Education for Sustainable Development: A Study on the Attitude and Concerns on Climate Change Issues among Elementary School Teachers of Odisha, India

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Authors’ contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

From fatal heat waves and cruel droughts to devastating floods and fast depleting water tables, climate change is the greatest destructor in the current time creating a threat to all living organisms including human being. Teachers being the agents of social change have an important role to play in moulding the behaviour of children to cope with the climate change stress. The present study was carried out with 462 (222 pre-service and 240 in-service) elementary school teachers taking a Likert type five point attitude scale with 30 items having six dimensions viz., science of climate change, causes of climate change, impacts of climate change, mitigation, national initiatives and policies and politics of climate change.

From the study, it was noted that though both pre-service and in-service teachers had favourable attitude towards climate change issues, pre-service teachers had higher level of concern than in-service teachers as reflected from their attitude scores. Dimension wise pre-service and in-service teachers had favourable attitude towards science of climate change, causes of climate change, impacts of climate change and mitigation, and negative attitude towards national initiatives and policies and politics of climate change.
policies and politics of climate change. Urban teachers were more favourable than rural teachers in first four dimensions studied. However, among in-service teachers rural teachers were more concerned on issues such as impacts of climate change and causes of climate change than on science of climate change, mitigation, national initiatives, policies and politics of climate change. Among pre-service teachers, there was no significant difference in the attitude scores between science and arts teachers, and male and female teachers. However, urban teachers had more favourable attitude than rural teachers. Among in-service teachers, there was significant difference in the attitude scores as far as subject (science/arts) and residence (urban/rural) are concerned. Rural in-service teachers had more favourable attitude than urban teachers.

The correlation between knowledge and attitude showed a positive relationship which reflected that with increase in knowledge there was increase in concern. The relationship between age and attitude showed that with increase in teacher’s age concern for climate change increased.

Keywords: Sustainable development; climate; attitude; elementary school teachers; concern.

1. INTRODUCTION

One of the major concerns that mankind faces today is the threat from global climate change. Rapid consumption of coal and fossil fuels in industry and transport has led to building of green house gases (GHGs) such as CO$_2$ leading to fast rise in temperature. World Commission on Environment and Development [1] in its report “Our common future” reflected that the current trend of economic development and environmental degradation are unsustainable and there is an urgent need to look into the health of the global environment for the future of mankind. As such United Nations Conference on Environment and Development (UNCED, 1992) popularly known as earth summit has called for reorientating education towards sustainable development [2], of the 17 goals set for agenda 2030 to attend a sustainability, goal no 13 calls for climate action [3].

Teachers being the agents of social change do play an active role in moulding the behaviour of learners [4] to promote desired quality for Sustainable Development. It is their level of concern, commitment and devotion that determine the future society and its development in terms of climate change issues. Education is an input as well as a dynamic force besides promoting knowledge, and understanding and disseminating information helps to change the learner’s attitude by giving stress on ethics and morality. In international research, education has been found [5] to increase agricultural productivity, enhance status of women, improve their health, reduce fertility, enhance environmental protection and increase industrial production which has implications for sustainable development. Very little work has been done on environmental sustainable development. Most of the studies to find out the level of environmental knowledge and attitude have been conducted from USA [6,7], Australia [8] and UK [9]. Other studies’ pertaining to knowledge and attitude has also been conducted by many others [10-13]. Reliable instruments such as environment science test and environmental attitude inventory were developed to measure knowledge and attitude of high school students of California, taking ecosystem, natural resources, pollution etc., as basic parameters [10]. From a sample of 15,000 students, it was noted that they had low cognitive information and positive attitude [7]. From Australia, students were found to have inadequate knowledge but positive attitude towards environment [8]. From a sample of 11,000 students in England, it was noted that they had not only good understanding on environmental concepts but also positive attitude [9].

A survey on environmental awareness among students carried out in Gujarat, most of the students were noted to have low level of environmental awareness [14]. Working on various issues on environment such as pollution, conservation of wildlife, forest, sanitation, etc., many workers observed a positive relationship between environmental knowledge and attitude [15-18]. From a study on student’s knowledge and attitude towards conservation of natural resources, it was noted that girl students were more knowledgeable and had a stronger positive attitude than boys [15].

From a survey among scientists and engineers, it was observed that most of the respondents favoured for promoting environmental protection
and more than 87% of the respondents agreed that environmental protection and economic development can go side by side by selecting appropriate technology [19]. Under this background, the present study was conceptualised to study the attitude and concern of elementary school teachers towards climate change.

1.1 Objectives of the Study

The specific objectives of the present study are:

i) To assess and compare the attitude of pre-service and in-service elementary school teachers towards climate change issues and its different dimensions.

ii) To compare the attitude of pre-service and in-service school teachers towards climate change issues with relation to their subject background, place of residence and sex.

iii) To find out the relationship, if any between Age and Attitude towards climate change among in-service male and female elementary school teachers.

2. METHODOLOGY

The present study tries to find out the attitude towards climate change issues and for its different dimensions, viz., science of climate change, causes of climate change, impacts of climate change, mitigation, national initiatives, and policies and politics of climate change.

2.1 Design of the Study

Survey method was followed in the present study. The sample was divided into two main groups (Pre-service and In-service) on the basis of teacher training programme and teaching experience of elementary school teachers. Under each main group, (2x2x2) sub-groups (teacher categories) were put on the basis of residence (Urban and Rural), sex (Male and Female) and subject background (Science and Arts) / subject combination/discipline the teacher pursued during his/her last education.

2.2 Sample

The study was carried on 462 (222 Pre and 240 In-service) elementary school teachers. Stratified random sampling was followed in the study. For stratification, subject combination, sex and residence variables were taken into consideration.

2.3 Tools

In absence of any attitude scale to measure attitude towards climate change issues and further, attitude being culture specific, an attitude scale was developed for collection of required data in the present study. A Likert type five point attitude scale with 30 items was developed following the formal procedure. The items were phrased in such a way as to generate strong reactions among the respondents. Both positive and negative statements keeping climate change concepts in view were prepared. In the construction and editing of the items, all formal criteria [20-22] were taken into consideration. After getting it reviewed by five experts, the reliability of the attitude scale was established using the test-retest method and the co-efficient of correlation was 0.66 which showed moderate reliability. The scale had content validity as evident from the way of its development.

2.4 Data Collection and its Analysis

Questionnaires were distributed to the pre-service and in-service teachers who were requested to fill up the necessary information desired about them. They were asked to read the questions/statements and give their response independently. Further the teachers were encouraged to write their opinion /suggestion, if any at the end of the questionnaires. For pre-service teachers, the investigator distributed the questionnaire in their classroom and collected back after they answered those. In the attitude scale, each item had five possible answers, viz., Strongly Agree (SA), Agree (A), Undecided (UD), Disagree (D) and Strongly disagree (SD). For positive item, the strongly agreed response was given a weight of 5, the agree response a weight of 4, the undecided response a weight of 3, the disagree response a weight of 2 and strongly disagree response a weight of 1. For negative statements, the scoring system was just opposite to the positive items. The total score of all items of a dimension formed the score for that dimension and the scores added up for all the dimensions gave the total attitude score. Analysis of variance (ANOVA) was carried out [23] for each set of data separately following a Factorial design and the treatments were separated by alphabets following Duncan’s Multiple Range Test (DMRT) using CROPSTAT (97-2003) software. To find out relationship among age and attitude linear regression was carried out using the excel worksheet.
3. RESULTS

3.1 Analysis of Variance on Attitude towards Climate Change Issues

Analysis of variance of attitude scores of elementary school teachers towards climate change issues using factorial design, showed service types was significant at 5% level. There was no significant difference among categories of teachers. The interaction between service types and categories of teachers was also insignificant.

3.2 Attitude towards Climate Change Issues of Different Categories of Pre-service and In-service Teachers

There were a total of 30 items divided into six dimensions of climate change attitude scale. A score of 90 represents neutral attitude, any score of more than 90 was considered as a positive/favourable attitude and similarly any score of less than 90 was considered as an indicator of negative/unfavourable attitude towards climate change issues of elementary school teachers.

From the mean attitude scores, it was observed that, all the pre-service and in-service teachers had positive/favourable attitude towards climate change issues. In general, the attitude mean score of pre-service teachers was higher than in-service teachers which mean the pre-service teachers had more favourable attitude than their in-service counterparts. There was significant difference among Arts Urban Male pre-service and in-service teacher’s categories at 1% level of significance. Among pre-service teachers, the Science Rural Female and Arts Urban Female teachers showed the significant difference at 5% level of significance. Among pre-service teachers, there was no significant difference between Science Rural Male and Arts Rural Male; Science Urban Female, Arts Urban Female and Arts Rural Female; Science Urban Male and Science Rural Female categories of teachers. Similarly there was no significant difference among Science Urban Male, Science Urban Female and Science Rural Female, and between Science Rural Male and Arts Rural Female in-service teacher categories (Table 1). Attitude scores of pre-service and in-service teachers have been depicted in Fig. 1.

A combined attitude scores of pre-service and in-service elementary school teachers showed that the science teachers had more favourable attitude than arts teachers (Fig. 2). Looking into place of residence for both urban and rural teachers, the urban pre-service teachers had more favourable attitude than the rural pre-service teachers and the rural in-service teachers were having more favourable attitude than urban in-service teachers (Fig. 3).

3.3 Attitude of Pre-service Teachers on different Dimensions of Climate Change Issues

In the dimension of science of climate change, almost all the teacher categories had a positive attitude with the score being granged from 15.70 to 16.70. There was no significant difference among Science Rural Male, Science Urban Female, Science Rural Female and Arts Rural Female category teachers. Similarly there was no significant difference among Science Urban Male, Arts Urban Male, Arts Rural Male and Arts Urban Female category teachers (Table 2).

Table 1. Mean score on attitude towards climate change issues of different teacher categories of pre-service and in-service elementary school teachers of Odisha

<table>
<thead>
<tr>
<th>Teacher Category</th>
<th>Percent Score</th>
<th>Pre-service</th>
<th>In-service</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUM</td>
<td>100.26a</td>
<td>98.23c</td>
<td>2.02 ns</td>
<td></td>
</tr>
<tr>
<td>SRM</td>
<td>96.26a</td>
<td>98.90b</td>
<td>2.63 ns</td>
<td></td>
</tr>
<tr>
<td>SUF</td>
<td>98.79a</td>
<td>98.70c</td>
<td>0.09 ns</td>
<td></td>
</tr>
<tr>
<td>SRF</td>
<td>100.89a</td>
<td>97.20e</td>
<td>3.69*</td>
<td></td>
</tr>
<tr>
<td>AUM</td>
<td>103.89d</td>
<td>93.40a</td>
<td>10.49**</td>
<td></td>
</tr>
<tr>
<td>ARM</td>
<td>97.00a</td>
<td>98.96b</td>
<td>1.96 ns</td>
<td></td>
</tr>
<tr>
<td>AUF</td>
<td>98.33b</td>
<td>94.66b</td>
<td>3.66*</td>
<td></td>
</tr>
<tr>
<td>ARF</td>
<td>98.13b</td>
<td>101.06e</td>
<td>2.93 ns</td>
<td></td>
</tr>
</tbody>
</table>

In a column, means followed by a common letter are not significantly different at the 5% level by DMRT
For a row, ** Significant at 1% level, * Significant at 5% level, ns= Not significant; S=Science, A=Arts, U=Urban, R=Rural, M=Male and F=Female

40
Fig. 1. Mean score in attitude on climate change issues of pre-service and in-service elementary school teachers (science and arts; male and female; urban and rural) of Odisha

Fig. 2. Average attitude score on climate change issues of pre-service and in-service (ps+is) (science, arts, urban, rural, male and female) elementary school teachers of Odisha
In the dimension of causes of climate change, the highest attitude score was with Arts Urban Male (20.88) category teachers whereas the lowest was with Arts Rural Male (16.87) teachers. In the science category teachers, there was no significant difference among Science Urban Male and Science Rural Female teachers whereas with arts background teachers, the difference among Arts Urban Female and Arts Rural Female teachers was statistically insignificant. All the elementary school teachers had favourable attitude towards the causes of climate change (Table 2).

Looking into the impacts of climate change, the attitude score ranged from 16.99 to 18.74 (Fig. 3) and all the teachers had favourable attitude reflecting their high concerns. The Science Urban Male and Science Rural Female teachers showed similar attitude score of 18.74 . There was no significant difference with Science Urban Female and Arts Rural Female teacher categories.

In the mitigation dimension, all the pr-service teachers had positive attitude with score ranged from 16.74 to 19.47 (Fig. 4). There was no significant difference in the scores among Science Urban Female, Arts Rural Male, Arts Urban Female and Arts Rural Female teachers. Similarly there was no significant difference in the scores among Science Urban Female, Science Rural Female and Arts Urban Male teachers.

### Table 2. Mean score on attitude towards different dimensions of climate change issues among pre-service elementary school teachers of Odisha

<table>
<thead>
<tr>
<th>Pre-Service Teacher Category</th>
<th>Science of Climate Change</th>
<th>Causes of Climate Change</th>
<th>Impacts of Climate Change</th>
<th>Mitigation</th>
<th>National Initiatives</th>
<th>Policies and Politics of Climate Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUM</td>
<td>16.55&lt;sup&gt;b&lt;/sup&gt;</td>
<td>19.31&lt;sup&gt;d&lt;/sup&gt;</td>
<td>18.74&lt;sup&gt;c&lt;/sup&gt;</td>
<td>19.47&lt;sup&gt;d&lt;/sup&gt;</td>
<td>12.06&lt;sup&gt;b&lt;/sup&gt;</td>
<td>14.12&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>SRM</td>
<td>15.70&lt;sup&gt;a&lt;/sup&gt;</td>
<td>19.00&lt;sup&gt;d&lt;/sup&gt;</td>
<td>16.99&lt;sup&gt;a&lt;/sup&gt;</td>
<td>16.74&lt;sup&gt;b&lt;/sup&gt;</td>
<td>14.51&lt;sup&gt;b&lt;/sup&gt;</td>
<td>13.33&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>SUF</td>
<td>15.88&lt;sup&gt;c&lt;/sup&gt;</td>
<td>18.44&lt;sup&gt;c&lt;/sup&gt;</td>
<td>18.48&lt;sup&gt;c&lt;/sup&gt;</td>
<td>17.85&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>14.44&lt;sup&gt;b&lt;/sup&gt;</td>
<td>13.70&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>SRF</td>
<td>16.03&lt;sup&gt;a&lt;/sup&gt;</td>
<td>19.36&lt;sup&gt;d&lt;/sup&gt;</td>
<td>18.74&lt;sup&gt;c&lt;/sup&gt;</td>
<td>18.14&lt;sup&gt;c&lt;/sup&gt;</td>
<td>14.66&lt;sup&gt;c&lt;/sup&gt;</td>
<td>13.96&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>AUM</td>
<td>16.49&lt;sup&gt;b&lt;/sup&gt;</td>
<td>20.88&lt;sup&gt;c&lt;/sup&gt;</td>
<td>17.65&lt;sup&gt;b&lt;/sup&gt;</td>
<td>18.67&lt;sup&gt;c&lt;/sup&gt;</td>
<td>15.80&lt;sup&gt;d&lt;/sup&gt;</td>
<td>14.41&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>ARM</td>
<td>16.70&lt;sup&gt;b&lt;/sup&gt;</td>
<td>16.87&lt;sup&gt;c&lt;/sup&gt;</td>
<td>17.23&lt;sup&gt;b&lt;/sup&gt;</td>
<td>17.47&lt;sup&gt;b&lt;/sup&gt;</td>
<td>14.52&lt;sup&gt;b&lt;/sup&gt;</td>
<td>14.22&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>AUF</td>
<td>16.07&lt;sup&gt;b&lt;/sup&gt;</td>
<td>17.57&lt;sup&gt;b&lt;/sup&gt;</td>
<td>17.60&lt;sup&gt;b&lt;/sup&gt;</td>
<td>17.53&lt;sup&gt;b&lt;/sup&gt;</td>
<td>14.43&lt;sup&gt;b&lt;/sup&gt;</td>
<td>15.13&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>ARF</td>
<td>16.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>17.63&lt;sup&gt;b&lt;/sup&gt;</td>
<td>17.90&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>17.17&lt;sup&gt;b&lt;/sup&gt;</td>
<td>14.93&lt;sup&gt;c&lt;/sup&gt;</td>
<td>14.50&lt;sup&gt;cd&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

In each column, means followed by a common letter are not significantly different at 5% level by DMRT


![Fig. 3. Mean score in attitude on climate change issues of pre-service and in-service (urban and rural) elementary school teachers of Odisha](image)
In the dimensions of national initiatives, except Arts Urban Male (15.80) teachers, all other had negative attitude. There was no significant difference in the scores among Science Urban Female, Arts Rural Male and Arts Urban Female category teachers. Similarly there was no significant difference between Science and Arts Rural Female teacher categories.

Looking into the policies and politics of climate change dimension, all elementary school teachers had unfavourable attitude with value ranged between 13.33 and 14.50. The average attitude score for arts teachers was better than science teacher categories. There was no significant difference in the scores among Science Urban Female and Science Rural Female teachers.

In general, average mean attitude score of science teachers was better than arts teachers. In dimensions such as causes of climate change, impacts of climate change and mitigation, the science teachers were more positive in their attitude than the arts teachers.

On gender basis, the male pre-service teachers were more favourable attitude than female teachers in the dimension of science of climate change, causes of climate change and mitigation. On the other hand female teachers were more favourable attitude than their male counterparts in the dimension of impacts of climate change, national initiatives, and policies and politics of climate change.

The pre-service elementary school teacher’s attitude scores in descending order were causes of climate change > impacts of climate change > mitigation > science of climate change > national initiatives > policies and politics of climate change (Fig. 4).

3.4 Attitude of In-service Teachers on Different Dimensions of Climate Change Issues

In the dimension of science of climate change, the attitude score of in-service teachers ranged from 16.23 to 17.40 reflecting their positive attitude. There was no difference in the scores among Science Rural Male, Science Urban Female and Arts Rural Male, and Science Rural Female and Arts Urban Male teachers. Similarly there was no difference in the scores among
Science Urban Male, Arts Urban Female and Arts Rural Female teacher categories (Table 3).

In the causes of climate change dimension, the average attitude scores of Science teachers were higher than their Arts counterparts. The scores of science and arts teachers varied from 18.40 to 19.00, and 16.57 to 18.90 respectively. There was no significant difference in the scores among Science Urban Male, Science Rural Male, Science Urban Female, Arts Rural Male, and Arts Rural Female teachers.

In the dimension of policies and politics of climate change, the attitude score of in-service elementary school teachers ranged from 13.27 to 14.63 reflecting their negative attitude.

In general, science and arts in-service teachers showed similar trend as in case of pre-service science and arts elementary school teachers (Fig. 5). The rural teacher's attitude score was more than the urban teachers in the dimension of causes of climate change, impacts of climate change, and policies and politics of climate change. Similarly the urban teachers had more favourable attitude than their rural counterparts in the dimension of science of climate change and national initiatives. Almost the same attitude mean score was noticed in the mitigation dimension of urban and rural teachers. The descending order of attitude score of in-service teachers for different dimensions was causes of climate change > impacts of climate change > science of climate change > mitigation > national initiatives > policies and politics of climate change (Fig. 4).

### 3.5 Attitude on Climate Change Issues with Relation to Specific Variables

#### 3.5.1 Pre-service teachers

#### 3.5.1.1 Subject orientation

Looking into subject background, both the science and arts teachers had favourable attitude and the average scores were 99.05 and 99.34 respectively. There was no significant difference in the scores of science and arts pre-service elementary school teachers (Table 4).

<table>
<thead>
<tr>
<th>In-Service Teacher Category</th>
<th>Science of Climate Change</th>
<th>Causes of Climate Change</th>
<th>Impacts of Climate Change</th>
<th>Mitigation</th>
<th>National Initiatives</th>
<th>Policies and Politics of Climate Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUM</td>
<td>17.40&lt;sup&gt;a&lt;/sup&gt;</td>
<td>18.53&lt;sup&gt;b&lt;/sup&gt;</td>
<td>17.17&lt;sup&gt;c&lt;/sup&gt;</td>
<td>17.17&lt;sup&gt;c&lt;/sup&gt;</td>
<td>14.70&lt;sup&gt;c&lt;/sup&gt;</td>
<td>13.27&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>SRM</td>
<td>16.43&lt;sup&gt;a&lt;/sup&gt;</td>
<td>18.40&lt;sup&gt;b&lt;/sup&gt;</td>
<td>18.10&lt;sup&gt;c&lt;/sup&gt;</td>
<td>17.37&lt;sup&gt;c&lt;/sup&gt;</td>
<td>14.13&lt;sup&gt;b&lt;/sup&gt;</td>
<td>14.47&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
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<td>18.53&lt;sup&gt;b&lt;/sup&gt;</td>
<td>19.27&lt;sup&gt;d&lt;/sup&gt;</td>
<td>16.60&lt;sup&gt;d&lt;/sup&gt;</td>
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<td>14.10&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
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<td>19.00&lt;sup&gt;c&lt;/sup&gt;</td>
<td>19.00&lt;sup&gt;d&lt;/sup&gt;</td>
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<td>14.53&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
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<td>15.33&lt;sup&gt;d&lt;/sup&gt;</td>
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<td>ARM</td>
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<td>18.90&lt;sup&gt;b&lt;/sup&gt;</td>
<td>18.03&lt;sup&gt;c&lt;/sup&gt;</td>
<td>16.87&lt;sup&gt;d&lt;/sup&gt;</td>
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<td>14.20&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td>AUF</td>
<td>17.13&lt;sup&gt;c&lt;/sup&gt;</td>
<td>16.63&lt;sup&gt;b&lt;/sup&gt;</td>
<td>16.80&lt;sup&gt;d&lt;/sup&gt;</td>
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<td>14.27&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>ARF</td>
<td>17.33&lt;sup&gt;c&lt;/sup&gt;</td>
<td>18.83&lt;sup&gt;d&lt;/sup&gt;</td>
<td>19.57&lt;sup&gt;d&lt;/sup&gt;</td>
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<td>14.33&lt;sup&gt;d&lt;/sup&gt;</td>
<td>14.63&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

*In each column, means followed by a common letter are not significantly different at 5% level by DMRT.*

3.5.1.2 Sex

On gender basis, the male teachers had favourable attitude as compared to their female counterparts. Though both male and female teachers had favourable attitude, there was no significant difference in the scores between the two groups.

3.5.1.3 Residence

Both urban and rural teachers had positive attitude towards climate change. The attitude mean scores were 100.32 and 98.08 for urban and rural teachers respectively. There was significant difference in their attitude scores at 1% level of significance (Table 4).

3.5.2 In-service teachers

3.5.2.1 Subject orientation

Both the science and arts in-service elementary school teachers had favourable attitude and the mean scores were 98.26 and 97.03 respectively. The science teachers had more favourable attitude than arts teachers and there was significant difference in their scores at 1% level of significance (Table 5).

3.5.2.2 Sex

The male and female teachers had favourable attitude and the mean scores were 97.38 and 97.91 respectively. Female teachers had higher attitude scores than their male counterparts, though there was no significant difference in the scores between the two groups.

3.5.2.3 Residence

Looking into the residence, both urban and rural teachers had favourable attitude with scores of 96.25 and 99.03 respectively. The rural in-service teachers had more favourable attitude than urban teachers. There was significant difference in the attitude scores at 1% level of significance.
Table 4. Sample size (N), Mean score (Mn) in percent, Standard deviation (SD) and ‘t’ value about attitude on climate change issues of pre-service elementary school teachers of Odisha

<table>
<thead>
<tr>
<th>Teacher Category</th>
<th>Sample size (N)</th>
<th>Mean Score (Mn)±SD</th>
<th>‘t value’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>108</td>
<td>99.05±2.06</td>
<td>0.83 ns</td>
</tr>
<tr>
<td>Arts</td>
<td>114</td>
<td>99.34±3.09</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>108</td>
<td>99.36±3.49</td>
<td>0.90 ns</td>
</tr>
<tr>
<td>Female</td>
<td>114</td>
<td>99.04±1.27</td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>111</td>
<td>100.32±2.52</td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>111</td>
<td>98.08±2.03</td>
<td></td>
</tr>
</tbody>
</table>

**= Significant at 1% level; *= Significant at 5% level; ns= Not Significant

Table 5. Sample size (N), Mean score (Mn) in percent, Standard deviation (SD) and ‘t’ value about attitude on climate change issues of in-service elementary school teachers of Odisha

<table>
<thead>
<tr>
<th>Teacher Category</th>
<th>Sample size (N)</th>
<th>Mean Score (Mn)±SD</th>
<th>‘t value’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>120</td>
<td>98.26±0.76</td>
<td>3.66**</td>
</tr>
<tr>
<td>Arts</td>
<td>120</td>
<td>97.03±3.60</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>120</td>
<td>97.38±2.67</td>
<td>1.62 ns</td>
</tr>
<tr>
<td>Female</td>
<td>120</td>
<td>97.91±2.68</td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>120</td>
<td>96.25±2.62</td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>120</td>
<td>99.03±1.52</td>
<td>9.95**</td>
</tr>
</tbody>
</table>

**= Significant at 1% level; *= Significant at 5% level; ns= Not Significant

3.6 Relationship between Age and Attitude of Male and Female Teachers towards Climate Change Issues

The relationship between age and attitude towards climate change was found to be positive for both male and female in-service elementary school teachers. The R² values for male and female teachers were 0.897 and 0.963 respectively. The concern increased with increase in age in years. With an increase of one year in age, there was an increase of 0.98 and 0.95 units in terms of attitude and concern for male and female in-service teachers respectively (Figs. 6 & 7).

3.7 Correlation between Knowledge and Attitude towards Climate Change Issues

The correlation between knowledge and attitude scores showed a positive relationship both for pre-service (Fig. 8) and in-service teachers (Fig. 9). It reflected that with increase in knowledge there was an increase in attitude for both the groups of teachers.

4. DISCUSSION

Global climate change caused by the fast rise in greenhouse gases (GHGs) in the environment has damaged the ecosystem, reflected through scarcity of water resource, melting of ice caps, rise in sea level, flood, drought, cyclone, social conflicts, etc.

Now the challenge [24] is to live sustainably and well within the material limits of the finite planet. In what is known as the Paris Agreement (2015), the countries around the world promised to limit the rise in temperature to 2°C above the pre industrial age. Further all efforts are being made to limit temperature rise to 1.5°C by 2030 failing which could lead to irreversible destruction, may be extinction of all life forms including human being. In order to ensure that the planet is liveable and to keep the global temperature under 1.5°C by 2030, it is realised that the world must reduce global CO₂ emissions by 45 percent of the levels that were in 2010 and make it absolutely zero by 2050.
Fig. 6. Relationship between age (in years) and attitude on climate change for in-service male elementary school teachers of Odisha

\[ y = 0.509x + 75.36 \]
\[ R^2 = 0.897 \]
\[ r=0.95 \]

Fig. 7. Relationship between age (in years) and attitude on climate change for in-service female elementary school teachers of Odisha

\[ y = 0.765x + 73.69 \]
\[ R^2 = 0.963 \]
\[ r=0.98 \]
Fig. 8. Correlation between knowledge and attitude towards climate change issues for pre-service elementary school teachers of Odisha

\[ y = 0.103x + 93.06 \]
\[ R^2 = 0.026 \]
\[ r = 0.162 \]

Fig. 9. Correlation between knowledge and attitude towards climate change issues for in-service elementary school teachers of Odisha

\[ y = 0.163x + 88.86 \]
\[ R^2 = 0.070 \]
\[ r = 0.266 \]
As teachers act as agents of social change, they have very important role to play in moulding the behaviour of children (Future citizens of the country) through changing their life style to cope with the changing climate. Sustainable life style of the individual can lead to a sustainable communities to sustainable nations and then to a sustainable globe [4].

From the present study, it was noted that both pre-service and in-service teachers have a positive attitude towards climate change. Pre-service teachers had higher concern than in-service teachers. This could be due to the facts that all people in the society including teachers have environmental concerns as realised in daily life. The issues are highlighted in the media, print and non-print regularly. Pre-service teachers realise the environmental issues more than in-service teachers. This could be due to their understanding of environmental problems and climate change issues as it is a contemporary concern and forms a part of school and college curricula currently [25]. Low level of knowledge among in-service teachers could be either due to lack of initiative by the teachers to keep themselves abreast of the contemporary concerns/developments or having a lack of training or both.

It was further noted that science teachers had a higher level of concern than arts teachers. This possibly is due to that all science curricula carry the concepts relating to environment, ecosystem, and environmental problems at school and college level. Further urban pre-service teachers had a strong concern as compared to their rural counterparts. This possibly due to that urban teachers have high level of exposure to polluted environment, dust, traffic jam, heat waves, foul smell, etc., that makes them restless. Similar observations have been made by others [26]. In-service teachers with rural background were found to have more favourable attitude than urban teachers contrary to pre-service teachers.

Regarding different dimensions of climate change, pre and in-service teacher had a positive attitude towards causes of climate change, impacts of climate change, science of climate change and a negative attitude towards national initiatives and policies and politics of climate change. This could be possible due to that teachers understand and realise the causes and impacts of climate change in their day to day life. They have also studied the concepts of weather and climate in their school and college careers in the science and social science text books. Poor knowledge in national and international policies such as Kyoto protocol, IPCC, carbon emission by developing and developed countries, green energy, United Nations Framework Convention on Climate Change (UNFCC), National climate change action plan, etc., had build a negative attitude in their mind. In the current study we have also observed that with increase in education there is an increase in their concern and attitude. Similar observation has also been made in earlier studies [27]. Thus there is an urgent need to provide orientation and training in the areas of environment, climate change and sustainable development to in-service elementary school teachers. This will enhance their knowledge leading to rise in concern and care for the nature and natural resources. From the study it was also noted that with increase in age of the in-service teachers there was increase in their attitude towards climate change issues. This possibly could be because of exposure to hazardous situation and experience with changing climate leads to realisation of the problems.

Though a lot of studies have been carried out on science of climate change, studies on climate change education are very limited. A study by Synuvate global [28] across 21 countries in the world observed that Canadians were the most concerned about climate change. After Canadian, Australians (84%) and Americans (57%) showed concerned about climate change. Most of the people blame the USA for climate problems. However, Canadian people prepared to take global lead in tackling climate issues.

A study [29] on Colorado public school teachers in 2007 on the topic of climate change instruction reflected that majority of science teachers were in favour of including climate and climate change in their courses. However majority of other teachers only informally discuss about climate change. Certain miss-conceptions about climate change area were wide spread among teachers. From the study, it was found that science teachers should benefit from professional development that focuses on climate science best practice in climate instruction and communication.

From a study on climate change on knowledge and attitude of pre-service and in-service Novascovia teachers [30], it was noted that teachers had high level of concern about the impacts of climate change as noted in the
present study and reported relatively low levels of self-perceived climate change knowledge. In spite of having good knowledge on recent science and climate-specific questions, teachers had a number of climate change misconceptions and misunderstandings. At the same time, they showed strong support for additional learning opportunity and reported that they presently received a little climate change information from University courses or government sources or professional studies. Teachers generally support strong action on climate change including government-led, individual, and community-based actions.

A study on the assessment of the knowledge, attitude, and practices on climate change education among secondary school teachers in Tehran, Iran reflected that teachers are equipped with appropriate knowledge and moderate levels of attitude but their practices were weak. Male teachers were having better knowledge and attitude than female teachers. However female teachers were having better practices than their male counterparts [31]. From a study on 400 voluntary individuals from Turkey it was noted that 94% of individuals had good knowledge on climate change issues [32].

The study from Israel [33] on teacher’s knowledge and attitude showed a gap on climate change consequences and misconceptions about the causes of climate change. The anthropogenic cause of climate change was well understood. There was a significant correlation between knowledge and attitude about the consequences of climate change and readiness to handle those.

In a study among USA students and teachers on climate change and beliefs, it was observed [34] that almost all students and teachers believed that climate change is happening but only few students believed that it is anthropogenic. Teachers believe the global warming had no relationship with student outcomes.

From Philippines [35] it was reported that knowledge, attitude, practices, and action on climate change in 22 villages. It reflected that the villagers had a moderate level of knowledge. Their environmental awareness did not translate into involvement in environmental conservation and protection.

Very limited study has been carried out in India. A study on senior secondary school students of Kochi, Kerala [36] it was noticed that all students had concern for the degrading environment. The attitude for protecting environment was high among majority of the students. About 53% of students had a poor level of practice concerning the environment.

5. CONCLUSION
As climate change and global warming are global issues, there is an urgent need to organize orientation and training programmes in the areas of environmental education, and climate change for the in-service teachers in order to improve their knowledge, promote participation in environmental conservation and bring change in their life style. There is a need for change the pre-service teacher training curricula putting stress on climate change and green life style as classroom teaching needs to be linked to life in the outside world.

CONSENT
As per international and university standard, participants written consent has been collected and preserved by the author (s).

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COMPETING INTERESTS
Authors have declared that no competing interests exist.

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