
52.	26	30	12	32*	8	12	13	67*
53.	43	37	8*	12	32	57	5*	6
54.	24	46*	19	11	24	34*	22	20
55.	24	32	19*	25	19	25	16*	40

* Correct response.

The results contained in Table 5.3 have been discussed according to eight areas of environment viz. population, pollution, deforestation, depletion of natural resources, land use, ecological disruption, extinction of species, and energy crisis.

Population Explosion (Items 2,16,24,32,33,45,50,51,52,53,54)

Items on population explosion were about demographic figures, cause and consequences of population growth, population resources relationship, methods of population control, forms of contraception, medical termination of pregnancy and Government incentives for family planning etc. The responses were as follows :

World population (Item 2) : Only 40 per cent of pre-service and 44 per cent of in-service teachers knew that the world population crossed five billion in July 1987. Such an important event which was celebrated with caution by the UNO went unnoticed by the majority of the teachers.

Population growth rate (Item 16): Less than one-third of the teachers (30 per cent pre-service and 26 per cent in-service) could compare the relative population growth rates of Orissa and India.

Population growth trends (Item 45, 24) : India's projected population at the turn of the century is likely to be 1000 million. This is known to about half (55 per cent) of pre-service and 63 per cent of in-service teachers. If the current trends in population growth continue, India is likely to be the most populous country in the world replacing China, towards the middle of the next century. Though nearly three-quarters (71 per cent) of in-service teachers know this, 59 per cent of pre-service teachers do not know it.

Causes of population growth (Item 32) : Fiftysix per cent of in-service teachers correctly ascribe improved medical practice leading to decrease in death rate as the main cause of

rapid population growth. The same percentage of pre-service teachers attribute this to total failure of government on family welfare programmes. Only one-third (32 per cent) of them know the correct response.

Consequences of population growth (Item 50) : Only one-third of pre-service teachers and two-thirds of in-service teachers (65 per cent) know that rapid population growth leads to environmental degradation, unemployment, urban migration and that it does not lead to enhancement in standard of living.

Malthusian theory (Item 54) : Thomas Robert Malthus as the originator of the theory of relationship between population and resources is remembered by only one-third of in-service teachers and less than half (46 per cent) of pre-service teachers.

Population control (Item 33) : Majority of the teachers hold the view that educating the people is the prime task before the government to control population growth. Only 32 per cent of the pre-service teachers know that in additon to the above, efforts are to be made to reduce infant mortality and provide social security in old-age. Less than a quarter of in-service teachers (23 per cent) realise the importance of all the three measures.

Forms of contraception (Item 52) : Less than one-third (32 per cent) of pre-service teachers, most of whom would be entering their family life, understand correctly dependability of various forms of contraception. However, more than two-thirds of in-service teachers (67 per cent) understand those correctly.

Medical termination of pregnancy (Item 53) : Virtually, none of the teachers barring 8 per cent pre-service and 5 per cent in-service understand medical termination of pregnancy act, which allows abortion upto 20 weeks of pregnancy under certain conditions.

Green card (Item 51) : As would be normally expected almost all the in-service teachers (88 per cent) and nearly three-quarters (71 per cent) of pre-service teachers are aware of the green card facility under which Government of Orissa provide reservation of seats in educational courses, advance increments, allotment of residence and other facilities to couples undergoing sterilisation with two or less children.

The responses to factual items pertaining to population explosion have been varied, depending upon the item. While the question on 'green card' is best answered, the one on MTP is the most poorly answered question in this section.

Pollution (Items 3,4,6,7,8,13,17,18,26,29,34,35,40,41,42,46,49)

Items on pollution covered the cause, severity, consequences and control of water, air, noise and radio-active pollution. In addition, questions on toxicity of DDT, Minamata tragedy, Ganga Action Plan, lake eutrophication, Bhopal gas tragedy, Chernobyl nuclear accident, and stone cancer on Tajmahal etc., were meant to measure teachers' awareness of current events pertaining to environmental pollution. The responses were as follows:

Causes of water pollution (Item 6) : Almost all the teachers (82 per cent pre-service and 87 per cent in-service) understand

the main causes of water pollution.

Test for water quality (Item 8) : Except a small minority (14 per cent pre-service and 16 per cent in-service) all teachers do not know the criteria on the basis of which quality of water is determined.

Severity of water pollution (Item 3) : The severity of water pollution, as inferred from the fact that, the source of 80 per cent of diseases in our country is polluted water, is known only to 14 per cent of pre-service teachers and a quarter of in-service teachers.

Toxicity of DDT (Item 4) : Nearly none (except 6 per cent) of the teachers understands the persistence of the toxicity of DDT. Approximately, 70 per cent of the teachers are under the false impression that DDT is toxic for a few weeks.

Minamata Tragedy (Item 40) : Less than one-third of the teachers (27 per cent pre-service and 29 per cent in-service) are aware of the effects of heavy metal poisoning like the fatal mercuric poisoning at Minamata Bay of Japan during 1950s.

Lake eutrophication (Item 17) : The mechanism of lake eutrophication due to phosphates etc. leading to death of aquatic life has not been properly understood by 71 per cent of the teachers.

Ganga Action Plan (Item 46) : A vast majority of teachers (74 per cent pre-service and 82 per cent in-service) are aware of the massive efforts currently being undertaken by the Government of India under 'Ganga Action Plan' to get rid the holy river of its impurities. This overwhelming awareness may be ascribed to religious and emotional attachement of Indian people with river Ganga and media publicity.

Causes of air pollution (Item 13) : About half of the pre-service teachers (46 per cent) and majority (57 per cent) of the in-service teachers have knowledge about main sources of air pollution.

Smog (Item 34) : Nearly half of the teachers (53 per cent pre-service and 46 per cent in-service) know about smog caused by mixing of smoke with fog under certain conditions.

Bhopal gas disaster (Item 18) : As expected Bhopal gas leak in the Union Carbide factory resulting in the death of thousands of people have caught the attention of an overwhelming majority (87 per cent pre-service and 94 per cent in-service) of teachers.

Tajmahal and Mathura refinery controversy (Item 26) : The controversy regarding Mathura refinery posing potential threat to the Tajmahal has not been well understood by most of the teachers. As the matter was quite topical at the time of data collection, teachers knew what had been debated in the mass media. Hence, a little over one-third (36 per cent) of pre-service and only one-fifth of the in-service teachers have correctly realised that the contemporary threat to Tajmahal was not the Mathura refinery but the railway yard and the foundries of Agra.

Depletion of ozone-layer (Item 7) : The harmful effects of ozone-depletion resulting in increased cases of skin-cancer have been understood by most (67 per cent) of the in-service teachers but less than half (41 per cent) of the pre-service teachers.

Greenhouse effect (Item 41) : The phenomenon of global warming, resulting out of greenhouse effect, has not been understood correctly by an overwhelming (except 13 per cent

pre-service and 16 per cent in-service) number of teachers.

Green-belt (Item 29) : The role of trees planted around urban areas to purify polluted air, has been known to a clear majority (62 per cent) of in-service teachers. But only 44 per cent of pre-service teachers know about it.

Noise pollution (Item 49) : Teachers in general, are not able to compare the noise pollution caused due to rail engine, village haat (weekly market), loud-speaker and a jet-engine during take-off. Among the four, the last one produces noise pollution of highest degree. Less than one third (30 per cent) of pre-service teachers and only 15 per cent of in-service teachers have answered this item correctly. This could be explained on the basis of unfamiliarity with the experience of jet-engine driven aeroplanes during take-off.

Radio-active pollution (Item 35) : The environmental problems associated with nuclear power plants such as heat and radio-active pollution, waste disposal have not been understood properly by nearly two-thirds of both categories of teachers.

Chernobyl nuclear disaster (Item 42) : The nuclear power plant accident at Chernobyl, USSR which again brought into focus the lurking hazards of such plants is known to the majority (59 per cent) of the in-service teachers. However, this fact is known to only 38 per cent of pre-service teachers.

Teachers have poor knowledge of water pollution as out of the seven items most of them did not know about five items. Only the Ganga Action Plan and causes of water pollution are understood by most of them. They have done moderately well on

other forms of pollution such as air, noise and radio-active, pollution. Greenhouse effect is the most poorly understood item. Bhopal gas disaster is the best answered item in this area of environment.

Deforestation (Items 12,21,37,39,48)

Denudation of forests is a serious environmental problem throughout the world. For India, it is a highly challenging problem. Questions in this section were about ideal forest cover, actual forest cover according to satellite imagery, tropical rain forests, Chipko Movement. The responses were as follows :

Forest cover (Item 12) : About one-third (36 per cent) of in-service and 42 per cent of pre-service teachers have knowledge about ideal forest cover as per national forest policy.

Forest cover as per satellites (Item 21) : According to data available from remote sensing satellite photographs, the actual forest cover in India is around 13 per cent of the total land area, quite contrary to the popular estimate of 20 per cent of land area. Less than one-third (31 per cent) of pre-service teachers and only 17 per cent of in-service teachers know about it.

Conservation of tropical rain forests (Item 37) : Tropical rain forests shelter nearly half of the world's plant and animal species. Their conservation is essential for preservation of gene-pool. This fact has been understood by a vast majority (69 per cent pre-service and 75 per cent in-service) of teachers.

Chipko Movement (Item 39,48) : Fiftysix per cent of in-service and 34 per cent of pre-service teachers know that 'Chipko Movement' was started against indiscriminate tree felling. However, the contribution of Mr Sunderlal Bahuguna as a harbinger of the movement is not remembered by a corresponding percentage of teachers. A disproportionate percentage (48 per cent pre-service and 39 per cent in-service) of teachers associate him with the movement. This lack of consistency in response between the two items implies that teachers probably have only superficial knowledge of the Chipko Movement.

Thus, teachers possess moderate knowledge on facts related to deforestation except the item on satellite imagery. They have shallow knowledge about the Chipko Movement.

Depletion of Natural Resources (Items 9,15,28)

The depletion of natural resources especially the non-renewable ones raises doubts about sustainable development. Questions in this section were about classification of natural resources, sea-bed mining and recycling. The responses were as follows :

Classification of natural resources (Item 15) : The meaning of non-renewable resource as inferred from identification of the correct example of such resource is known to majority (60 per cent in-service and 54 per cent pre-service) of the teachers.

Recycling (Item 9) : Half of the pre-service teachers and nearly two-thirds (65 per cent) of the in-service teachers recognise the importance of recycling as the best method of disposing of solid-waste.

Sea-bed mining (Item 28) : Oceans hold prospect for meeting future needs for metal through mining of metallic nodules lying on their bed. This fact has been very poorly understood as only one-fifth of pre-service and less than one-third (30 per cent) of in-service teachers have responded to the item correctly.

Thus, teachers have correctly undertood all items in this section except the one on sea - bed mining.

Land Use (Items 11,23)

Meaning of land use (Item 23) : Most of the teachers have confused land use with consolidation of land holdings. Only a quarter of in-service teachers and 16 per cent of pre-service teachers have understood the meaning of land use.

Baliapal Test Range movement (Item 11) : Although the agitation by local people at Baliapal, Orissa, against the establishment of a test range for missiles has caught the attention of mass media, the teachers are not able to link it to the problem of land use. This is obvious from the fact that nearly one-third (35 per cent pre-service and 38 per cent in-service) of teachers have responded to this item correctly.

Ecological Disruption (Items, 1,14,19,25,27,36,43,47)

The items in this section were about movements against ecological disruption, biodegradation, role of decomposers, integrated pest management etc. The responses were as follows:

Environmental problems (Item 1) : Only 42 per cent of pre-service and nearly one-third (32 per cent) of in-service teachers know about all the main causes of environmental problems.

Silent Valley Project (Item 47) : The hydro-electric project over Iduki river in Kerala was shelved due to protests from environmentalists, as it had potential for severe ecological disruption. This fact is known to less than one-third (29 per cent) of pre-service and 41 per cent of in-service teachers.

BALCO Bauxite Mining Project (Item 43) : The bauxite mining project in Gandhamardan hills of western Orissa is being resisted by local people on ecological grounds. Work has stopped in these hills, though the project is not yet abandoned. Fortytwo per cent of pre-service and a majority (61 per cent) of in-service, teachers are aware of it.

Role of decomposers (Item 14) : Only one-third (35 per cent) of pre-service and a majority (57 per cent) of in-service teachers understand the vital role of decomposers like bacteria in releasing basic elements from compounds.

Bio-degradation (Item 19) : Nearly two-thirds (60 per cent pre-service and 64 per cent in-service) of teachers understand the phenomenon of bio-degradation correctly.

Integrated pest management (Item 27) : The modern method of controlling pestilence through a combination of spraying insecticides and employing pest predators is known to nearly one-third (35 per cent) of the teachers.

Crop-rotation (Item 36) : A majority (69 per cent in-service and 57 per cent pre-service) of teachers realise that it is crop-rotation rather than mono-culture that maintains soil fertility through preservation of soil nutrients.

Consequences of fossil fuel burning (Item 25) : More than three-quarters of in-service teachers and a majority (58 per cent) of pre-service teachers are aware of the grave environmental consequences arising out of burning of coal and petroleum products.

Thus, except for the question pertaining to integrated pest control, the knowledge of in-service teachers about other items is moderately well. The pre-service teachers have poor knowledge of environmental problems, Silent Valley Project, role of decomposers and integrated pest control as more than 70 per cent of them do not know correct answer to these items.

Extinction of Species (Items, 5,22,30,38,44,55)

Due to ecological disruption and loss of habitat many species of plants and animals are already extinct or on the verge of extinction. Items on species extinction were about causes of extinction, Red-Data Book, WWF, national parks and wild-life sanctuaries in Orissa etc.

The responses were as follows :

Causes of extinction (Item 44) : A clear majority of teachers (53 per cent pre-service and 66 per cent in-service) have identified correctly, the loss of habitat due to deforestation as the main cause of species extinction.

Red-Data Book (Item 22) : Most of the teachers (except 19 per cent pre-service and 30 per cent in-service) donot know about 'Red Data Book' which enlists plant and animal species on the verge of extinction.

World-wide Fund for Nature (Item 55) : Teachers' lack of knowledge about conservation of endangered species is evident from the fact that more than 80 per cent of them do not know the symbol of 'World-wide Fund for Nature', the giant panda.

National parks in Orissa (Item 5) : Nearly half of the teachers of both the groups have confused Nandankanan, the state zoological garden, with Similipal, the only national park in Orissa. Fortyfive per cent of pre-service teachers and 53 per cent of in-service teachers know it correctly.

Wild-life sanctuary in Orissa (Item 30) : Majority (61 per cent) of in-service and 44 per cent of pre-service teachers know that the Bhitarkanika wild-life sanctuary was unique as it contained the only white crocodile of the country.

Dr. Salim Ali (Item 38) : The late Dr. Salim Ali, the famous ornithologist was known to a majority (56 per cent pre-service and 63 per cent in-service) of teachers.

Thus, except for the questions relating to Red Data Book and WWF, teachers possess moderate knowledge on other items dealing with extinction of species.

Energy Crisis (Item 10,20,31)

Questions were asked about solar energy, problems associated with its use and on crude imports in the energy crisis area. The responses were :

Solar energy (Item 10,31) : Although majority of teachers (58 per cent pre-service and 57 per cent in-service) realise the potential of sun as main future sources of global energy needs,

nearly half of them (52 per cent in-service and 48 per cent pre-service) do not know the problems associated with its large scale use.

Self-sufficiency in crude oil (Item 20) : The dependence on import of crude oil to meet energy requirements of the country has been well recognised by four-fifths of in-service teachers and two-thirds of pre-service teachers.

Item-wise Analysis of Conceptual Environmental Knowledge

The frequency of responses to conceptual knowledge items expressed in percentages against the alternatives to each item is given in Table 5.4. The correct response from among the alternatives have been indicated by an asterisk.

Table - 5.4

Frequency of Responses (in percentages) to Conceptual Environmental Knowledge Items.

Item No.	Pre-service Teachers Alternatives			In-service Teachers Alternatives		
	True	False	Do not know	True	False	Do not know
(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)
1.	55	36*	9	64	30*	6
2.	66*	22	12	61*	23	16
3.	67*	20	13	76*	19	5
4.	88*	8	4	95*	3	2
5.	40*	43	17	62*	32	6
6.	13	74*	13	9	78*	13
7.	19	70*	11	8	89*	3
8.	40	28*	32	46	27*	27
9.	17	76*	7	5	93*	2
10.	82*	10	8	87*	6	7

(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)
11.	42*	40	18	37*	44	19
12.	50*	30	20	41*	31	28
13.	43*	46	11	48*	46	6
14.	23	67*	10	15	76*	9
15.	42*	36	22	51*	32	17
16.	64*	28	8	80*	14	6
17.	26	64*	10	47	48*	5
18.	56*	25	19	66*	18	16
19.	48*	29	23	68*	15	17
20.	45*	37	18	20*	64	16
21.	29*	44	27	11*	54	35
22.	28	63*	9	26	66*	8
23.	51*	32	17	50*	34	16
24.	50*	32	18	51*	27	22
25.	45	44*	11	15	81*	4
26.	58	31*	11	63	31*	6
27.	58*	28	14	36*	66	18
28.	41*	47	12	30*	54	16
29.	48	36*	16	54	25*	21
30.	73*	19	8	88*	6	6
31.	82*	13	5	92*	8	0
32.	34	51*	15	26	61*	13
33.	57*	28	15	58*	28	14
34.	56*	26	18	70*	24	6
35.	34	57*	9	26	69*	6
36.	10*	16	74	9*	15	76
37.	76*	19	5	94*	5	1
38.	57	34*	9	68	25*	7
39.	30	55*	15	17	77*	6
40.	37	37*	26	25	56*	19

* Correct response.

The results contained in Table 5.4 have been discussed item-wise in eight areas of environment mentioned earlier.

Population Explosion (Items 1,16,17)

Zero population growth (Item 1) : The concept of zero population growth has been poorly understood by teachers as about one third (36 per cent pre-service and 30 per cent in-service) of the teachers have correctly responded to the item.

Population density affects behaviour (Item 16) : A vast majority (80 per cent in-service and 64 per cent pre-service) of teachers are aware of the above concept.

Education and family size (Item 17) : The relationship between family size and educational background of parents is known to nearly two-thirds (64 per cent) of pre-service teachers but about half (48 per cent) of in-service teachers.

Pollution (Items 2,3,11,20,22,23)

Acid rain (Item 2) : The harmful effect of acid rain on biota is known to the majority (61 per cent in-service and 66 per cent pre-service) of teachers.

Pollution and genetic change (Item 3) : Pollution can cause genetic changes. This concept has been understood by more than two-thirds of the teachers.

Pollution and economy (Item 11) : About two-fifths (42 per cent pre-service and 37 per cent in-service) of teachers are able to visualise the linkage between affluence of developed

countries, and poverty of the third world both of which cause pollution.

Pollution and environmental change (Item 20) : Man induced pollution can cause irreversible changes in the environment. This concept has not been understood well by 80 per cent of in-service teachers and more than half (55 per cent) of pre-service teachers.

Ozone depletion (Item 23) : The supersonic aircrafts can damage ozone layer. Only about half of the teachers of both categories have realized this.

Food additives (Item 22) : A clear majority (63 per cent pre-service and 66 per cent in-service) of teachers understand that many of the food additives and preservatives are harmful to health.

Deforestation (Items 7,31)

Social forestry (Item 7) : The concept of social forestry, aimed at providing fuel and fodder rather than timber has been understood by an overwhelming majority (70 per cent pre-service and 89 per cent in-service) of teachers.

Deforestation and climatic change (Item 31) : The relationship between the large-scale deforestation and consequent climatic changes is known to almost all (82 per cent pre-service and 92 per cent in-service) the teachers.

Depletion of Natural Resources (Items 6,15,27,30,40)

Non-renewable resource (Item 40) : Nearly one third (37 per cent) of pre-service and 56 per cent of in-service teachers understand the finite nature of non-renewable resources.

Space-ship earth (Item 27) : The concept of space-ship earth, so vital to the understanding of the finite nature of resources is known to only 36 per cent of in-service and 58 per cent of pre-service teachers.

Resource use and development (Item 30) : Nearly three-fourths (73 per cent pre-service and 88 per cent in-service) of the teachers understood the concept that the level of development of a country is related to the use of its natural resources.

Distribution of natural resources (Item 6) : Nearly three-quarters of the teachers know that natural resources of the earth are not evenly distributed with reference to land area among countries.

Alternative technology (Item 15) : While nearly half (51 per cent) of the in-service teachers have understood the role of alternative technologies in slowing down consumption of natural resources, only 42 per cent of pre-service teachers know about it.

Land Use (Items 9,32,39)

Soil erosion (Item 9) : An overwhelming majority (76 per cent pre-service and 93 per cent in-service) of teachers have understood the concept of soil erosion.

Desertification (Item 32) : The damage done to land by overgrazing of live-stock and subsequent desertification has been understood by half of the pre-service teachers and 61 per cent of in-service teachers.

Land use pattern (Item 39) : A clear majority (55 per cent pre-service and 77 per cent in-service) of teachers know that the land use patterns of a country are affected by its stage of economic development.

Ecological Disruption (Items 4,5,10,12,14,18,21,24,26,28,29,33)

Interdependence (Item 4) : Almost all the teachers (88 per cent pre-service and 95 per cent in-service) have realised the interdependence among living things as well as their environment.

Self-cleansing mechanism (Item 33) : A little more than half of the teachers (57 per cent pre-service and 58 per cent in-service) have understood the concept that nature has its own mechanism to get rid of waste.

Ecosystem stability (Item 18) : The stability of an ecosystem depends upon its biological diversity. Sixtysix per cent of in-service teachers and 56 per cent of the pre-service teachers have responded to the item correctly.

Ecoystem change (Item 12) : The subtle nature of an ecosystem where any change can produce a chain reaction, tending to change the ecosystem to a new equilibrium, has not been understood by a majority of teachers as only 41 per cent of the in-service teachers and 50 per cent of the pre-service teachers have correctly responded to the item.

Adaptation (Item 26) : The concept of animals not adapting at the same pace in which environmental changes occur, has been understood by less than one-third (31 per cent) of teachers of both categories.

Bio-magnification (Item 29) : Bio-magnification which results in increasing concentration of substances while passing through a food chain has not been understood by most of the teachers as only 36 per cent of pre-service and 25 per cent of in-service teachers have correctly responded to the item.

Greenhouse effect (Item 21) : Global warming due to greenhouse effect may melt the polar ice caps and snow on high mountain peaks, leading to drowning of cities in low lying areas. This concept has not been understood by almost all in-service and two-thirds of the pre-service teachers.

Ecological damage due to dams (Item 28) : Contrary to popular belief, large dams and reservoirs affect the local ecosystem adversely. Less than, one-third (30 per cent) of in-service and half (41 per cent) of pre-service teachers have understood this concept .

Pest resistance (Item 5) : A majority (62 per cent) of in-service teachers have realised the harmful effect of indiscriminate use of pesticides, which leads to resistance in pests. However, only 40 per cent of pre-service teachers have undertsood this concept.

Nuclear winter (Item 24) : Half of the teachers have understood that nuclear winter may follow a nuclear war, resulting in catastrophic damage to the ecological balance of the planet.

Man as agent of ecological change (Item 14) : The capacity of men to manipulate and change the environment resulting in eco-disruption, has been recognised by more than two-thirds of the teachers.

Nature of environmental problems (Item 10) : An overwhelming majority (82 per cent pre-service and 87 per cent in-service) of teachers realise the global nature of environmental problems.

Extinction of Species (Items 8,13,19,25,34,35,36)

Gene erosion (Item 36) : The concept of gene erosion which unlike soil erosion is invisible, has not been understood by almost all (except 9 per cent in-service and 10 per cent pre-service) the teachers.

Tolerance (Item 35) : A clear majority (69 per cent in-service and 57 per cent pre-service) of teachers understand that there is a limit to tolerate pollution, on the part of species, beyond which they tend to become extinct.

Carrying capacity (Item 19) : Nearly two-thirds (68 per cent) of in-service teachers and less than half (48 per cent) of the pre-service teachers know the concept of carrying capacity.

Safe number (Item 8) : Less than one-third (28 per cent pre-service and 27 per cent in-service) of the teachers have knowledge of 'safe number', the critical number below which survival of species becomes difficult, under standard environmental conditions.

Killing and conservation (Item 13) : Only 43 per cent of pre-service and 48 per cent of in-service teachers have correctly responded to an apparently paradoxical concept that selective killing of animals help their conservation.

Captive breeding (Item 34) : The role of captive breeding in saving endangered animals is known to a clear majority (70 per cent in-service and 56 per cent pre-service) of teachers.

Wild-life sanctuaries (Item 25) : An overwhelming majority (81 per cent) of in-service teachers have understood that the main function of wild-life sanctuaries is preservation of gene pool and not recreational. However, less than half (44 per cent) of the pre-service teachers have understood it.

Energy Crisis (Items 37, 38)

Sun as ultimate source (Item 37) : Almost all the in-service teachers (94 per cent) and more than three quarters (76 per cent) of pre-service teachers have realised the importance of sun as the ultimate source of all energy on earth.

Bio-gas plant (Item 38) : Teachers, in general, do not have the concept of a bio-gas plant as evident from the response to this item, since only about one third (34 per cent pre-service and 25 per cent in-service) of the teachers know correct response to this item.

Identification of Deficiency in Conceptual and Factual Knowledge

An analysis of frequency of response to factual and conceptual items contained in Table 5.3 and 5.4 revealed deficiency in factual and conceptual knowledge respectively among the pre-service and in-service teachers in eight areas of environment. This identification of deficiency is based on the criterion that teachers are said to have deficiency in knowledge about a factual or conceptual item if 60 per cent or more teachers did not know the correct answer to that item. Tables 5.5. and 5.6 respectively give factual and conceptual deficiency in environmental knowledge among teachers of both categories.

Table - 5.5

Deficiency in Factual Environmental Knowledge among Teachers

Areas of Environmental Knowledge	Items of Factual Knowledge Deficiency among Both Pre-service and In-service Teachers.	Pre-service Teachers only	In-service Teachers only
(1)	(2)	(3)	(4)
Population Explosion	- Population growth rate	- World population figure	- Malthusian theory
	- Strategies for population control	- Cause of population growth	
	- Medical termination of pregnancy	- Consequences of population growth	
		- Forms of contraception	
Pollution	- Diseases due to polluted water	- Chernobyl nuclear plant disaster	
	- Toxicity of DDT		
	- Criterion for water quality		
	- Lake eutrophication		
	- Threat to Tajmahal due to Mathura refinery		
	- Radio-active pollution		
	- Minamata tragedy		
	- Greenhouse effect		
	- Noise pollution		

(1)	(2)	(3)	(4)
Deforestation	- Forest cover as per satellite imagery	- Chipko Movement	- Forest cover as per national forest policy - Sunderlal Bahuguna
Depletion of Natural Resources	- Mining of metallic nodules from sea-bed		
Land use	- Meaning of land use - Agitation against National Test Range at Baliapal		
Ecological Disruption	- Integrated pest management	- Role of decomposers - Silent valley project	- Causes of environmental problems
Extinction of species	- Red Data Book - Symbol of WWF		
Energy Crisis	-	-	-

Table-5.6

Deficiency in Conceptual Environmental Knowledge among Teachers.

Areas of Environmental knowledge	Items of Conceptual Knowledge Deficiency among		
	Both Pre-service and In-service teachers	Pre-service Teachers only	In-service Teachers only
Population Explosion	- Concept of zero population growth	-	-
Pollution	- -	-	- Pollution, poverty and affluence linkage - Pollution and environmental change
Deforestation	-	-	-
Depletion of Natural Resources	-	- Non-renewable resources	- Space-ship earth concept
Land use	-	-	-
Ecological Disruption	- Greenhouse effect - Concept of adaptation - Bio-magnification	-Pest-resistance	- Dams disrupt ecology
Extinction of Species	- Concept of gene-erosion - Concept of safe number	-	-
Energy Crisis	- Biogas plant	-	-

Analysis of data in Table 5.5. reveals that 60 per cent or more teachers of both the categories are deficient in factual environmental knowledge about 19 out of 55 items or about 35 per cent of the total factual knowledge items. In addition to this, deficiency in factual knowledge also extends to 8 and 4 more items, in case in pre-service and in-service teachers respectively. Thus, the total deficiency in factual environmental knowledge among pre-service teachers is 49 per cent (27 out of 55 items). The percentage for in-service teachers is 42 per cent (23 items out of 55 items).

Analysis of data in Table 5.6 reveals that 60 per cent or more of both pre-service and in-service teachers are deficient in conceptual environmental knowledge about 7 out of 40 items or about 18 per cent of the total conceptual items. In additon to this, deficiency in conceptual knowledge also extends to 2 and 4 more items in case of pre-service and in-service teachers respectively. Thus the total deficiency in conceptual environmental knowledge among pre-service teachers is 23 per cent (9 out of 40 items). The corresponding figure for in-service teachers is 28 per cent (11 out of 40 items).

Both the groups of teachers have more deficiency in factual knowledge as compared to conceptual knowledge. Also no deficiency has been observed in areas of energy crisis in factual knowledge and deforestation and land use in case of conceptual knowledge, among both the groups of teachers.

Analysis of Environmental Attitude

Objective-2

The second objective was to study the environmental attitude of pre-service and in-service secondary school teachers.

More specifically this objective can be stated as ;

(i) To find out the environmental attitude of pre-service and in-service teachers, and

(ii) To compare the environmental attitude of pre-service and in-service teachers.

A statistical summary of scores on environmental attitude of both categories of teachers and the results of 't' test, to find out the significance of difference in the mean attitude scores of these groups are presented in Table 5.7.

Table - 5.7

Scores on Environmental Attitude of Teachers.

Categories of Teachers	Environmental Attitude Score		't'
	Mean	S.D.	
Pre-service (N=297)	100.66	10.35	11.39**
In-service (N=220)	111.32	10.65	

** Significant at 0.01 level.

A score of 3 in each item of environmental attitude scale denoted a neutral attitude towards environment. Since there were 30 items on the scale any score of more than 90 can be considered as indicative of a positive or favourable attitude towards environment. Similarly, any score less than 90 can be construed as an indication of negative or unfavourable attitude towards environment. The mean attitude

scores of both the groups of teachers, given in Table 5.7 being more than 90, it is obvious that both the in-service and pre-service teachers as a group hold favourable or positive attitude towards environment. Further, the difference between mean scores on environmental attitude between these two groups of teachers being significant, at 0.01 level, it indicates that the in-service teachers have a more favourable attitude towards environment compared to the pre-service teachers.

The hypothesis that there is no significant difference among in-service and pre-service secondary school teachers with reference to their environmental attitude, is rejected.

Analysis of relationship between Environmental Knowledge and Environmental Attitude

Objective-3

The third objective of the study was to find out the relationship between environmental knowledge and environmental attitude of the pre-service and in-service secondary school teachers. This objective entails relationship between ;

(i) factual environmental knowledge and environmental attitude,

(ii) conceptual environmental knowledge and environmental attitude, and

(iii) total environmental knowledge and environmental attitude.

To find out these relationships, coefficient of correlations were computed between knowledge scores (factual, conceptual and total) and attitude scores by applying product-moment method. Fisher's z-transformation was used to establish the significance of computed correlations. The coefficient of correlations are given in Table 5.8.

Table - 5.8

Co-efficient of Correlation between Environmental Knowledge and Environmental Attitude.

Categories of Teachers	N	Coefficient of Correlation		
		Factual Knowledge and Attitude	Conceptual Knowledge and Attitude	Total Knowledge and Attitude
In-service	220	0.47**	0.38**	0.43**
Pre-service	297	0.42**	0.32**	0.42**

** Significant at 0.01 level.

The analysis of results contained in Table 5.8 shows that the factual, conceptual and total environmental knowledge of both pre-service and in-service teachers bear a positive moderate significant correlation with their environmental attitude. The highest correlationship has been observed between factual environmental knowledge and environmental attitude. The lowest correlationship is between conceptual environmental knowledge and environmental attitude.

The null hypotheses concerning the relationship between factual, conceptual and total environmental knowledge and environmental attitude stand rejected because of the obtained significant positive correlations.

Analysis of the relationship between Environmental Knowledge and Selected Variables

Objective - 4

The fourth objective of the study was to determine, whether there are significant differences in environmental knowledge of pre-service and in-service teachers with reference to the following variables;

i) Sex,
ii) Place of Residence,
iii) Subject Orientation,
iv) Socio-economic Background and
v) Teaching Experience.

More specifically this objective can be stated as :

To determine whether both pre-service and in-service teachers of different, sex, place of residence, subject orientation, socio-economic background and lengths of teaching experience differed among themselves significantly in their ; factual,conceptual and total environmental knowledge.

Different null hypotheses formed for the purpose taking into consideration the above mentioned variables have been tested using the techniques of analysis of variance, and 't' test. The relationships of variables with indices of environmental knowledge have been presented variable-wise.

Environmental Knowledge and Sex

Table 5.9 gives the scores on environmental knowledge of male and female teachers along with the results of the 't' test between their mean scores on all the three indices of environmental knowledge-factual, conceptual and total.

Table - 5.9

Mean Scores on Environmental Knowledge of Male and Female Teachers.

Categories of Teachers	Indices of Environmental Knowledge	Male		Female		't'
		Mean	SD	Mean	SD	
Pre-service	Factual	21.98	5.70	22.96	5.72	1.44
	Conceptual	21.21	4.33	21.87	4.45	1.27
	Total	43.05	9.15	44.79	8.33	1.66
In-service	Factual	27.58	6.21	26.02	5.73	0.54
	Conceptual	21.93	5.93	20.86	5.54	1.37
	Total	49.39	9.82	46.74	8.33	2.17 **

Pre-service : Male N=118, Female N = 179, ** Significant at 0.01 level.

In-service : Male N=120, Female N=100;

The result contained in Table 5.9 shows that male and female teachers of pre-service and in-service groups do not differ significantly in their factual and conceptual environmental knowledge. In the pre-service group, this difference is also not significant in their total environmental knowledge. Only in case of in-service teachers male teachers possess significantly higher total environmental knowledge compared to their female counterparts, as the difference between their mean scores is significant at 0.01 level.

Hence, the null hypotheses concerning the difference in factual, conceptual and total environmental knowledge between male and female teachers of the pre-service group and factual and conceptual knowledge between male and female teachers of the in-service group are retained. Only the null hypothesis that in-service male and female teachers do not differ in their total environmental knowledge is rejected.

Environmental Knowledge and Place of Residence

To find out if urban in-service and pre-service teachers differed from their counterparts in rural areas on all three indices of environmental knowledge, the difference between their mean scores was tested for significance using 't' test. The results, along with the mean scores have been presented in Table 5.10.

Table - 5.10

Mean Scores on Environmental Knowledge of Urban and Rural Teachers.

Categories of Teachers	Indices of Environmental Knowledge	Urban Teachers		Rural Teachers		't'
		Mean	SD	Mean	SD	
Pre-service	Factual	22.95	5.91	22.15	5.72	1.18
	Conceptual	21.85	4.63	21.45	4.35	0.77
	Total	45.80	8.09	43.64	8.05	2.30*
In-service	Factual	27.08	5.77	26.56	6.42	0.62
	Conceptual	22.64	5.57	21.31	5.71	1.73
	Total	49.29	9.87	46.56	8.54	2.20*

Pre-service : Urban teachers N=160
Rural teachers N=137

In-service : Urban teachers N=123
Rural teachers N=97

* Significant at 0.05 level.

From Table 5.10, it is observed that urban and rural teachers of in-service and pre-service group do not differ, significantly in their factual and conceptual environmental

knowledge. However, both pre-service and in-service teachers residing in urban areas have significantly better total environmental knowledge compared to their counterparts residing in rural areas, as the difference in their mean scores is significant at 0.05 level.

The null hypotheses concerning difference between urban and rural teachers of pre-service and in-service groups in their factual and conceptual environmental knowledge are retained. However, the null hypothesis that urban teachers of pre-service and in-service group differ significantly from rural teachers of these groups in their total environmental knowledge is rejected.

Environmental Knowledge and Subject Orientation

To find out whether science teachers of in-service and pre-service groups differed significantly in their factual, conceptual and total environmental knowledge from the non-science teachers of these groups, the difference between the mean scores on all the three indices of environmental knowledge of these teachers were tested for significance using 't' test. The results are contained in Table 5.11. Since in secondary schools of Orissa there are no specific posts according to subjects a teacher was considered to have science orientation if he/she has passed his/her graduation with science subjects. All other teachers of the school were considered as non-science teachers.

Table - 5.11

Mean Scores on Environmental Knowledge of Teachers with Science and Non-science Background.

Categories of Teachers	Indices of Environmental Knowledge.	Science Teachers		Non-Science Teachers		't'
		Mean	SD	Mean	SD	
Pre-service	Factual	24.40	6.38	21.57	5.31	3.93**
	Conceptual	22.26	4.58	21.32	4.44	1.71
	Total	46.65	9.37	42.81	7.78	3.63**
In-service	Factual	23.52	6.55	24.07	6.77	0.57
	Conceptual	22.15	4.67	22.91	4.86	1.10
	Total	46.40	8.42	46.91	9.73	0.40

Pre-service : Science teachers N=111
Non-Science teachers N=187

** Significant at 0.01 level.

In-service : Science teachers N=70
Non-Science teachers N=150

As could be seen from the Table 5.11 the difference in the mean score on factual and total environmental knowledge of science and non-science teachers of pre-service group is significant at 0.01 level. This indicates science teachers of pre-service group possess significantly better factual and total environmental knowledge than non-science teachers of this group. Hence, the null hypotheses concerning the difference in factual and total environmental knowledge between the science and non-science teachers of pre-service group are rejected. The science teachers of pre-service group do not differ significantly in their conceptual environmental knowledge from the non-science teachers as the difference between their mean scores is not significant. Hence, the null hypothesis that science teachers of pre-service group do not

differ significantly from non-science teachers of this group in their conceptual environmental knowledge is retained.

Table 5.11 further shows that the science teachers of in-service group do not differ from non-science teachers of that group on any indices of environmental knowledge significantly , since the difference in mean scores for these groups in factual, conceptual and total environmental knowledge is not significant at accepted levels. Hence, the null hypotheses concerning the difference in factual, conceptual and total environmental knowledge between in-service, science and non-science teachers are retained.

Environmental Knowledge and Socio-economic Background

The teachers were divided into three socio-economic groups viz. high, middle and low for the purpose of determining differences, if any, among these groups in their factual, conceptual and total environmental knowledge. The mean scores on the three indices of environmental knowledge of these groups are given in Table 5.12.

For dividing the teachers into three socio-economic groups viz. low, middle and high, education and occupation of parents and their monthly family income were taken into account in case of pre-service teachers. Monthly family income, education and occupation of self and spouse were considered in case of in-service teachers. Weightages were given to these parameters as given in Appendix - IV.

Table - 5.12

Mean Scores on Environmental Knowledge of Teachers by Socio-economic Background

Categories of Teachers	Socio-economic Background	N	Scores on different Indices of Environmenal Knowledge					
			Factual		Conceptual		Total	
			Mean	SD	Mean	SD	Mean	SD
Pre-service	High	15	26.73	4.87	22.93	5.38	49.66	8.66
	Middle	178	23.12	5.77	21.94	4.45	44.91	8.63
	Low	104	21.14	5.72	20.92	4.31	42.07	9.03
In-service	High	26	28.46	5.02	20.03	5.30	48.05	7.58
	Middle	176	26.55	6.17	21.84	5.68	48.00	9.96
	Low	18	26.39	5.55	19.77	6.66	47.55	10.29

The analysis of data presented in Table 5.12 reveals a trend. The mean scores on all indices of environmental knowledge are in ascending order with reference to the socio-economic background of teachers of both in-service and pre-service groups. This indicates that apparently teachers from high and middle socio-economic background possess higher environmental knowledge than those in the preceding socio-economic groups.

In order to find out if the observed difference in the mean scores of different socio-economic group of teachers represent true differences, the scores on different indices of environmental knowledge were analysed using the technique of analysis of variance (ANOVA). The summary of ANOVA for pre-service and in-service teachers is given in Table 5.13, and 5.15 respectively.

Table - 5.13

ANOVA Summary of Environmental Knowledge Scores by Socio-economic Background of Pre-service Teachers.

Sources of Variation	Sum of squares	Degrees of freedom	Mean square	'F'
Factual Environmental Knowledge				
Between Groups	525	2	262.50	7.97**
Within Groups	9681	294	32.92	
Conceptual Environmental Knowledge				
Between Groups	95.58	2	47.79	2.38
Within Groups	5906	294	20.08	
Total Environmental Knowledge				
Between Groups	43916	2	21958	17.06**
Within Groups	378378	294	1287	

** Significant at 0.01 level.

Analysis of the results contained in Table 5.13 reveals the following :

(i) The 'F' ratio being significant for factual and total environmental knowledge implies that there are significant differences among pre-service teachers belonging to low, middle and high socio-economic background with reference to their factual and total environmental knowledge. Hence the null hypotheses that there are no significant difference among pre-service teachers coming from low, middle and high socio-economic background in their factual and total environmental knowledge are rejected.

(ii) On the other hand the 'F' ratio being non-significant for conceptual environmental knowledge, implies that there are no significant differences among pre-service teachers of different socio-economic groups in their conceptual environmental knowledge. Hence the null hypothesis that there are no signifcant differences among pre-service teachers belonging to low, middle and high scoio-economic groups in their conceptual environmental knowledge is retained.

In order to find out which of the socio-economic groups of teachers have better environmental knowledge 't' test was applied to mean scores of different groups. Table 5.14 gives the results of such 't' tests.

Table - 5.14

Comparison of Factual and Total Environmental Knowledge Mean Scores of Pre-service Teachers with different Socio-economic Background

Indices of Environmental Knowledge	Socio-economic Groups	Mean	S.D.	Degrees of freedom	't'
Factual	High and Middle	26.73 23.12	4.87 5.77	191	2.71**
	High and Low	26.73 21.14	4.87 5.72	117	3.32**
	Middle and Low	23.12 21.14	5.77 5.72	280	2.79**
Total	High and Middle	49.66 44.91	8.66 8.63	191	2.04*
	High and Low	49.66 42.07	8.66 9.03	117	3.16**
	Middle and Low	44.91 42.07	8.63 9.03	280	2.60**

* Significant at 0.05 level.
** Significant at 0.01 level.

The results contained in Table 5.14 reveal that pre-service teachers belonging to high and middle socio-economic background possess significantly higher, factual and total environmental knowledge compared to the other groups, since all the 't's in the above table are significant.

Table - 5.15

ANOVA Summary of Environmental Knowledge Scores of In-service Teachers by Socio-economic Background

Sources of Variation	Sum of Squares	Degrees of freedom	Mean square	'F'
Factual Environmental Knowledge				
Between Groups	81.79	2	40.89	1.22
Within Groups	7260.62	217	33.46	
Conceptual Environmental Knowledge				
Between Groups	146.36	2	73.18	2.34
Within Groups	6771.86	217	31.20	
Total Environmental Knowledge				
Between Groups	9.94	2	4.97	0.05
Within Groups	20882	217	96.23	

The results contained in Table 5.15 show that none of 'F' ratios are significant. This means that there are no significant differences among in-service teachers belonging to high, middle and low socio-economic groups in their factual, conceptual and total environmental knowledge.

Hence, the null hypotheses concerning the difference in environmental knowledge among in-service teachers with high, middle and low socio-economic background are retained.

Environmental Knowledge and Teaching Experience

In-service teachers were categorised into three groups on the basis of their teaching experience, for the purpose of finding out difference in their environmental knowledge. The mean scores of these groups on factual, conceptual and total environmental knowledge are given in Table 5.16.

Table 5.16

Mean Scores on Environmental Knowledge of In-service Teachers by Length of Teaching Experience

Groups in terms of Teaching Experience	N	Scores on Environmental Knowledge					
		Factual		Conceptual		Total	
		Mean	SD	Mean	SD	Mean	SD
Less than 5 years.	22	27.54	6.86	24.18	4.86	51.70	9.62
5-10 years	56	26.80	5.79	21.91	5.21	48.89	8.23
More than 10 years	142	26.73	5.92	20.85	5.85	47.46	9.28

The scores in Table 5.16 show a trend on all indices of environmental knowledge. The scores are observed to be decreasing with increase in teaching experience, from which it appears that people with less teaching experience, who may be relatively young teachers are more knowledgeable about environment compared with teachers who are relatively older.

To find out the significance of these differences in environmental knowledge the technique of analysis of variance was applied to the scores. The summary of ANOVA is presented in Table 5.17.

Table - 5.17

ANOVA Summary of Scores on Environmental Knowledge of Teachers by Length of Teaching Experience

Sources of Variation	Sum of squares	Degrees of freedom	Mean square	'F'
Factual Environmental Knowledge				
Between Groups	13	2	6.50	0.17
Within Groups	7896	217	36.39	
Conceptual Environmental Knowledge				
Between Groups	226	2	113	3.54*
Within Groups	6921	217	31.89	
Total Environmental Knowledge				
Between Groups	377	2	188.5	2.26
Within Groups	18083	217	83.33	

* Significant at 0.05 level.

Analysis of the results presented in Table 5.17, shows that 'F' ratio is significant only in case of conceptual environmental knowledge. This means that there are significant differences among in-service teachers in their conceptual environmental knowledge attributable to the length of their teaching experience. There are no significant differences among in-service teachers with less than 5 years, 5-10 years and more than 10 years of teaching experience in their factual and total environmental knowledge.

Hence, the null hypotheses concering difference among in-service teachers with different lengths of teaching experience, in their factual and total environmental knowledge are retained. On the other hand, the null hypotheses concerning differences among teachers in their conceptual environmental knowledge attributable to the length of their teaching experience are rejected.

To find out the significance of difference in conceptual environmental knowledge among teachers with less than 5 years, 5-10 years and more than 10 years of teaching experience the differences in their mean scores were tested using 't' test. The results of the 't' tests are given in Table 5.18. The degrees of freedom as shown in Table 5.18 have been calculated from the number of in-service teachers with less than 5 years, 5-10 years and more than 10 years of teaching experience as given in Table 5.16.

Table - 5.18

Comparison of Mean Scores on Conceptual Environmental Knowledge of In-service Teachers with different Length of Teaching Experience

Groups in terms of Teaching Experience	Conceptual Knowledge Score		Degrees of freedom	't'
	Mean	S.D		
Less than 5 years and	24.18	4.86	76	2.39*
5-10 years	21.91	5.21		
5-10 years and	21.91	5.21	196	1.19
More than 10 years	20.85	5.85		
Less than 5 years and	24.18	4.86	162	2.9**
More than 10 years	20.85	5.85		

* Significant at 0.05 level.

** Significant at 0.01 level

Analysis of the results in Table 5.18 shows that teachers with less than 5 years of teaching experience possess significantly more conceptual environmental knowledge compared to teachers with 5-10 years and more than 10 years of teaching experience, as the differences in their mean scores are significant.

Analysis of the relationship between Environmental Attitude and Selected Variables

Objective-5

The fifth objective was to determine whether there are significant differences in environmental attitude of pre-service and in-service secondary school teachers with reference to following variables : sex, place of residence, subject orientation, socio-economic background and teaching experience.

To test the differences in environmental attitude the scores were analysed using 't' test and analysis of variance. The results have been presented variable-wise.

Environmental Attitude and Sex

To find out whether male and female teachers of pre-service and in-service groups differed significantly in their environmental attitude, the difference in their mean environmental attitude score was tested for significance using 't' test. The results have been given in Table 5.19.

Table - 5.19

Mean Scores on Environmental Attitude of Male and Female Teachers

Categories of Teachers	Male		Female		Degrees of freedom	't'
	Mean	SD	Mean	SD		
Pre-service	100.39	11.04	101.70	9.93	295	1.03
In-service	111.75	11.05	110.76	10.38	218	0.68

Pre-service : Male N=118, Female N=179

In-service : Male N=120, Female N=100

It is observed from the results in Table 5.19 that the difference among male and female teachers of both pre-service and in-service groups in their mean score in environmental attitude is not significant. Hence, the null hypothesis that there are no significant differences in environmental attitude of pre-service and in-service teachers on account of their sex is retained.

Environmental Attitude and Place of Residence

The difference in mean environmental attitude scores of teachers residing in urban areas was compared to those residing in rural areas for both pre-service and in-service teachers using 't' test. The results are given in Table 5.20.

Table - 5.20

Mean Scores on Environmental Attitude of Urban and Rural Teachers

Categories of Teachers	Place of Residence				Degrees of freedom	't'
	Urban		Rural			
	Mean	SD	Mean	SD		
Pre-service	101.38	10.01	100.56	11.46	295	0.63
In-service	110.68	10.16	111.96	11.40	218	0.86

Pre-service : Urban Teachers N = 160
Rural Teachers N = 137

In-service : Urban Teachers N = 123
Rural Teachers N = 97

Since both the 't' values in Table 5.20 are not significant, urban and rural teachers of both pre-service and in-service groups do not differ significantly in their

environmental attitude. Hence, the null hypotheses concerning the difference in environmental attitude among pre-service and in-service teachers with reference to their place of residence are retained.

Environmental Attitude and Subject Orientation

The mean scores on environmental attitude of teachers with science and non-science background were compared using 't' test. The results are given in Table 5.21.

Table 5.21

Mean Scores on Environmental Attitude of Science and Non-Science Teachers

Categories of Teachers	Subject Orientation				Degrees of freedom	't'
	Science		Non-Science			
	Mean	SD	Mean	SD		
Pre-service	100.87	9.90	100.64	10.59	295	0.19
In-service	104.85	13.75	106.29	10.39	218	0.77

Pre-service : Science Teachers N = 111
Non-Science Teachers N = 186

In-service : Science Teachers N = 70
Non-science Teachers N = 150

From Table 5.21 it is observed that 't' values being non-significant, the science and non-science teachers of pre-service and in-service groups do not differ significantly in their environmental attitude. Hence, the null hypotheses concerning the difference among pre-service and in-service teachers with reference to their subject orientation are retained.

Environmental Attitude and Socio-economic Background

The mean scores on environmental attitude secured by pre-service and in-service teachers belonging to high, middle and low socio-economic groups are presented in Table 5.22.

Table 5.22

Mean Scores on Environmental Attitude of Teachers by Socio-economic Background

Categories of Teachers	Socio-economic Background	N	Mean	SD
Pre-service	High	15	104.6	8.36
	Middle	178	101.6	9.71
	Low	104	99.41	12.34
In-service	High	26	109.65	10.19
	Middle	176	110.53	11.73
	Low	18	115.72	10.66

The analysis of the scores in Table 5.22 reveals that the mean scores on environmental attitude gradually increases with higher socio-economic background in case of pre-service teachers. In case of in-service teachers however, a reverse trend is noticed. To find out the significance of these differences ,the scores on environmental attitude possessed by teachers of various socio-economic groups were analysed by applying the technique of analysis of variance. The ANOVA summary is given in Table 5.23.

Table - 5.23

ANOVA Summary of Environmental Attitude Scores of Teachers by Socio-economic Background

Sources of Variation	Sum of squares	Degrees of freedom	Mean square	'F'
Pre-service Teachers				
Between Groups	682.86	2	341.43	4.29*
Within Groups	23,371.30	294	79.49	
In-service Teachers				
Between Groups	483.21	2	241.60	1.80
Within Groups	28,995.29	217	133.61	

* Significant at 0.05 level.

The 'F' ratio being significant only for pre-service teachers of different socio-economic groups, it implies that there are significant differences among pre-service teachers in their environmental attitude attributable to their socio-economic background. Hence, the null hypotheses concerning difference in environmental attitude among pre-service teachers with reference to their socio-economic background, are rejected.

On the other hand, the 'F' ratio for the in-service teachers of various socio-economic groups not being significant, the null hypotheses concerning those differences

in environmental attitude among in-service teachers with reference to their socio-economic background areretained.

In order to find out which of the socio-economic group, viz. low, middle and high, of teachers possess significantly better environmental attitude compared to other, 't' test was applied to find out the significance of difference between their mean scores. The results are contained in Table 5.24.

Table - 5.24

Comparison of Mean Environmental Attitude Scores of Pre-service Teachers with different Socio-economic Background

Socio-economic Groups	Environmental Attitude Scores		Degrees of freedom	't'
	Mean	SD		
High	104.6	8.36		
and			191	1.31
Middle	101.6	9.71		
High	104.6	8.36		
and			117	2.10*
Low	99.41	12.34		
Middle	101.6	9.71		
and			280	1.10
Low	99.41	12.34		

* Significant at 0.05 level

From the result of 't' test shown in Table 5.24 it is observed that only the difference in environmental attitude of pre-service teachers belonging to high and low socio-economic group is significant. The teachers from high socio-economic background possess significantly more favourable attitude towards environment compared to those teachers coming from low socio-economic background.

Environmental Attitude and Teaching Experience

To find out the significance of difference in environmental attitude of in-service teachers attributable to teaching experience, the scores of teachers with less than 5 years, 5-10 years and more than 10 years of teaching experience were analysed using the technique of analysis of variance. The ANOVA summary is given in Table 5.25.

Table - 5.25

ANOVA Summary of Scores on Environmental Attitude of In-service Teachers by Length of Teaching Experience

Source of Variation	Sum of squares	Degrees of freedom	Mean square	'F'
Between Groups	261.89	2	130.94	1.29
Within Groups	22011.01	217	101.43	

Since the 'F' ratio is not significant, it implies that teachers with less than 5, 5-10, and more than 10 years of teaching experience do not differ significantly in their environmental attitude. Hence, the null hypotheses concerning the differences in environmental attitude among in-service teachers with reference to their length of teaching experience are retained.

Analysis of Perception regarding Environmental Education

Objective-6

The sixth objective was to study the perception of in-service and pre-service teachers' regarding environmental education in the school curriculum.

The questionnaire developed for the purpose was concerned with a study of the following aspects : existence of environmental crisis, the meaning and nature of environmental education, its underlying philosophy, status of environmental education in school curriculum, training need for teachers, constraints in environmental education programmes and themes and concepts in environmental education. The results obtained have been analysed dimension-wise.

Existence of Environmental Crisis

Almost all the teachers (94 per cent pre-service and 98 per cent in-service) have perceived that the world today faces a grave environmental crisis (item 5). Teachers were asked to identify the most serious environmental problem facing the world, India and Orissa out of a list of nine environmental problems (item 6). The responses of teachers in terms of percentages are given in Table 5.26.

Table - 5.26

Most serious Environmental Problem as identified by Teachers

Environmental Problems	World		India		Orissa	
	pre-service	in-service	pre-service	in-service	pre-service	in-service
Deforestation	7*	9	7	8	38	58
Ecological Disruption	17	4	2	2	8	2
Loss of Wildlife	1	1	2	2	4	2
Population Explosion	6	6	71	81	2	2
Threat of Nuclear War	64	62	3	1	1	1
Pollution	2	6	10	4	2	6
Resources Depletion	2	7	3	1	25	19
Energy Crisis	1	2	2	1	13	10
Land Use	0	3	0	0	7	1

* Figures in this table are responses of teachers in percentages

From the Table 5.26 it is obvious that 'Threat of Nuclear War' has been identified as the most serious environmental problem facing the world by nearly two-thirds of teachers. 'Population Explosion' has been identified as the most serious environmental problem of India by more than 70 per cent of teachers of both categories. While a clear majority (58 per cent) of in-service teachers have identified 'Deforestation' as the most serious environmental problem for Orissa, only a little more than one-third (38 per cent) of pre-service teachers agree with this perception.

Need for Environmental Education

Almost all the teachers (99 per cent in-service and 95 per cent pre-service) were unanimous that offering a course in environmental education is helpful in the solution/prevention of environmental problems (item 7).

Meaning and Nature of Environmental Education

The definition of the term environment (item 1) which encompasses all the living and non-living things in the biosphere, with interactions between and within themselves, has been correctly perceived by little more than two-fifths (42 per cent pre-service and 44 per cent in-service) of teachers.

The comprehensive meaning of the term environmental education (item 2) which includes education, through, about and for the environment, has been correctly grasped by only one-third of pre-service and a small minority (13 per cent) of in-service teachers. One-fifth of teachers of both categories perceive the meaning of environmental education as an approach to teaching where environment is used as a resource for learning. One third of in-service group and 23 per cent pre-service teachers visualise it as education about the environment. Only one-third of in-service group perceive it as education for environment i.e. education for improving environment, the Stockholm sense of the term.

The Goal of Environmental Education

A vast majority (85 per cent pre-service and 87 per cent in-service) of teachers have correctly perceived the goal of environmental education (item 3) as solution of environmental problems through awareness, concern and committed action.

Philosophy of Environmental Education

The man and nature relationship embodying a type of symbiosis and dependency, which represents the underlying philosophy of environmental education (item 4) has been correctly perceived by three-quarters of pre-service teachers and a little more than 80 per cent of in-service teachers.

The Status of Environmental Education

Table 5.27 gives responses of teachers regarding the status of environmental education (item 9) at secondary level as perceived by them in terms of percentages.

Table - 5.27

Status of Environmental Education

Status	Responses of Teachers (in percentages)	
	Pre-service	In-service
A separate subject	34	29
A methodological approach for all subjects	23	13
An interdisciplinary subject	35	54
An appendix to some other subject	8	4
Other status	0	0

From the data in Table 5.27, it is inferred that pre-service teachers have not expressed their clear-cut perception about status of environmental education in the secondary school curriculum. Nearly one-third visualize it as a separate subject, while another one-third of them emphasise its interdisciplinary nature. A small minority (8 per cent) want it as an appendage to some other subject. On the other hand, a majority (54 per cent) of in-service teachers favour an interdisciplinary status for the subject. This may be due to their thorough understanding of the nature of the subject compared to the pre-service teachers. Another thing that emerges clearly from the above analysis is that teachers do not want environmental education to be an appendage to some other subject in the curriculum. Probably they think that this will not give the subject the due importance it deserves in the present context.

Stage of Introduction of Environmental Education

Teachers' perception about the stages at which environmental education should find place in the school curriculum, (item 8) is given in Table 5.28.

Table 5.28

Stage of Introduction of Environmental Education

Stages for Introduction of Environmental Education	Responses of Teachers(in percentages)	
	Pre-service	In-service
Elementary Level	18	26
Secondary Level	29	28
College Level	6	2
Teacher Training Level	7	1
All the above Levels	40	43

Table 5.28 shows that the response of teachers about stages of introduction of environmental education has been varied depending upon individual perception. Nearly two-fifths of teachers of both the categories favour the introduction of the subject right from elementary level to college level and also at the teacher training level. Most of the teachers do not favour its introduction at teacher training level and at college level.

Organisation of Content in Environmental Education Curriculum

A vast majority (86 per cent in-service and 73 per cent pre-service) of teachers have stated that the best way of organising content in environmental education curriculum (item 10) is to keep environmental problems at the focus of such organisation. Other form of organisation of content, such as those based on concepts, laws, theories, themes and those based on activities do not find much acceptance (Only one to ten per cent have opted for it) among the teachers.

Core-curriclum in Environmental Education

Almost all the teachers (98 per cent pre-service and 93 per cent in-service) have perceived the need to have a core-curriclum in environmental education, (item 11) woven into the contents of a particular subject. The views of teachers about the subject, which offers maximum scope for such core-curriculum have been shown in Table 5.29.

Table - 5.29

Core-curriculum in Environmental Education

Subjects offering maximum scope	Response of Teachers (in percentages)	
	Pre-service	In-service
Language	6	11
Mathematics	2	2
Science	29	30
Social Sciences	46	45
Games	3	3
Creative Expression	14	9

From the data in Table 5.29, it is obvious that social sciences offer maximum scope for core-curriculum in environmental education followed by science. Mathematics and Games have been opted by least percentage of teachers.

Concepts/Themes in Environmental Education

The teachers were asked about the suitability or otherwise of a list of 20 concepts/themes (item 12) to be used in environmental education curriculum. Specifically the teachers were asked to pointout the concepts/themes, which were unsuitable for secondary stage. Their responses are summarised in Table 5.30. The list of these 20 concepts/themes was obtained from the list of Environmental Concepts developed by Roth et al(1970) and the Framework for Environmental Education Curriculum developed by W.B. Stapp (1978). The list was also left open-ended asking the teachers to suggest additional concepts/themes for inclusion in the list.

Table - 5.30

Unsuitability of Concepts/Themes in Environmental Education

Concepts/Themes	Responses of Teachers (in percentages)	
	Pre-service	In-service
Ecosystem	17	19
Biosphere	9	7
Space-ship Earth	38	50
Population	14	4
Pollution	16	5
Recycling	26	20
Erosion	20	9
Technology	20	33
Science	6	2
Values	16	23
Environmental Ethics	10	2
Natural Resources	4	3
Conservation	3	5
Problem-solving	9	11
Decision-making	18	21
Energy	17	14

Thus, all the concepts/themes suggested for environmental education have been accepted by teachers with certain reservation. Concepts like ecosystem, space-ship earth, recycling and technology which are considered very important by experts in the field, have been perceived to be unsuitable by 17 to 50 per cent of the teachers. Similarly decision-making, problem-solving, energy and values have been found unsuitable by 9 to 23 per cent of teachers. With a view to knowing as to why these concepts have been perceived to be unsuitable for secondary stage, the investigator met ten

pre-service and in-service teachers each, from among those teachers who had perceived the concepts as unsuitable by selecting them at random. The teachers reported that they themselves, did not know about these concepts/themes and hence have branded them as unsuitable. Interpreting the suitability of concepts/themes in this vein, one can say that all these concepts/themes are suitable for secondary stage and that disagreement, if any, about their inclusion as reported by teachers reflect lack of knowledge and understanding about these concepts/themes. Their lack of knowledge is further supported by the fact that they have failed to supplement this list of concepts/themes.

Focus of Environmental Education

Teacher's perception is divided about the focus of environmental education at secondary school (item 14) level. While 40 per cent of in-service teachers perceive that environmental education should confine itself to local environment 22, 27 and 11 per cent of them favour its scope to be confined to regional, national and global environment respectively. The pre-service teachers are equally divided about limiting the scope of environmental education.

Teacher Training and Environmental Education

A large majority (75 per cent in-service and 62 per cent pre-service) of teachers perceive the existence of environmental education material in the existing secondary school curriculum as inadequate (item 13). Almost all of them (92 per cent) say that environmental education material is practically non-existent in the secondary teachers' pre-service training programme.

Nearly two-fifths of teachers say that existing teacher training courses do not help them to teach environmental education effectively (item 15). On the other hand 41 per cent of pre-service and 54 per cent of in-service teachers say that it does help partially. Since there exists no content matter in the B.Ed. syllabus about environmental education, as stated earlier, it is essentially the methods, field study, activity method and problem solving method which might have been transferred to the teaching of environmental education. An overwhelming majority of teachers (96 per cent in-service and 87 per cent pre-service) perceive the need for a change in the existing secondary teachers pre-service training courses, with additional inputs of environmental education (item 17).

Need for Training in Environmental Education

Almost all the teachers (97 per cent in-service and 94 per cent pre-service) perceive the need for additional training (item 16) in environmental education. This is understandable from their 'low' level of environmental knowledge.

Sources of Environmental Knowledge for Teachers

Teachers were asked to identify the sources (item 18) which they utilised for obtaining their environmental knowledge. The response of teachers expressed in terms of percentage of teachers using a particular source is given in Table 5.31. They also had the option to identify more than one source if they have utilised it for obtaining their environmental knowledge.

Table - 5.31

Sources of Environmental Knowledge of Teachers

Sources	Percentage of teachers using the source	
	Pre-service	In-service
Television	72	75
Newspaper	60	62
Journals and Magazines	56	50
Radio	54	53
School and College Education	23	26
Social contact	19	29
Participation in orientation courses and workshops.	14	18
Pre-service Training	11	7
Teaching Experience	10	12
In-service Training	0	26
Other sources	1	1

From data in Table 5.31 it is obvious that television is the most widely used source of environmental knowledge for teachers followed by print media. Around half of the teachers also rely on print media like newspapers, journals, and magazines. The curriculum at schools and colleges is not the main source of environmental knowledge for teachers, as only about one-fourth of teachers have acknowledged its contribution in enhancing their environmental knowledge.

Constraints in Implementing Environmental Education Programmes

Undertaking field trips and working with community for helping to solve environmental problems are two important facets of environmental education programme in schools.

Teachers were asked (item 19) whether they have sufficient flexibility in school schedule/routine to undertake field trips and work with community. While the in-service teachers who have practical experience of school situations perceive little scope for such endeavours, the pre-service teachers are divided in their perceptions about flexibility. While half of them say that there is scope for such flexibility in the routine, the other half perceive the routine to be too rigid for such work.

However, an overwhelming majority of (95 per cent in-service and 84 per cent pre-service) teachers are in favour of recasting the common school schedule/routine for the above purpose (Item 20).

Table 5.32 gives the summary of other constraints (item 21) perceived by the teacher in implementing environmental education programmes in schools.

Table - 5.32

Constraints in Implementing Environmental Education Programmes

Constraints	Percentage of teachers perceiving the constraints	
	Pre-service	In-service
Public Apathy	65	82
Difficulty in Evaluation of outcomes	46	52
Lack of Trained Teachers	54	43
Inadequacy of Resource Materials	40	21
Other constraints	0	0

As obvious from the data in Table 5.32, indifference of the general public to the programme of environmental education has been perceived as the major stumbling block in implementing environmental education programme. This has been perceived by majority of both categories of teachers. Other constraints as mentioned in the table have been perceived by 21 to 54 per cent of the teachers.

Discussion of Results

The general level of environmental knowledge of both pre-service and in-service teachers' is low. This is evident from their average scores on factual, conceptual and total environmental knowledge, which are less than or just on the borderline of half the maximum possible score. It is further supported by the fact that more than one third of the factual knowledge items and about one-fifth of the conceptual knowledge items could not be answered correctly by 60 per cent or more of both the categories of teachers. This implies that teachers are not keeping themselves abreast of the changes taking place. There seems to be no attempt on their part to update their own subject knowledge-base or explore the inter-relatedness of different disciplines (environmental education calls for an interdisciplinary approach as all environmental problems have social, educational, economic, cultural and natural/physical dimension) to acquire a broader perspective. It seems that the teachers are not exposed to the latest knowledge, trends and techniques in the subject matter. A number of reasons can be ascribed to this.

i) Due to relatively low status and emoluments paid to the teachers in the state of Orissa, the profession does not attract the best talents. Teaching is at the lowest rung of career preference scale for many teachers. They have entered the profession because other better alternatives were not available. Such teachers confine themselves to the four walls of the classroom and beyond school hours, most of them spend a large chunk of their time in private tuitions which earn them a handsome amount. A few, who are not engaged in private tuitions, engage themselves in other lucrative activities like operating shops, acting as agents for insurance companies and non-banking investment firms and even idling away time by politicising. This information was gathered by the investigator during his personal contact with teachers. A microscopic proportion of teachers, who are genuinely interested in their profession, are facing many odds to come up to the expectation.

ii) In spite of the National Council for Teacher Education (NCTE)'s recommendation for inclusion of environmental education components in the pre-service and in-service training programmes for teachers, it is far from being implemented. In-service and refresher courses are organised once in a blue-moon and these are grossly inadequate keeping in mind the need for them.

iii) The scheme of 'Environmental Orientation to School Education' under the National Policy on Education-1986, envisages in-service teacher training in environmental education. But the scheme, it seems, has degenerated and confined itself to raising nurseries and plantation for schools in Orissa.

iv) Paucity of resource persons for in-service training and lack of resources in terms of equipment, supplementary reading and reference materials in environmental education are major stumbling blocks for training of teachers in environmental education. Out of 50 schools the investigator visited, only three schools had some reading material, worth the name pertaining to environmental education. Similarly, of the three teacher training colleges in the district only Regional College of Education, Bhubaneswar, a constituent of NCERT has a handful of reading materials on the subject.

(v) Lack of co-ordination, intermingling and interaction among teacher training colleges, voluntary agencies dealing with environmental education, State Department of Environment and Forests, Pollution Control Board and other supporting agencies, all working in isolation, deprive the teachers of important resource bases.

vi) In Orissa there is no university department of education. The pre-service training is handled by affiliated teacher training colleges. This limits the scope of teacher educators in these colleges to move out of their own shells and seek renewal of subject matter in conjunction with other allied disciplines pertaining to environmental education to extend and enrich their subject base. The programmes of 'Academic Staff College' Orissa located at Bhubaneswar, falls far short of expectation both quantitatively and qualitatively. This was gathered from a few teacher educators who had attended the omnibus orientation

courses of Academic Staff College. The problem is further compounded due to the fact that 'education' is not looked as a pure discipline like physics, chemistry and economics. This sometimes puts teacher educators of teacher training colleges in an embarrassing situation and may be the beginning of the development of a type of complex in their mind. This is indirectly transferred to the school teachers coming in contact with them.

vii) Any innovation when it is first implemented often meets resistance. This is more true of teacher training colleges in the context of environmental education. During July 1989 SCERT, Orissa conducted a workshop to update the elementary and secondary teacher training curriculum for pre-service courses as per NCTE's recommendations. The investigator was a participant in this workshop. Attempts were made to introduce latest content of environmental education as per recommendations of 'UNESCO-UNEP Pre-service Teacher Training Module'. The changes sought to be incorporated were met with stiff resistance from the participants, who were mostly teachers of education on the ground that this will entail inviting teachers of pure disciplines to take classes in teacher training colleges, which will belittle themselves and water down their self-worth. Finally, environmental education was incorporated in the pre-service teacher training curriculum, bereft of its content dimension. The initial reluctance of school teachers to co-operate with the investigator as indicated by their unwillingness to receive the questionnaires, and necessitating, in many

cases, the intervention of headmasters is a classic example of resistance of teaching community to the introduction of innovation.

The low level of environmental knowledge possessed by the pre-service teachers, in addition to implying the fact that existing pre-service teacher training curriculum does not impart requisite environmental knowledge, also reflects their poor educational background or entry characteristics before entering the pre-service course. In other words, this means that existing curricula at school and college level only benefit the students informally as far as their knowledge of environment is concerned. This is further corroborated by the fact that only 23 per cent of pre-service and 26 per cent of in-service teachers admit their school and college education to be a source of their environmental knowledge. The compartmentalisation of higher education into specific disciplines hinders environmental education background of teachers as the latter is interdisciplinary in nature. This brings into focus urgent need for overhauling the curricula at school and college stage for incorporation of environmental education. Special attention should be paid to the non-science disciplines because the study has revealed significant differences in factual and total environmental knowledge between pre-service teachers with science background compared to those with non-science background. The difference can be attributed to the nature of science subjects which contain many elements and competencies common to environmental education to form a broad base.

Since understanding of environmental concepts bank$_S$ on competencies like generalisation and abstraction of related facts which are common to both science and non-sciences, it is no wonder that no significant difference has been obtained in

the mean scores on conceptual environmental knowledge of science and non-science pre-service teachers. Contrary to common expectation, the in-service teachers with science background do not differ significantly from those with non-science background on any of the indices of environmental knowledge. It implies that probably after graduation, science teachers seem to have lost track with the current events in science. They appear to have been teaching science mechanically. The way science teaching was going on in schools, (the investigator observed only chalk and talk method instead of experiments and demonstrations) does not demand much endeavour and perseverance on the part of the teacher and may be responsible for erosion of their knowledge. The routine, stereotyped and mechanical way of teaching science is a matter of great concern and calls for deeper investigation.

The significant difference in the level of environmental knowledge between teachers belonging to high vs low and middle vs. low socio-economic background can be explained on the basis of greater availability of mass media like TV, radio, newspapers, journals and books which the higher and middle socio-economic group can afford more compared to the low socio-economic group. In case of in-service teachers no significant difference in the level of environmental knowledge has been found with reference to their socio-economic background. This may be due to common access to these facilities at schools enjoyed by the low socio-economic group of teachers to be at par with other groups. This brings into focus the need for more facilities in the form of provision of TV, newspapers, journals and reference book at the teacher training colleges for the benefit of pre-service teachers.

The greater environmental awareness of male in-service teachers compared to their female counterparts may be due to the wider exposure of male teachers to the outside world primarily because of their greater mobility. Barring a few female teachers in urban areas all other female teachers with whom the investigator had a discussion, used to spend their outside school hours in domestic chores, with hardly anytime left for academic growth. As reported by them, most of the woman teachers also do not read newspapers. This calls for special refresher courses for in-service women teachers.

The urban-rural divide among both pre-service and in-service teachers, with former possessing significantly more total environmental knowledge can be, due to the direct exposure to and experience in environmental problems. Traffic congestion, inhalation of polluted air, water scarcity, growth of slum areas etc are few of the many environmental problems impinging directly on the urbanites, making them more knowledgeable about environmental problems.

The mean scores on environmental knowledge of in-service teachers also show another perplexing phenomenon, i.e. with more teaching experience their mean score decreases. This can be interpreted as greater environmental knowledge in favour of comparatively young teachers. Although the difference in mean environmental knowledge scores is only significant at conceptual level, this definitely shows a trend. The findings imply that with increasing years in service, teachers become complacent and do not grow their knowledge. This makes old teachers (those with more than ten years of teaching experience) a vulnerable group requiring continuous refresher courses for updating their knowledge.

The favourable attitude towards environment, shown by both the groups of teachers, indicate their concern about happenings in the environment and health of the planet. However, this attitude towards environment is not too strong as obvious from the mean score of 100 and 111 (neutral attitude score being 90 and maximum attitude score being 150) respectively in case of pre-service and in-service teachers. The average environmental attitude score can be explained on the basis of their low/moderate knowledge scores and also the moderate correlation between knowledge and attitude. The significant positive correlation between knowledge and attitude hold potential for inculcating a strong positive environmental attitude among teachers by enhancing their factual and conceptual knowledge through refresher courses. On the contrary, when such a strong positive attitude is developed, it will have transference value and the person will endeavour to become environmentally more literate. As Dispoto (1976) has found; emotion, knowledge and action are all interrelated, acquisition of more knowledge and development of a strong positive attitude help the person to discharge his legitimate role as a citizen in helping to combat environmental problems.

Irrespective of sex, place of residence, subject orientation and teaching experience both in-service teachers and pre-service teachers do not differ among themselves in their environmental attitude. This reflects the concern expressed by all. In-service teachers coming from high socio-economic background possess significantly more favourable attitude than those coming from low socio-economic background. This may be explained on the basis of quantum of environmental knowledge possessed by these two groups.

The 'Threat of nuclear war' between nations has receded appreciably with coming in closer of the two super powers, the changes taking place in Eastern Europe, and crumbling down of Berlin wall. These developments had not taken place at the time of data collection. That seems to be the reason for teachers, identifying 'Threat of nuclear war' as most serious environmental problem of the world. Teachers identification of 'Deforestation' and 'Population explosion' as most serious environmental problem facing Orissa and India respectively, implies that they have correctly understood and realised the intensity of different environmental problems.

The lack of conceptual clarity among teachers about meaning of the term 'environment', 'environmental education' brings home the need for orientation courses for teachers. Their failure to understand the interdisciplinary nature of environmental education, need for its introduction at all stages of education and many basic concepts like space-ship earth, ecosystem and decision-making reflects their knowledge inadequacy. This is further corroborated by teacher's failure to suggest additional concepts for inclusion in environmental education, in addition to those given in the questionnaire.

Analysis of teachers sources of environmental knowledge reveals the important role played by electronic and print media in promoting environmental education. Electronic media exposures have been catchy and forceful but they have been sporadic rather than systematic. Hence, the broadcast and telecast of environmental programmes need to be systematic at a fixed time like the TV serials and other regular features. Constraints for implementing environmental education programmes as perceived by the teachers such as lack of trained teachers, etc. need to be looked into by curriculum planners and administrators.

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