CHAPTER 6
6.1 Chapter preview

This chapter deals with the analysis of the data obtained through the administration of the questionnaires on the assessment of students knowledge, behaviour, attitude and skills on various environmental issues mainly focused on water, air, biodiversity conservation and solid waste management. The analysis and interpretations of student’s knowledge, behaviour, attitude and skills on water, air, biodiversity conservation and solid waste management and their local concern, prevention, control and conservation issues were presented.

Each test item of the questionnaire was coded into four domains (behaviour, attitudes, knowledge and skills), and then coded into five test themes (water, air, biodiversity conservation and solid waste management). A two tailed t-test was used to determine whether the active EESD teaching learning approach had any significant effect on the post-test results. The results revealed that there was a significant difference between pre and post test results.

6.2 Student’s Assessments on Water quality

Statistical analysis have shown that there was a significant increase in student’s knowledge, skills, attitudes and behaviours on water quality issues among the members of the experimental group (Figure 11,12,13 and 14).

![Water Quality Studies](image)

**Figure 11** statistical analyses of student’s attitude, behaviour, skills and knowledge - Javagar Navodya Vidyalaya, Puducherry.
**Figure 12** statistical analyses of student’s attitude, behaviour, skills and knowledge on water quality - Chewalier Sellane Government Higher Secondary School Puducherry.

**Figure 13** statistical analyses of student’s attitude, behaviour, skills and knowledge - Makkal Thalaivar Vasudeva Subya Government High School, Puducherry.
There was a significant increase (P>0.05 level) in experimental group students on knowledge on the fundamental concepts of water quality studies. These include definition of water pollution, global distribution of water on earth, various water pollution sources and control and prevention methods besides conservation of water at local level (CSS -t = 6.7, p <0.05; JNV -t=5.0, p <0.05; MTV -t=6.73, p <0.05; VV -t=4.0, p <0.05; CON- t=1.1, p <0.05).

The post test results revealed that student’s skills have improved in manipulating the water quality assessment instruments and monitoring the drinking water quality from the school as well as local residential areas was found (CSS-t = 12.122, p< 0.05; JNV- t = 11.99, p< 0.05; MTV-t = 10.10, p< 0.05; VV-t = 6.4, p< 0.05 CON-t=0.8, p <0.05). The attitudes towards conserving and protecting local drinking water sources were significantly higher at P>0.05 level in experimental group than the control group (CSS-t = 6.70, p < 0.05; JNV-t = 5.4, p< 0.05; MTV-t = 4.7, p< 0.005; VV-t = 3.7, p< 0.05 CON- t=1.6, p <0.05).

There was a significant difference between pre and post test results on behavioural changes on water quality issues related to water conservation (CSS-t = 12.10, p< 0.05; JNV-t = 4.6, p< 0.005; MTV -t = 6.4, p< 0.05; VV-t =2.5, p< 0.05; CON-t=1.4, p <0.05).

**6.2.1 Student’s Assessments on Air quality**

The post test analysis revealed that there was a significant difference in experimental students knowledge on air quality studies such as the basic concepts of air pollution, composition of air in the atmosphere, sources of air pollution (anthropogenic and natural), various air pollutants and their origin (primary and secondary), effects of air...
pollution on human, plants, environment and its associated problems such as, green house effect, global warming and climate change. Whereas in control group students there was no significant difference in between pre and post test analysis (CSS-t = 11.34, p <0.05; JNV-t = 5.1, p< 0.05; MTV -t = 12.34, p< 0.05; VV-t =4.6, p< 0.05; CON-t=1.4, p <0.05).

The analytical skills significantly improved among experimental group students in comparison to the control group on handling of air quality monitoring kits and monitoring physical chemical concentration in sampled air such as nitrogen dioxide NO2, sulphur dioxide SO2 and suspended particulate matter (SPM) from various places ranging from school campuses, highways and nearby industrial places. (CSS-t = 15.1, p <0.05; JNV-t = 8.16, p< 0.05; MTV -t = 12.1, p< 0.05; VV-t =3.6, p< 0.05; CON-t=1.8, p <0.05) The average post-attitude score of the students in the experimental group were significantly greater - at 0.05 level (CSS-t = 11.34, p <0.05; JNV-t = 6.7, p< 0.05; MTV -t = 12.34, p< 0.05; VV-t =4.6, p< 0.05; CON-t=2.4, p <0.05). The active EESD teaching strategy has enabled the students to gain positive attitudes towards the air quality studies and towards actions towards protection of local air quality.

The questionnaires on students behavioural changes to minimize the air pollution and protect air quality at school level as well as at local level was found significantly higher in experimental group students (CSS-t = 7.9, p <0.05; JNV-t = 6.6, p< 0.05; MTV -t = 13, p< 0.05; VV-t =6.6, p< 0.05; CON-t=1, p <0.05) whereas in the control group students there was not much difference between pre and post test analysis (Figure 15,16,17 and 18).

![Air Quality Studies](image)

**Figure 15** statistical analyses of student’s attitude, behaviour, skills and knowledge on air quality- Javagar Navodya Vidyalaya students, Puducherry.
**Figure 16** statistical analyses of student’s attitude, behaviour, skills and knowledge on air quality - Chewalier Sellane Government Higher Secondary School Puducherry.

**Figure 17** statistical analyses of student’s attitude, behaviour, skills and knowledge on air quality - Makkal Thalaivar Vasudeva Subya Government High School, Puducherry.
6.2.2 Students assessment on biodiversity conservation

There was a significant increase (CSS\(t = 3.64, p < 0.05\); JNV\(t = 5.64, p < 0.05\); MTV\(t = 7.71, p < 0.05\); VV\(t = 7.3, p < 0.05\); CON\(t = 2.64, p < 0.05\)) in students biodiversity knowledge such as defining the term biodiversity, levels of biodiversity, importance of biodiversity, causes of biodiversity loss and conservation of biological diversity in the case of the experimental group. Students reported significantly higher values (CSS\(t = 12.2, p < 0.05\); JNV\(t = 8.6, p < 0.05\); MTV\(t = 8.1, p < 0.05\); VV\(t = 5.6, p < 0.05\); CON\(t = 1, p < 0.05\)).

Biodiversity assessment skills, such as identifying plants and animal species and identifying human threats to biodiversity and conservation strategies, various biodiversity process skills such as oral communication about biological resources, written communication about biodiversity issues, identifying conservation problems, gathering credible information to support a project, sorting and filtering diverse sources of information, applying critical thinking to solve biodiversity problems, collecting data and managing information and working collaboratively with and in a group besides attitudinal changes towards the conservation and protection of local biodiversity and its protection/conservation significantly increased in experimental group students (CSS\(t = 10.9, p < 0.05\); JNV\(t = 16.7, p < 0.05\); MTV\(t = 4, p < 0.05\); VV\(t = 3.2, p < 0.05\); CON\(t = 1, p < 0.005\)).
Behavioural changes in conservation and protection of local biodiversity significantly increased in the case of the experimental group (CSS-$t$ = 4.9, $p < 0.05$; JNV-$t$ = 14.2, $p < 0.05$; MTV-$t$ = 7.1, $p < 0.05$; VV-$t$ = 6.8, $p < 0.05$; CON-$t$ = 1.8, $p < 0.05$) (Figure 19, 20, 21 and 22).

**Figure 19** statistical analyses of student’s attitude, behaviour, skills and knowledge on biodiversity conservation - Javagar Navodya Vidyalaya students, Puducherry.

**Figure 20** statistical analyses of student’s attitude, behaviour, skills and knowledge on biodiversity conservation - Chewalier Sellane Government Higher Secondary School Puducherry.
**Figure 21** statistical analyses of student’s attitude, behaviour, skills and knowledge on biodiversity conservation - Makkal Thalaivar Vasudeva Subya Government High School, Puducherry.

**Figure 22** statistical analyses of student’s attitude, behaviour, skills and knowledge on biodiversity conservation - Valliamal Vidyalaya Matric Higher Secondary School, Cuddalore.
6.2.3 Solid waste management

The post-test results revealed that there was significant increases in experimental group student’s knowledge on solid waste issues such as the problems associated with wastes, classification of waste and its characterization, various management strategies which includes the 4R concept; refuse, reduce, reuse and recycle besides this microbial compost and vermi-compost (CSS-\( t = 12.3, p < 0.005 \); JNV-\( t = 10.7, p < 0.005 \); MTV-\( t = 11.1, p < 0.005 \); VV-\( t = 9.8, p < 0.005 \); CON-\( t = 2.8, p < 0.005 \)) while control group reported that there was not much difference in post test results.

Students skills such as classification, quantification of waste and sustainable way of waste management methods such as microbial and vermi-compost for the experimental group portrayed higher values than the control group students (CSS-\( t = 4.9, p < 0.005 \); JNV-\( t = 14.2, p < 0.005 \); MTV-\( t = 7.1, p < 0.005 \); VV-\( t = 6.8, p < 0.005 \); CON-\( t = 1.8, p < 0.005 \)).

The attitudes towards the segregation and management of waste at school level as well as local level improved through the active EESD teaching strategy among the experimental group students (CSS-\( t = 8.9, p < 0.005 \); JNV-\( t = 13.2, p < 0.005 \); MTV-\( t = 8.8, p < 0.005 \); VV-\( t = 5.3, p < 0.005 \); CON-\( t = 1.7, p < 0.005 \)) whereas in control group there was not much difference between pre and post test (Figure 23, 24, 25 and 26).

![Solid Waste Management](image)

**Figure 23** statistical analyses of student’s attitude, behaviour, skills and knowledge on solid waste management - Javagar Navodya Vidyalaya students, Puducherry.
Figure 24 statistical analyses of student’s attitude, behaviour, skills and knowledge on solid waste management - Chewalier Sellane Government Higher Secondary School Puducherry.

Figure 25 statistical analyses of student’s attitude, behaviour, skills and knowledge on solid waste management - Makkal Thalaivar Vasudeva Subya Government High School, Puducherry.
There was a significant statistical difference between the pre and post test overall on student’s environmental knowledge, behaviour, attitude, and skills level of the students who have been educated by active EESD teaching strategies and the students who have been educated by the traditional instructional methods. The former (EESD group) have gained significantly more overall p value $t = 9.16$, $p < 0.05$. They have gained more basic conceptual knowledge on air, water, biodiversity conservation and solid waste management than the students who have been educated by the traditional teaching methods with existing curriculum.

6.3 Discussion

6.3.1 The Effectiveness of Active EESD program

There was a statistically significant difference between the pre and post test assessments on student’s environmental knowledge, behaviour, attitude, and skills. Students who have been exposed to active EESD teaching strategies have gained more knowledge, behaviour, attitude and skills on environment with special focuses on air, water, biodiversity conservation and solid waste management.

The results of this study are consistent with the other studies that showed a significant increase in learning gains as well as concern for the environment after a
biodiversity education and environmental science courses (Leeming, 1993; Zelezny, 1999; Humston and Orti, 2007; Anderson et al., 2007; Hagenbuch et al., 2009). Despite the small sample size in this experimental study, knowledge, skills, attitudes and behaviour gains were recorded, across different types of schools—such as government, residential and private schools, and with different amounts of time devoted to the materials. This indicates that the activity based environmental education module (EESD) is an effective tool in a wide range of settings and situations. The results of this study support the concept that environmental attitudes may be based on different sources of information (Julie and Pooley, 2000; Moira and Connor, 2000) that could lead to specific environmental information—cognition, emotions and feelings. Studies related to attitudes assessment on students that are made through direct experiences are also seen as better predictors of behaviour (Millar and Millar, 1996). This suggests that understanding the basis of an attitude is important for behavioural changes. The ultimate objective of environmental education is to change behaviour; it is essential first to understand the basis of environmental attitudes to assist changing environmental behaviour.

The multiple teaching learning approaches had an effect on the student’s attitudes towards conserving and protecting the local precious natural resources. The results of the present study is consistent with the findings of Pooley and Connor (2007) that support the concept that environmental attitudes may be based on different sources of information. The improved environmental behaviour on specific issues reported in this study such as increased levels of protection and conservation of local air quality and water quality studies, biodiversity conservation and solid waste management are in agreement with reported research (Hungerford and Volk, 1990). The active EESD teaching strategy was used in this research showed significant differences in students overall changes in knowledge, attitudes, behaviour and skills was in agreement with the findings recorded by Al-Balhan (2006). According to his report, the students whose multiple intelligences were applied to learning, performed better and would achieve overall academic success. In the present study, the active EESD teaching approach has significantly enhanced the conceptual understanding and attitudes of students, when compared with traditional methods of instruction (Kaya, 2002). Students solving in local environmental problems through the active EESD teaching strategy with the middle school students enhanced their interest and motivation (Tsevreni, 2011). The EESD module that prepared through the research proved to be a tool for students to develop their participatory capacities and, especially, to gain self confidence about their perceptions of their environment and understandings of the local issues facing them as children and adults in the future. Through the active EESD teaching strategy in the hazards course students developed an empirically rich analysis of an important hazard event (Tamara et al., 2011).

The active EESD teaching strategy facilitated in the natural areas motivated the students to enjoy learning about small animals more than before intervention (Drissner, et al., 2010). It could be assumed that contact with local natural source like school gardens, botanical gardens, wildlife sanctuaries, lakes and ponds encountered in the EESD.
program motivated students' ongoing interest and approach towards local biological diversity, subsequently manifesting in a more positive attitude and behaviours towards biodiversity conservation.

Fieldwork, one of the sub-components of the active EESD teaching strategy was used in this study. The experimental group students were exposed to field work in the local natural environment in order to create conservation and protection attitudes and behaviour. Field trips are important in environmental education for cognitive and affective gains (Dillon et al., 2006). Fieldtrips serve as a tool for improving thinking skills, interest and success in science learning (Hamilton, 2007). An environmental science fieldtrip can clearly influence basic knowledge of science-related subjects (Uitto et al., 2006). Whether a project involves an exploration of a park’s natural history or investigating the effect of a pollutant in a local ecosystem, the participant will come away with more knowledge about ecology and environmental issues (Magntorn and Hellden, 2007). Nundy (2001) reports significant effective learning gains in upper primary school students attending a field course compared with a treatment group learning in the classroom. These gains are especially strong in student’s perceptions of their academic potential and ability. He also reports significant gains in cognitive outcomes, with those attending the field course showing deeper understanding and more developed skills than classroom- taught pupils. As result of the extensive field study in present active EESD curriculum has significantly improved students’ knowledge on biodiversity, skills and attitude to conservation of local biodiversity. The findings of this study is consistent with other previous studies (Uitto et al., 2006) that support the importance of activities outside the classroom that can construct students learning’s about their immediate environment and increase their knowledge of environmental issues. Therefore field trips to natural areas are an important component for sustainable future and student’s personal development.

Students were involved in various experiential activities like water quality monitoring from the residential places, solid waste assessment and biodiversity assessment in the present study. Such activities have improved their understanding of the real life situations about local environment and they also gained necessary skills to solve local environmental problems. Interactive and experiential approach has significant changes across a wide range of disciplines in education and psychology as reported by Kolb and Kolb (2006). A growing body of empirical evidence (Cleave and Morgan, 2002; Dyer and Schumann, 1993; Gopinah and Sawyer, 1999; McGlinn, 2003; Stienborg and Zaldivar, 1996) indicates the effectiveness of experiential learning in enhancing students’ meta-cognitive abilities, their capacity to apply newly acquired skills and knowledge to real-life situations, and the ability to become self-directed learners (Kolb and Kolb, 2006).

Students should be encouraged to be involved by expressing and communicating their experiences, ideas and emotions about their natural environment and their everyday life (Barratt et al., 2007). However, student’s involvement can take place at different
levels, along a broad spectrum of opportunities: from local issues to international policies (Simovska and Jensen, 2009). The active EESD teaching strategy was an attempt to demonstrate that students can develop an eagerness and ability to act through the expression and communication of their ideas. Furthermore, the active EESD teaching module is a didactic proposition for environmental education. The core of this proposition is placing student’s ideas in the centre of interest, the development of a communication and interaction framework, and an emphasis on action. There is a strong need for an alternative approach to environmental education which focuses on student’s participation and action (Reid et al., 2008). Educational setting has a valuable formative influence, which impacts upon attitudes and motivation towards specific animals and could carry over to general environmental attitudes as well as to long-term knowledge and emotions associated with the specific animals encountered in the ‘Green Classroom’ (Drissner et al., 2010). This kind of environmental education can be used as a tool for children’s involvement in the community and it can contribute to children’s emancipation and sustainable future.

The environmental dimension of the sustainable development is necessary for the continuation of the living life on the earth. The active EESD teaching strategy was found to be one among the most powerful teaching/learning methods by facilitating consciousness and sensitivity towards conservation and protection of the local environment, biodiversity, and natural resources, besides managing the solid wastes and protection/conservation of air and water quality along with local community. Though the school text books have some level of environmental literacy component, they are not sufficient to make students to understand their immediate environment, as the incorporation of environmental concepts from local context is important in environmental science curriculum that makes connections with ground realities. In addition to this, environmental science should be considered as a separate subject, and then only adequate attention could be paid for teaching/learning by the teachers as well as students. The teaching approach for environmental science subjects should include the active EESD teaching strategy with various activities, problem solving techniques, issue investigation, hands-on-experiences, field exposures, service learning opportunities and active classroom sessions. These would be more appropriate for developing student’s knowledge, attitudes, behaviours and skills to solve various environmental problems at local level. Hence, this research provides detailed guidelines for planning/implementing environmental education for sustainable development (EESD) program at the middle school level. Based on this, it may be concluded that the EESD modules provide an effective exposures to the topical material, and spark students’ skills, attitudes and behaviour on local environmental issues.

Active EESD teaching strategy could be the most important teaching/learning methods in environmental education at middle school level which are needed for the sustainable development, with special reference to sustainable environment. Students
should be led to active learning experiences step by step, from the beginning of their schooling (Hannele, 2002).

6.3.2 Environmental action

This active EESD teaching strategy includes cleanliness of local areas, assessing air and water quality tests from school premises as well as local residential places, planting trees and gardening in schools and students residents and public places. It is important that the community members and public understand the benefits of those activities, which has helped to address some problems faced by local residents. Much of the modern environmental education literature emphasised the involvement of students in decision-making, as children will be able to develop action competence to solve the environmental problems. Supporting this development of action competence are a range of pedagogical approaches that has been successful in promoting its development, such as experiential learning, field-based learning cooperative learning and problem solving strategies. A need for support towards active EESD teaching strategies would enable the students to involve them in decision-making, while supporting local area community in identifying issues and helping them to take worthwhile actions by addressing the root causes of environmental problems. The need for cooperation and coordination context the study has demonstrated similar findings from research in other parts of the world e.g. in New Zealand (Brown, 2003; McLean, 2003, Bolstad et al., 2004) about the concerns with respect to teaching of EE.

6.3.3 Environmental behaviour

The findings of this study related with environmental knowledge, behaviour, attitude, skills, sensitivity and responsibility, that can be translated into action. Changes in behaviour are particularly relevant in India as the major cause of environmental problems has been associated with individual actions and practices. This study suggests that students can participate in different ways to encourage behaviour change in India towards protecting and conserving the environment. There appears to be a need for parents, family members, teachers and community members to change their behaviour so that they can be role models for children. The schools are also encouraged to design programs that encourage children to discuss issues with their parents to involve them in solving issues that affect their lives.

6.3.4 Local issues

The active EESD teaching strategies seeks to involve the community to in creating awareness on environmental issues and planning, decision-making and participation in education while improving the quality of the environment (Hart, 2003). In this way,
EESD teaching strategies provides a suitable educational approach that bridges informal and formal aspects and brings together students, teachers and community in order to make some contribution to a better community life and sustainable environmental quality (Tal, 2004). Findings from this study indicated that school-community collaboration may be facilitated by providing service learning environmental education for sustainable development to address local problems.

Active EESD teaching approach can develop students’ skills and knowledge, attitude and behaviour to deal with current environmental issues at local level. The studies related to environment (Air, water, biodiversity conservation and solid waste management) can increase students important ecological and environmental awareness of both local and global environments. EESD can also increase environmental literacy, foster and encourage responsible citizenship, develop and teach personal, civic and global responsibilities, and generally help to prepare students for life success. Environmental education for sustainable development encourages individual activism and emphasizes local ideas in the context of active EESD learning that is tied to purposeful activity and action in support of the environment and people (Hage and Daniels, 1996; Whitty, 2003; Proulx, 2004; Tal, 2004).

Environmental education for sustainable development modules that involved school-community relationship can involve parents and community members, as it typically incorporates a service-learning component community service and community work that build students’ community action skills. EESD often develops environment related benefits that the society and school community relationships and parent programs outside formal education (Tal, 2004). Although EESD includes both indoor and outdoor activities, it allows students to go out of the classroom, and into natural outdoor settings. As such, EESD can build on real-world knowledge that students already have.

EESD program can provide students with a variety of transferable skills such as basic classification skills. In addition, students can build their collaborative problem-solving skills. Since EESD emphasizes cooperative learning, students can increase their group cooperation skills. Environmental learning can focus on students’ independent thinking, critical thinking and critical-inquiry skills (Gifford, 2002; Proulx, 2004).

Students gain understanding and skills that enable the development of capabilities for living and working sustainably, now and in the future. Ofsted (2009) visited 14 schools over a three year period and found that their focus on sustainability had a wide range of positive consequences. Sustainability captured the interest of young people because they could see its relevance to their own lives and futures. There was evidence of an increase in knowledge and understanding of the importance of leading more sustainable lives, and there were examples of more positive attitudes to learning, better behaviour and attendance, and improved standards and achievement. Importantly, the findings show that sustainability was a significant factor in improving teaching and learning in these schools. Such benefits are also shown in other research in England, for

Students have to be involved in assessments and improvements of school as well as local natural environment, that could enhance their learning about living more sustainably and efficiently, and strengthen the connections between environmental quality and well-being. In the schools studied by Ofsted (2009) and Gayford (2009), students and staff’s responsibility on improving the sustainability of the school, for example, through monitoring and reducing electricity and water usage, auditing and planning sustainable transport to and from school, making improvements to the school’s playgrounds and habitats, and growing plants for the school kitchen. In these schools, the involvement of all students and staff resulted in the embedding of sustainability within the culture of the school. For example, the young people in Gayford’s study were able to explain their learning about sustainability in terms of healthy lifestyle, saving energy, and recycling, and were also able to relate this to their personal actions and sense of responsibility.

Students were facilitated with active learning experiences of the natural world, integrating this into EESD curriculum. This motivates them and contributes directly to their perception and environmental sustainability, and to their strong sense of place in relation to the local environment and community. There are several publications that illustrate the importance of environmental experience and contact with nature to promote students physical and mental health and interests (Blakeley and Glover et al. 2009). The studies conducted by Frumkin (2001); Louv (2004); Faber and Kuo (2006); Chawla and Flanders (2007) found evidence to show that a variety of school-community activity resulted in improvements to students knowledge of and attitudes towards diversity, as well as to their understandings of their own cultures and backgrounds. Duffin et al. (2004) found that educational programmes relating to the local community and environment improved student’s attachment to place, civic engagement, and environmental stewardship.

Participating in constructive way of approach, meaningful activities towards their immediate environment and natural resources helps students understanding of what they can do themselves for sustainable environment and when collaborative social action is needed for sustainable development (Chawla and Flanders Cushing, 2007b). Hicks and Holden’s (2007) reported that, the environment is a consistent theme in concerns of students about the future and that provide collaborative, positive and supportive learning environments for facilitating action on the ground. This research also shows that enabling students to develop a sense of activity through active EESD strategy helps students engage in their learning and feel more hopeful; this is similar to the findings of the Cambridge Primary Review (Alexander, 2009), and that of Chawla and Flanders, (2007).

Working on real world environmental issues and taking action to resolve issues, makes environmental educational experience meaningful and motivating, and enhances
understanding and learning. This supports strong community school relationships, and help students to improve environmental and social development. Ofsted (2010) cite multiple examples where student’s participation in community related issues resulted in learning benefits including understanding local issues, the democratic processes needed to resolve them, and developing team and leadership skills. Keating et al (2009) found similar benefits including how community based activities extended and reinforced learning in the classroom. Ofsted also found evidence of genuine benefits for the community, for example, local environment regeneration and improved community facilities. International research shows that experiential learning with community organisations, for example on conservation projects, can impact positively on young people’s engagement and learning, including improvements in environmental behaviour, community awareness, and relationships between community members, students and schools (Schneller, 2008; Bogner, 1999; Powers, 2004).

Taking part in activities such as gardening, planting trees, and conservation, in and around the school enables students to see the interconnections between healthy lifestyles and environmental quality. It can also prepare students for their sustainable future. In research for gardening and outdoor Education, Malone (2008) found strong evidence from across the world that when students engage in explorative play and experiential learning activities in school grounds, local community settings, their lives can be changed positively, with improvements in attention and achievement, physical and mental health, social interaction and personal concept/esteem. Malone also found that outdoor learning enhanced young people’s environmental responsibility and their resilience to changes in their environment. International research by Bell and Dyment (2008) and Blair (2009) provides strong evidence to show that activities in school grounds including gardening, habitat restoration, tree planting, etc. contribute to students learning, environmental awareness, social behaviour, and relationships.

When students engaged with sustainable school environmental improvement such as water and air quality improvement, gardening, energy efficiency and solid waste management they will learn about sustainability practices, and increase their familiarity with the wide range of career opportunities in this field. Percy-Smith’s (2009) research in six schools with an interest in sustainability demonstrates that practical and experiential learning, such as active engagement in the school garden, enables young people to act on their learning in respect of sustainable lifestyles. The present study shows that developing sustainability as a cultural practice rather than simply a set of skills and knowledge, and enabling young people to be ‘actors of change’ as well as learners, has greatest impact on learning. Gayford (2009) found that where students were involved in monitoring, recording and reporting the effectiveness of the measures taken to improve sustainability within the school, or in planning changes in the school or local community, there were valuable educational outcomes, social networking, and increased student motivation. Similar findings were reported by Uzzell, (1999) and Ofsted, (2010).
Providing students with different perspectives on issues and information about doubts helps them appreciate the complexity of sustainability, the role that values play in making decisions about what to do, and the importance of learning. A recent report on citizenship described work carried out by fifth grade students who explored how their school recycles, reduces waste and reuses materials as ‘outstanding’. The students discussed both positive and negative consequences of particular approaches to sustainability, grappled with complex questions such as whether recycling necessarily reduced consumption and the impact that re-using may have on the manufacturing economy (Ofsted, 2010). Research reported in Rickinson et al. (2009), brings learners and their experiences to the fore, and illustrates how skilled teaching can build on young people’s own views and interests in order to enhance understanding, and Percy-Smith (2009) reported that by using action based forms of learning young people were able to examine issues more effectively, understand the complexities of their real world contexts, and consequently develop effective intervention strategies.

The ability of environmental education programs in schools and resident camps to positively affect the environmental awareness and attitudes of children and adolescents depends on educators enabling students to develop critical thinking, environmental action skills and internal locus of control (Yerkes and Biederman, 2003). The difference between the scientific question-posing capabilities of middle school students of high and low academic levels is significant in both the number and complexity of questions asked about air quality (Dori and Herscovitz, 1999). High-school students are capable of conducting primary research on a variety of environment-related topics such as the greenhouse effect, ecotourism and green business, and they can also hold a classroom environmental summit to discuss their findings (Bushell, 1997).

Present study demonstrate that by using active teaching learning approach in EESD program, significantly improved knowledge, attitude, skills and knowledge on environmental issues of students with special emphasis on air, water, biodiversity conservation and solid waste management. EESD program has connected students with local community to understand the various environmental problems. Students have gained ability to communicate with local people by service learning opportunities have led to understanding about the interaction of the environmental problem with its community. Students had also improved their thinking, and solved environmental problems at local level which would lead to sustainable development.

6.3.5 Teacher’s perception on EE

Teachers tended to teach more EE if they held more favourable attitudes towards EE, had more skills in teaching EE, realised the relevance of EE, and would actually want to teach more EE classes if there were fewer constraints.
Moreover, variations in teaching of EE were reflected in teacher’s emphasis on teaching environmental education, their use of a variety of teaching methods, and their regular practices of extra-curricular activities on environmental education.

While majority of the teachers (82.7%) involved in EE employed conventional text book methods, a few of them (46.2%) occasionally used other methods, such as informal discussion and group projects as well as resources, such as newspaper cuttings, EE learning packages, and environment-related web pages. In addition, some teachers (42.3%) promoted EE through extra-curricular activities.

Most teachers (70.1 percent) showed positive attitudes toward the environment and all of them agreed that the essence of EE should be education for the environment, with emphasis on development of suitable attitudes among the students. Moreover, some teachers (42.3%) are convinced of the importance of activity based EE.

Many teachers (46.2%) thought that lack of class time was a major barrier to teaching EE. Some others (17.3%) thought that inadequate knowledge and training on EE, as well as lack of readily usable materials were also problems. In addition, the safety problem was perceived to be a barrier to the provision of field experience especially for girls.

The findings from this study, however, are subject to a limitation. There was no classroom observation or participant observation to substantiate the self reported actual practices of the case study of teacher’s perception on EE. Despite this limitation, the study provided an initial understanding of teacher’s perceptions on environmental education in Puducherry and Cuddalore region with some important implications for curriculum and pedagogical strategies for environmental science education in the future.

6.4 Discussion (Teachers Perception on EE)

The results obtained in the present study that the male teachers had more environmental attitudes are in agreement with study conducted by several earlier workers (Patel, 1999; Badkobi and Hadipour, 2001; Tripathi, 2000; Hadipour, 2001 Patel and Patel, 1994; Pradhan, 1995; Sabhlok 1995).

The present study indicated that the teachers working in Government schools had better awareness on EE as compared to private schools. The reason could be that in Government schools, encouragement in participation on various programs on environment related issues such as National Green corps (NGC), was higher which is not so pronounced in most of private schools (that gave a higher emphasis on regular school curriculum and are more concerned with the Board examinations. A similar finding was reported by (Sabhlok, 1995 Shobeiri et.al., 2006) and Rou (1995).
Stimson (1997) has pointed out that India suffered from an absence of mandated courses in EE for school teachers. The lack of cross-curricular perspectives in teacher’s education in India has provided limited opportunities to develop such themes in schools. Thus, developing an EE perspective has posed major pedagogical challenges for teacher educators. Interdisciplinary and student-centred elements were usually absent from such programs. Short in-service courses dealing with cross curricular programs were the major form of teachers training. The tendency was to provide information rather than to facilitate teachers’ reflection (Andre Chi-chung Ko and John Chi-kin Lee 2003). This was reflected by some complaints received through interviews that official seminars about environmental education were not useful to their teaching of environmental education.

Developing teachers own knowledge and beliefs about the environment, that could enhance environmental education, was a priority by earlier workers (Hart, 2002, Andre Chi-chung Ko and John Chi-kin Lee 2003). With regard to the findings from the present study, teachers tended to give more importance towards development of attitudes rather than actions. In the future, environmental education for teachers may highlight the importance of enhancing student’s environmental competence through the action competence model (Palmer, 1998). Moreover, some scholars advocate that teachers should be given opportunities to reflect critically on their own pedagogical beliefs and assumptions, to participate in community action and interaction as well as social critique (Hart, 2002).

These findings are very similar to that of Loughland et al., (2002) study on 2000 primary and secondary school students in New South Wales. Moreover the results of the present study is similar to that of the study by Bradbeer et al. (2004) in which the freshmen in Australia, New Zealand, United Kingdom and the USA. When conceptions of prospective teachers about the environment were examined, it was realized that non-relational conceptions are more available than relational conceptions, which indicates that such issues are not examined and discussed adequately in primary school teaching. Simon (1993) discussed the importance of knowing the weaknesses of prospective teachers in order to help them to be better equipped with content knowledge to prepare them for teaching EE.

If teachers are made aware of how they learn best as well as how others learn best, they may not just teach to their own style of learning (Smith et.al. 2002). Eventually, with this knowledge of learning styles, the teachers will be able to create more effective learning environments which can better accommodate individual differences in their own classrooms. While environmental issues are examined in classes, local environmental problems should be taken into consideration first followed by discussion on global environmental problems. Their Individual views /experience of their surroundings can be critically evaluated and interpreted so that a balanced appreciation can be reached (Palmer and Neal, 1996).
It must be emphasized that environmental problems are not restricted to a single region. More often than not, there are trans-boundary issues to be tackled. The students must be encouraged to play active roles by arranging wide-ranging environmental campaigns and collaborating with schools, local authorities and non-governmental organizations. Pre-service primary school teachers would benefit from using scientific models and theories for problem-solving, so they could appreciate them as a tool of inquiry rather than a package of facts (Abell and Smith, 1994). Encouraging students to participate in project work, case studies and problem-based learning activities should provide them with a positive attitude and behaviour towards the environment (Abell and Smith, 1994).

Ham (1987) and Sewing (1988) found that logistical barriers, on average, were more important than other more personal barriers. Lack of class time and preparation time were perceived as the greatest barriers. Secondary School teachers in Puducherry and Tamil Nadu were overwhelmed with school duties and academic pressures especially in private schools more than the Government schools. Fear of “not covering the syllabus” and “not achieving hundred percent pass and state ranks” were the major concerns of many teachers. Chan (1995) found that teachers spent most of their time on examination related activities, which may explain why they lack the time to teach environmental education. The results of the present study obtained through the feedback of a cross section of secondary school teachers in the study area indicated these facts. In addition, sometimes additional duties were assigned - administrative/office and at times others such as census, etc. Teachers in general need a supportive school set up so that they can have the opportunity to make use of the knowledge and skills they have acquired. The burdens of Teachers on school duties need to be reduced. Moreover, science and social science teachers should be empowered to realize their vision of acting as agents for social change and working for the betterment of the environment Ref Andre Chi-chung Ko and John Chi-kin Lee 2003; Ham, 1987 and Sewing, 1988).

6.4.1 Content Analysis

The comparative analysis of the objectives of the selected Science and Social science curricula from Tamil Nadu text books indicated that Environmental literacy in Tamil Nadu text books was not considered as a separate subject in middle school level but was mainly incorporated in the Science subjects. On the other side, in the elementary level in Tamil Nadu, there was a separate subject course called Environmental education. In Tamil Nadu, EL was incorporated mainly in Science courses, e.g. Chemistry, Biology and our Environment. EL in Social science was incorporated in Civics and Geography. The fundamental scientific concepts, needed for environmental literacy, are dealt with in the science curricula.
In addition to regular curricula, there is special incorporation of Environmental studies in all the subjects recently implemented from 2011-2012 academic years by the Government of Tamil Nadu. In some courses, the environmental literacy components are absolutely stated, such as Life science course for 1st to 3rd grade, Social science course for 4th to 8th grades, and Agriculture course (elective course) although only a Science education course was selected because of its suitability to the purpose of the study.

6.4.2 Environmental Literacy components in Standard VI

As a curricular activity, Environmental education in VI standard text books is currently composed of the following components; Knowing the environment; Natural Resource and their utilization; Waste generation; Management of Waste

6.4.3 Knowing the environment

This component of environmental literacy includes three sub components. In Science subjects, these sub components mainly dealt with earth system, different living things on the earth, and ecosystem and ecological factors that sustain the ecosystem whereas in Social science text books, the Social ecology and community attitudes to protection and conservation of nature is very less.

6.4.4 Natural Resources and their utilization

This component includes two sub-components each pertaining to natural resources such as biodiversity; different types of biodiversity, significance of various organisms; water resources- the water cycle and oceans, fresh water, and ground water, and various basic physical measurements. Knowledge focus of these components is marginal in science text books, while these components in social science text books were largely absent.

6.4.5 Waste generation

This section was divided into four sub themes - generation of waste and its sources, types of waste - solid, liquid and gaseous, hazards of waste accumulation community health and sanitation in science curriculum. In Social science curriculum, the issues of community involvement of sustainable solid waste management were largely ignored and the attitudinal components were not covered adequately.
6.4.6 Management of Waste

This section included two sub themes, waste and its disposal, solid waste (physical removal and dumping), liquid waste (drainage and sewer system) and gaseous waste (discharged directly into air) and conditions for proper waste management, co-operation of individuals and community; proper functioning of governmental and local bodies. This section were largely ignored the proper waste management practices and local examples were also absent.

6.4.7 Environmental Literacy components in VII standard

As a curricular activity, environmental literacy is currently composed of the following components; Environment and Natural Resources and Man and Environment

6.4.8 Environment and Natural Resources

This component explains physical and biological components of environmental literacy such as water - a precious resource; essential for life and life activities, a habitat of plants and animals (fresh and marine), sources of water (fresh and marine) rain, snow, ponds, wells, lakes, rivers and seas; soil - a medium for growth of plants, types of soil, habitat for organisms, facilitator for percolation and retention of water; forests - a habitat for plants and animals, an agent for percolation and retention of water; maintaining ground water level; prevention of soil erosion; maintaining air humidity; a source of firewood, timber, fruits, resins and medicinal plants. In the field of biological resources, the components presented included- our environment; biosphere, living and non living components of biosphere, levels of organization; different types of plant and animal cells, organization of tissues in plant and animal, different organs and its functions, functions of blood, population ecology; population density.

6.4.9 Man and Environment

This component was sub divided into five components; response of living beings to changes in environment adaptation in plants and animals; modification of environment by human beings to protect themselves against changes and meet their needs; impacts of human activities and population growth on agriculture, harnessing of energy, housing, industrial development and other areas of consumption and social activities; consequences of human activities - stress on land use, water sources, energy and mineral resources; forests, ocean life; environmental degradation and the role of individuals in maintaining peace, harmony and equity in nature; good neighbourly behaviour; use and misuse of common property resources.
6.4.10 Environmental Literacy components in VIII standard

The following components were covered- Balance in Nature; impacts of population on environment; harnessing resources and environmental pollution causes and effects.

6.4.11 Balance in Nature

This component were sub divided into three sub-components such as eco-system interaction between living and non-living components, structure and function and the energy flow through ecosystem (food chain, food webs); examples of terrestrial and marine food chains; balance in nature, importance of eco-systems. In the biological aspects, the sub components included biodiversity; Monera-bacteria-e-coli, flagella, gram stains-gram positive and negative, bacterial cell wall, cell size and cell type, general features of protista, fungi, cryptogams and cockroach; metals and non metals; characteristics of metals and non metals, uses of metals and non metals, noble metals and their uses, alloys, purity of gold and the levels of organization; need for classification, five kingdoms concept, classification of angiosperms, animal phyla, binomial nomenclature.

6.4.12 Impacts of Population on Environment

This component includes three sub-components which are mainly dealt with impact of population growth on eco-systems, human settlements, land distribution; stress due to population growth on common social facilities and civic services and the increase in consumption, encroachment on monuments. These components of environmental literacy were largely ignored both in science and social science curriculum.

6.4.13 Harnessing Resources

This component included seven sub-components which are mainly focusing on sources of energy - renewable and non-renewable sources, availability and potential (Indian context); Renewable sources - solar, wind, hydro-energy, ocean (tidal), biomass including bio wastes; non-renewable sources - coal, petroleum and its products and natural gas; agriculture and animal husbandry - impact on environment; utilisation of resources for industry - processing and production of goods; need for planning and management; adoption of efficient and environment friendly technologies; industrial waste management practices were explained in science text books.
6.4.14 Environmental Pollution causes and effects

This component included eight sub-components such as emerging lifestyles in modern societies - overutilization of resources; increasing consumption of energy (electricity and fuels), materials and facilities; synthetic materials like plastics, detergents, paints and refrigerants; advantages and disadvantages of using them; factors affecting environment - overexploitation of resources, population growth, industrialisation, use of synthetic materials; pollution of soil, air and water - sources, impact on physical environment and all forms of life, control and preventive measures (modern and traditional); noise pollution sources, impact and preventive measures; impact of environmental degradation on - natural habitats, living forms (endangered and extinct species) and domestic animals; impacts of environmental pollution on human health - indoor and outdoor pollution, pollution related diseases (respiratory, dietary, physiological, genetic, and psychological), occupational hazards and disorders (local examples) and the role of individuals, community and government in planning, decision-making, legislation and social action for prevention of pollution and improvement of environment were explained in the science subject these were ignored in the social science curriculum.

Environmental studies exist as a separate subject at the primary school level. At the middle and high school level, though environmental science is not a separate subject in the school curriculum, some environment related concepts and issues are integrated with other subjects. Non formal environment related programs like the National Green corps of Ministry of Environment and forests and the school eco club scheme of State governments have helped in providing learning experiences to deepen the understanding of environmental issues. But, these efforts could not bring about the attitudinal change in students, equip them to face the environmental challenges or help them in making the right decisions such that it help to develop responsible environmental behaviour leading to an improved environment.

These results indicated that all the components of environmental literacy in science and social science text books from 6th standard to 10th standards have not received the equal attention in national mission for environmental education and Tamil Nadu text books both in science and social science curriculum. For example, greater attention was paid to the environmental knowledge, relatively little attention to skill, and little attention to activities and behavioural components in Tamil Nadu text books in contrast to that of National mission which has given equal importance to all components.

6.5 Discussion (Content Analysis)

The general rationale for providing environmental education programs is helping school students to develop environmental awareness and sensitiveness to the environmental threats (Dhavse, 2003). The systematic incorporation of environmental
literacy in to the school text books not only focus on the knowledge components but also focus on the attitudinal and behavioural components and provide necessary skills so that it leads to action on the ground. In the present study, the attitudinal component in the school text book was conspicuously lacking or covered to a lesser extent. The objectives of environmental literacy cover basic skills, understanding and feeling for the man environment relationship (Harvey, 1976) and facts about environmental concepts (Bueth and Smallwood, 1987). Moreover, Individuals’ environmental behaviours and attitudes reflect their environmental literacy. Hence, developing environmental literacy is equivalent to developing responsible environmental behaviour, and individuals’ behaviours and attitudes reflect the level of their environmental literacy (Roth, 1992; Wilke, 1995).

Environmental literacy must go beyond the factual knowledge, and it must include understandings of ecological processes, scientific reasoning, and the relationship of individual actions to the larger ecosystem (Simmons, 2004, Berkowitz et.al, 2005; Hungerford, 2010; Potter, 2010). The interactions between individuals and their biophysical environment are embedded in environmental education program, which in turn interacts with natural resources management practices, environmental policies, and other elements of a local social-ecological system (Keith et.al. 2011).

The National Curriculum Framework (NCF 2005) envisages that environmental education to be included in upper primary (Middle school- Vito VIII standard) and secondary (High school IX to X standard) school education with an aim to bring about sensitivity towards the natural environment. The policy document has emphasized on the importance of creating awareness among the future citizens of the country since 1968. But no concrete action towards this end was initiated at a larger scale (NCERT, 2005). Therefore, the proposed EESD curriculum must be sensitive and oriented for working towards sustainable development with holistic approach that will form the new paradigm. This will replace sectoral thinking by multidisiplinary perspectives. Environmental literacy must build in capacity for critical thinking and problem solving and attitudinal change instead of rote methods and mere curriculum on environmental literacy in school text books. This fact has to be integrated while delivering EESD programs.

Environmental education in school system is generally lacking the logical concept, knowledge, and skills that are needed to deal with the environmental problems. Instead, the introduction to EE in the overall curricula created incoherence (NCERT, 1987, 1989). The country’s main environmental problems are land degradation, degradation of forest, pollution of soil, water, air, biodiversity conservation, solid waste management and the degradation of landscape. But introducing students to bigger and wider issues of a wider territory is as logical and beneficial to introduce children to local eco-systems. Unless the environmental problems are adequately defined and solved at the local levels, we cannot deal with such issues at national or global levels (Pande, 2000). But local specific environmental problem is not easy to conceptualize objectively. These
may be driven by their special socioeconomic group interests and also for some students it can be based on their coverage in school text books and media exposure.

Lack of sequence and uncertainty in environmental literacy caused by such incorporations of environmental studies in science subjects is not fulfilled, completed and updated as reported by Kumar (1996) and Pande (2000). They also propose that environmental literacy must have holistic and multidisciplinary view of environmental science teaching. In the contemporary school text books, the socio-economic explanation of environmental degradation has not been addressed properly. Hence, the modern ecological and environmental science in the curriculum along with the socio-economic contexts must be included in the text books that can change the student’s attitude, behaviour, and skills to solve local environmental problems (Gordon, 1995).

The active learning including various teaching learning activities, skills based education in the curriculum are widely accepted to be an important dimension to learning process (Gardner 1983, 1993; Goleman, 1996; Morgan, 1997; Kelly, 2004; Lee, 2005; Cree, 2006). A number of studies are mainly concerned with attitudes on learning process of EE (Laforgia; 1988; Crawley and Koballa 1994; Simpson et al, 1994; Stone and Glascott 1997; Kupermintz 1997; Watts and Alsop 1997; André et al. 1999; Francis and Greer 1999; Thompson and Mintzes 1999; Alsop and Watts 2000; Southerland et al. 2000; Abell 2005; Waters-Adams 2006).

Similar to Athens, (2002), several other researchers have also suggested that EE can effectively contribute to sustainable development. Indeed EESD is a lifelong teaching learning approach which has the potential to strengthen the students’ capacity to address environment and developmental issues, to be more aware of and better understand such complexity; to develop knowledge, values and attitudes, and behaviours consistent with sustainable development. Hence, the EESD has to be introduced in all schools of Puducherry and cuddalore region as well as the rest of India. The first step towards this direction will be the preparation of EESD curricula specific to each state, based on local realities. The curricula, however can have some essential common elements. The specific topics/field exercises can vary based on the local environmental issues/problems. Modern multi-media class rooms will be more effective for imparting EESD.