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DEVELOPING LOW CARBON SCHOOLS MODEL THROUGH STUDENTS' INVOLVEMENT IN SUSTAINABILITY ACTIVITIES

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ABSTRACT

Low Carbon Schools is an initiative that promotes activities of sustainability among school children by minimising carbon emission in the school environment. This study aimed to build a model of a Low Carbon School involving 224 secondary school students of SMK Kalumpang, Selangor, Malaysia. The survey was conducted using the seven steps of the Low Carbon Schools framework, by setting up low carbon clubs, conducting field studies, building action plans, monitoring and reviewing plans, developing links to the curriculum, encouraging involvement among the school community, and implementing a low carbon code. Evaluation of the framework results was conducted using pre-test and post-test assessments to examine carbon literacy knowledge, low carbon attitudes, carbon literacy values, and low carbon practices. The findings show that there was an increase in levels for the four variables between the assessments before and after the implementation of the programme. The results of this study are important for use as guides and examples for the schools that are interested in the implementation of this Low Carbon Schools initiative.

Contribution/ Originality: This study contributes in the existing literature in Low Carbon School by modifying the Eco Schools framework and was first conducted in Malaysia in promoting reduction of carbon emissions in schools. The paper should be of interest to readers in the areas of environmental education.

1. INTRODUCTION

Environmental conservation has become the main topic in development activity both globally and in Malaysia. Understanding the need for environmental conservation in development, academics at the Stockholm Conference, in 1972, concluded that economic and social development should take into consideration the environmental aspects known as sustainable development. Sustainable development is a broad discipline that covers three major components: social, economic, and environmental. The definition of sustainability in the context of sustainable development is a development that meets current needs without affecting future generations' ability to meet current needs (World Commission on Environment and Development (WCED), 2003). This sustainable development effort can also be seen through exposure to environmental education, known variously as Sustainability Education (SE), Education for Sustainability (EfS), and, more recently, Education for Sustainable Development (ESD).

In addition, Geiser (2006) emphasised that ESD should involve environmental awareness components focusing on ecosystems and natural resources, their significance and limitations, the threat of human activity on the ecosystem, and building monitoring, analysis, and engagement skills. This is also supported by Cheong (2005) which states that ESD can be divided into two kind of abilities, cognitive abilities and affective abilities, involving investigation and research; lateral, analytical, and creative thinking; collaboration; communication; literacy; and observation. According to Hanifah *et al.* (2016) ESD has a positive impact on sustainability when implemented in a structured programme. Furthermore, Joshi (2009) also acknowledged the positive effects of ESD, which clearly contributed to the enhancement of values, behaviours, lifestyles, and concerns for social change and a sustainable future. The sustainability approach to education is commonly provided by means of an intra-subject delivery medium, such as the cross-curricular involvement of Geography and Science subjects (John, 2012).

The sustainability education approach has also been discussed internationally in an effort to raise public awareness on environmental care in addressing global issues, such as climate change and global warming. In Malaysia, ESD has been formally and informally implemented through the Environmental Award Sustainable School Environmental Award (SLAAS) programme, in 2005. The ESD, implemented through SLAAS, is an overall movement of the school community in the field of management, curriculum, co-curriculum, and greening, for achieving the two main objectives, which are to nurture the school community's values and to raise their awareness of the importance of environmental conservation and preservation (Department of Environment, 2007; Shaharudin *et al.*, 2010). This clearly shows that Malaysia's Ministry of Education (MOE), along with the Malaysian Department of Environment (DOE), strives to achieve this SLAAS programme by providing ESD exposure in a non-formal way, in order to cultivate public awareness and commitment to participating in the sustainable development agenda.

Apart from that, there are further activities that have been implemented by governmental and non-governmental organisations, such as the Low Carbon Schools, Green Schools, and Nature Schools initiatives that have been implemented in Malaysia (Shaharudin *et al.*, 2010). The approach may differ according to the programme but they share the objective of further enhancing love for the environment among students and the school community. Therefore, this article will discuss the implementation of a low carbon school community programme, which has a smaller scope compared to sustainable schools implemented at the national level in Malaysia.

1.1. The Approach to Developing Low Carbon Schools through Education for Sustainable Development

Schools, as formal educational institutions, have undergone many changes and developments. Nowadays, schools do not just functioning to achieve social objectives and to produce excellence in the humanities and sciences; they also aim to form a well-respected human beings who understand their responsibilities, to change the thinking, behaviour, and attitudes of the students, and to create a balanced generation in both spiritual and mental terms (Surendran and Norazlinda, 2014). In Malaysia, schools play an important role in realising the National Education Philosophy (FPK), which aims to further expand individuals' potential in a holistic and integrated way, to create balanced and harmonious individuals, in terms of intellectual, spiritual, emotional, and physical harmony, based on a firm belief in and devotion to God (Malaysian Ministry of Education, 2016). The schools are also seen to function in helping to integrate ESD among students and communities in schools through Environmental Education (PAS), which was formally implemented in Malaysia in 1986, when the *Alam dan Manusia* subject was introduced by the Ministry of Education Malaysia (MOE) for level 2 students of Standard 4 (Nurul *et al.*, 2013).

In line with the function and role of schools in integrating Environmental Education (PAS) in the curriculum, the Low Carbon Schools programme is seen as a turning point in the formation of a Low Carbon Society (LCS) through sustainable practice. Sustainability is practised through a continuous use of low carbon energy at low rates to avoid climate change (Suziana, 2013; Kalnins *et al.*, 2014). Other than that, a Low Carbon School is defined as a school that produces zero carbon or at the lowest level possible with normal energy consumption, and with the

school members adopting low carbon practices in balancing carbon cycles. Through the implementation of the Low Carbon School initiative, the school community will be able to adopt a lifestyle that using renewable energy alternatives, involves less dependence on fossil fuels, and adopts "3R" practices of Reuse, Reduce and Recycle. In fact, through this programme, students' literacy can be enhanced through the foundation of this energy-literate education and low carbon practice (Mageswary *et al.*, 2015). A study by John *et al.* (2016) at primary schools around New South Wales, Australia showed that the implementation of the Climate Clever Energy Savers (CCES) programme was effective in helping students to identify ways to reduce electricity consumption and improve their literacy knowledge. Through this programme, students' active involvement in indoor and outdoor activities was seen as being capable of indirectly enhancing the students' vital experience and soft skills (Reaves *et al.*, 2010). Based on Astin (1984) involvement is defined as the use of physical and psychological energy that occurs throughout the activity, and can be measured both qualitatively and quantitatively. According to Fredericks *et al.* (2004) this involvement is comprised of three forms, namely emotional, behavioural, and cognitive involvement.

Involvement is also seen as being able to enhance the leadership potential of individual students (Elizabeth and Michael, 2013). If looked at within the environmental context, the involvement of students in hands-on activities and activities outside of the classroom can enhance the knowledge and practices of the students. A study by Karpudewan *et al.* (2015) showed that active involvement of students in the classroom had increased students' understanding of global warming, the greenhouse effect, acid rain, and ozone depletion. Access to nature outside the classroom can also build confidence, responsibility, pride, cooperation, problem-solving in the classroom, and the relationship between students and teachers (Seyedehzahra *et al.*, 2011). However, the positive knowledge of students about environmental care is also influenced by family practices, teachers, media, reading practice, and the school curriculum's environmental content (Zarrintaj *et al.*, 2013). In addition, effective teaching approaches can also help to improve the students' levels of environmental energy literacy (Mageswary *et al.*, 2016). The theory of student involvement, developed from Vygotsky (1978) emphasises the role of the environment in students' learning process by encouraging their involvement through the introduction of effective pedagogical practices in the learning process (Figure 1). This means that the activities implemented in schools can influence and enhance the students' knowledge and skills according to the focus and attention given.

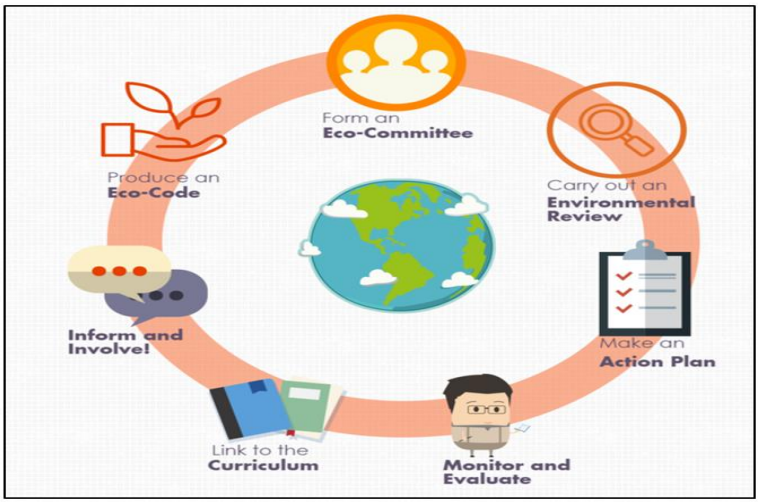

Figure-1. Student Engagement Theory

Source: Vygotsky (1978)

In line with this approach, a programme has been implemented at SMK Kalumpang, Kerling, Selangor, in collaboration with the Department of Geography and Environment, Faculty of Human Sciences, Universiti Pendidikan Sultan Idris (UPSI). The school is located in the district of Hulu Selangor, Selangor Darul Ehsan, which is in a rural area and is surrounded by public housing areas. The number of students was 635, consisting of 305

male students and 330 female students (Selangor State Education Department, 2016). The main purpose of the programme was to build an actual model of a low carbon school by involving student involvement. The objective of the programme is to evaluate the level of knowledge of carbon footprint, low carbon attitudes, carbon literacy, and low carbon practices among students, and to build a model of "Low Carbon School". The implementation process of the low carbon school model was modified based on the seven-step of Eco-Schools framework (Figure 2), which is a basic initiative that encourages young people to be involved with the environment by actively protecting the environment. The seven steps of the framework are forming low carbon clubs; conducting field studies; building action plans; monitoring and re-evaluating plans; developing links to the curriculum; encouraging school community involvement; and implementing a low carbon code (Figure 3).

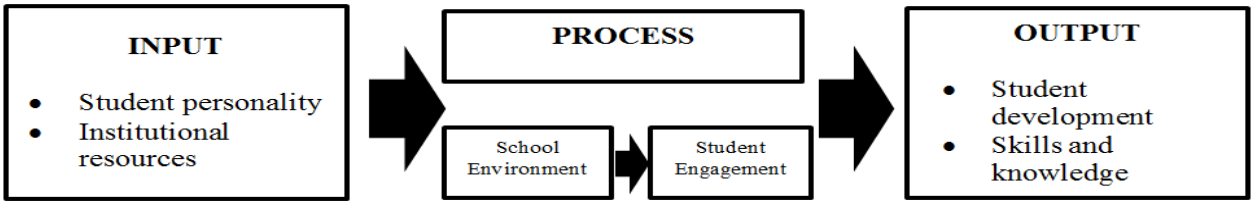

Figure-2. Seven Steps of the Eco Schools Framework

Source: Foundation for Environmental Education (2014)

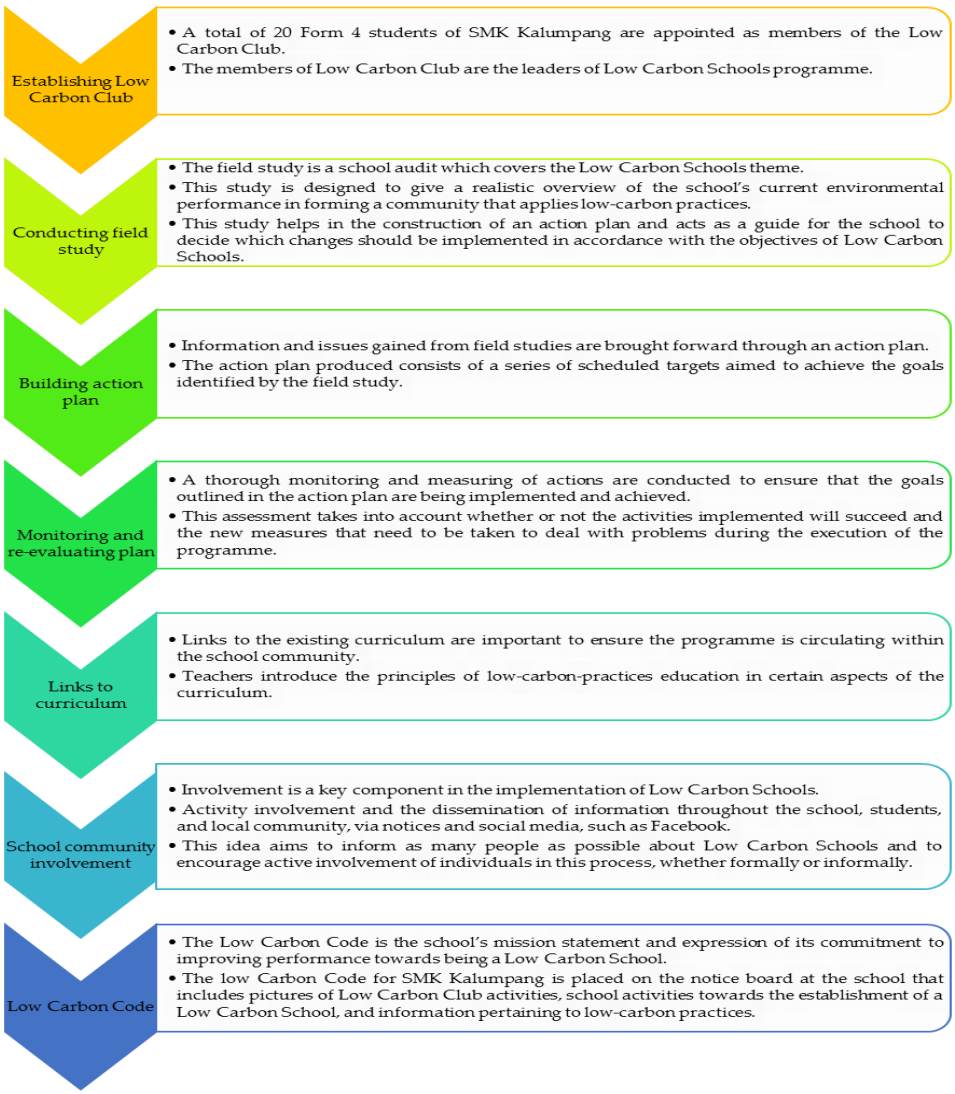

Figure-3. Seven Steps of the Low Carbon School Framework

Source: Hanifah *et al.* (2016)

Therefore, this article discusses the implementation of activities throughout the programme for transforming ESD by using the seven steps of the Low Carbon Schools framework adapted from the Eco-Schools, as well as building an actual model of a Low Carbon School.

2. METHODS

This study involved pre-test and post-test experimental methods to compare the effects on a group of samples (Chua, 2006) constituted by the school students involved in the Low Carbon School activity. The implementation method consisted of six steps, the first was observation of the school's green environment. Then, a pre-test assessment was conducted to determine students' levels of carbon literacy knowledge, low carbon attitudes, carbon literacy values, and low carbon practices. Once the pre-test was completed, an action plan was developed based on the pre-test findings and observations of the school's surrounding area. The sustainability activities included energy-saving activities, tree planting projects, talks, 3R contests, and environmental exhibition. Next, a post-test assessment was conducted to further evaluate students' level of carbon literacy knowledge, low carbon attitudes, carbon literacy values, and low carbon practices. Finally, the last step was the construction of a Low Carbon School model, which was formed based on the information from the implementation steps that had been carried out (Figure 4).

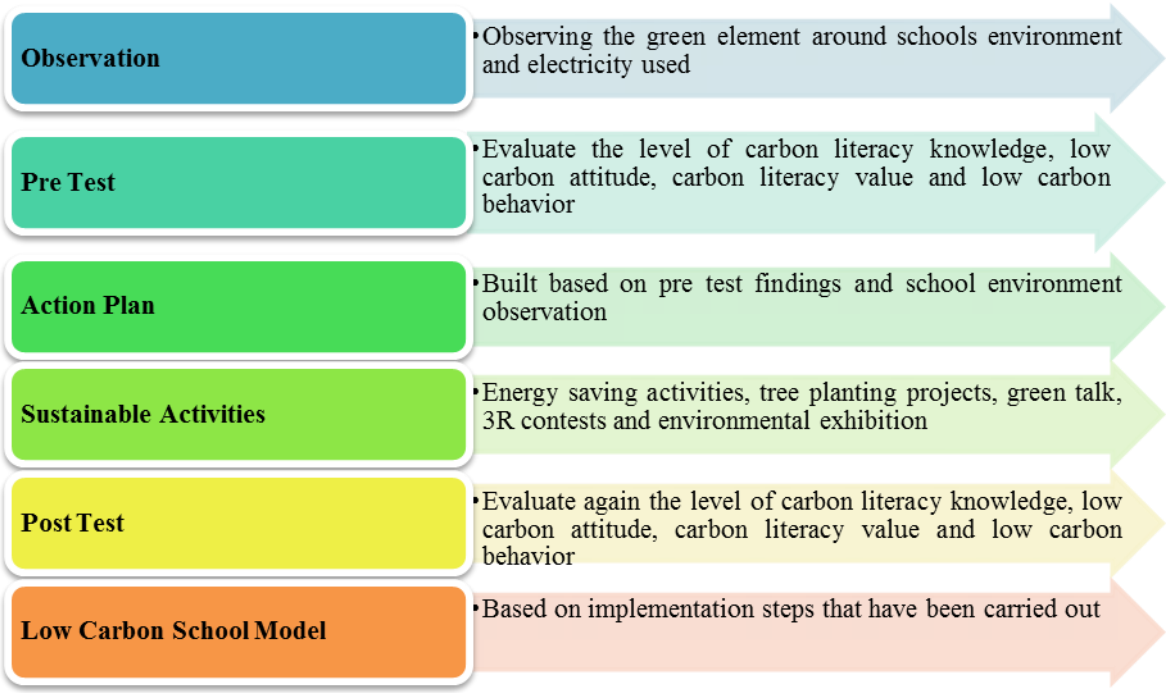

Figure-4. Low Carbon School Model Implementation Steps

Source: Hanifah *et al.* (2016)

3. RESULTS AND DISCUSSION

Discussion on the findings was divided into two parts; respondents' background, and pre-test and post-test levels for carbon literacy knowledge, low carbon attitude, carbon literacy values, and low carbon practices.

3.1. Background of Respondents

Table 1 shows the backgrounds of the respondents, who were 224 secondary school students of SMK Kalumpang, Selangor. A total of 78 Form 1 students (34.8%), 98 (43.8%) Form 2 students, and 48 Form 4 students (21.4%) were involved in this study. As for the gender of the students involved in this study, 111 (49.6%) are male

students and the rest were female students. The majority of the respondents involved in this study were Malays, with a total of 154 (68.8%), and the rest were Chinese, Indians, Sarawak Bumiputeras, and other races.

Table-1. Background of respondents

Background of respondents		**N**	**%**
Form	One	78	34.8
	Two	98	43.8
	Four	48	21.4
	Total	224	100
Gender	Male	111	49.6
	Female	113	50.4
	Total	224	100
Race	Malay	154	68.8
	Chinese	45	20.1
	Indians	22	9.8
	Sarawak Bumiputera	1	0.4
	Other	2	0.9
	Total	224	100

Source: Hanifah *et al.* (2016)

3.2. Activities of Education for Sustainable Development

The implemented sustainability activities include the formation of a low carbon club for members of SMK Kalumpang; pasting sustainable practice awareness posters; tree planting and greening activities in school areas; design competitions and building sculptures from wasted items for the school garden; and environmental care awareness campaigns in the form of talks and exhibitions.

Figure-5. Establishing Low Carbon Club

Source: Hanifah *et al.* (2016)

Figure-6. Distribute Awareness Poster on Sustainable Practices

Source: Hanifah *et al.* (2016)

Figure-7. Greening Activities Around School Area

Source: Hanifah *et al.* (2016)

Figure-8. Recycle Competition

Source: Hanifah *et al.* (2016)

Figure-9. Talks and Exhibitions of Environmental Awareness

Source: Hanifah *et al.* (2016)

3.3. Differences in Mean Score of Variables before and After the Programme

Analysis of the difference in levels of students' carbon footprint knowledge, low carbon attitudes, carbon literacy values, and low carbon practices was done by using descriptive analysis of the mean values. The levels in this study were based on the mean indicator values divided into three; low level (score 1.00-2.33), medium level (score 2.34-3.66), and high level (score 3.67-5.00). Figure 10 shows the difference in the students' carbon footprint knowledge before and after the programme. It was found that, in general, the students' carbon literacy knowledge was at a high level before and after the programme. As for the energy-saving sub-variable, there was no change before and after the programme was conducted. This was similarly the case for recycling activities, travel mode, and carbon footprint sub-variables. As for the air pollution sub-variable, there was no change, with a medium level both before and after the programme. However, for the greenhouse effect sub-variable, there was a rise in levels from medium to high after the programme was implemented.

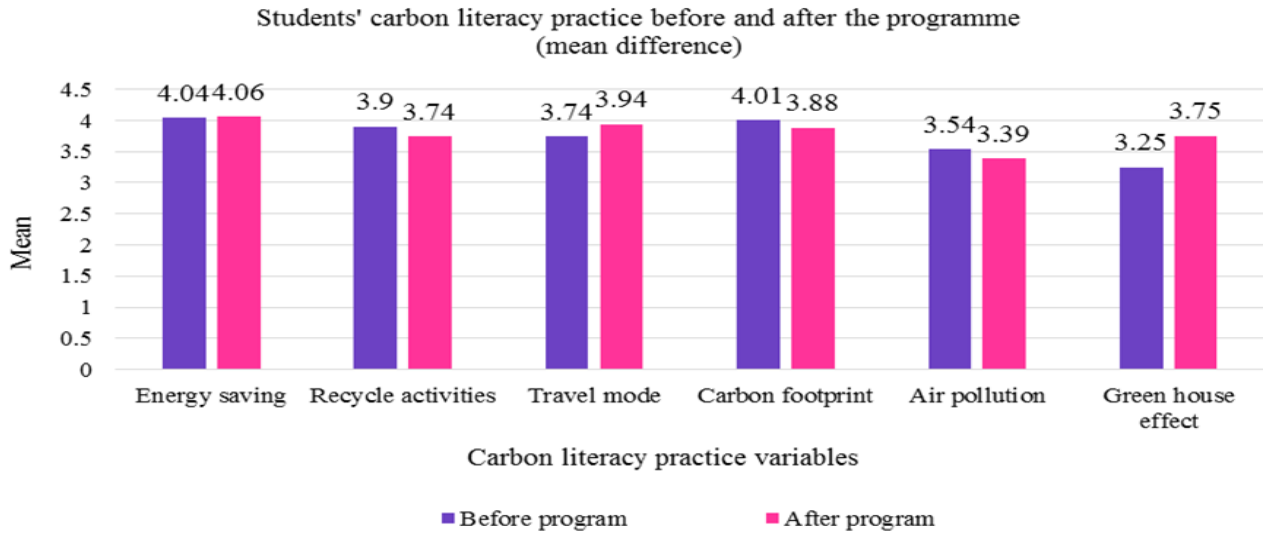

Figure-10. Students' Carbon Literacy Practice Before and After the Programme (Mean Difference)

Source: Hanifah *et al.* (2016)

Figure 11 shows the difference in the low carbon attitude of the students before and after the programme. It was found that, in general, the low carbon attitude of the students was at a high level before and after the programme. For each low carbon attitude sub-variable, namely energy saving, recycling activity, and travel mode, there was also no change in level before and after the programme, with a high level for all three.

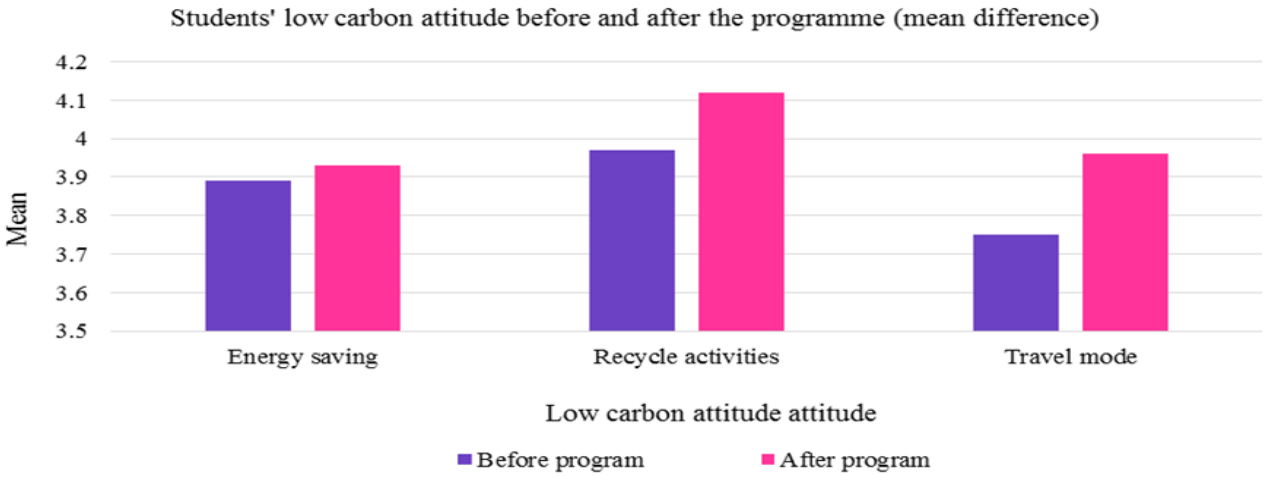

Figure-11. Students' Low Carbon Attitude Before and After the Programme (Mean Difference)

Source: Hanifah *et al.* (2016)

Figure 12 shows the difference in the values of students' carbon literacy before and after the programme. It was found that, overall, the student's carbon literacy value was at a high level before and after the programme. For each sub-variable of student's literacy values, namely individual and community, there was also no change in the levels before and after the programme, which were at high level for both.

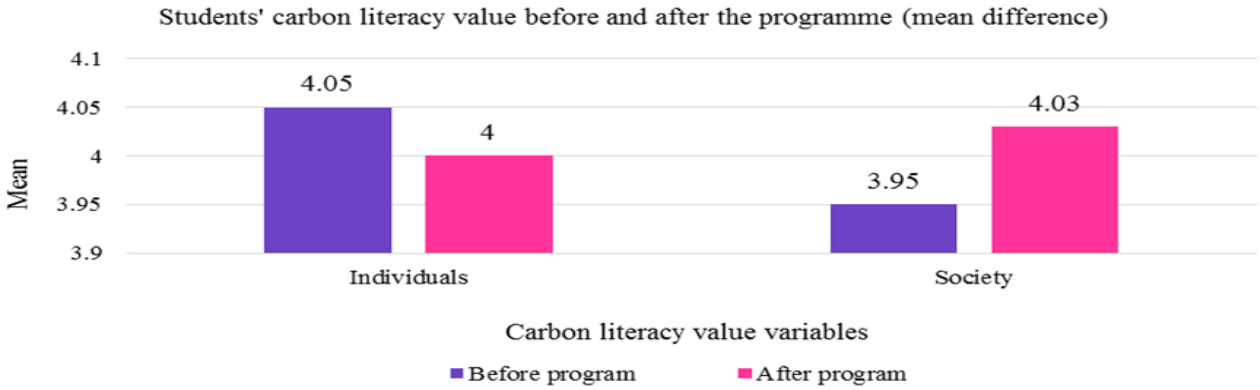

Figure-12. Students' Carbon Literacy Value Before and After the Programme (Mean Difference)

Source: Hanifah *et al.* (2016)

This shows that the greenhouse effect knowledge of the students can be enhanced by the activities and low carbon curriculum implemented in the Low Carbon Schools programme. This is in line with a study by Karpudewan *et al.* (2015) which showed that students' active participation in classroom activities had improved their understanding of global warming, the greenhouse effect, acid rain, and ozone depletion. In fact, a study by Hanifah *et al.* (2016) also revealed that students undergoing sustainability activities had a positive impact on the students' knowledge and practices. In addition, the positive knowledge of students in environmental care is also strongly influenced by the cooperation of the individuals close to the students, such as teachers and parents (Zarrintaj *et al.*, 2013). Next, as for the students' low carbon practices before and after the programme, there was no change in the test results (Figure 13).

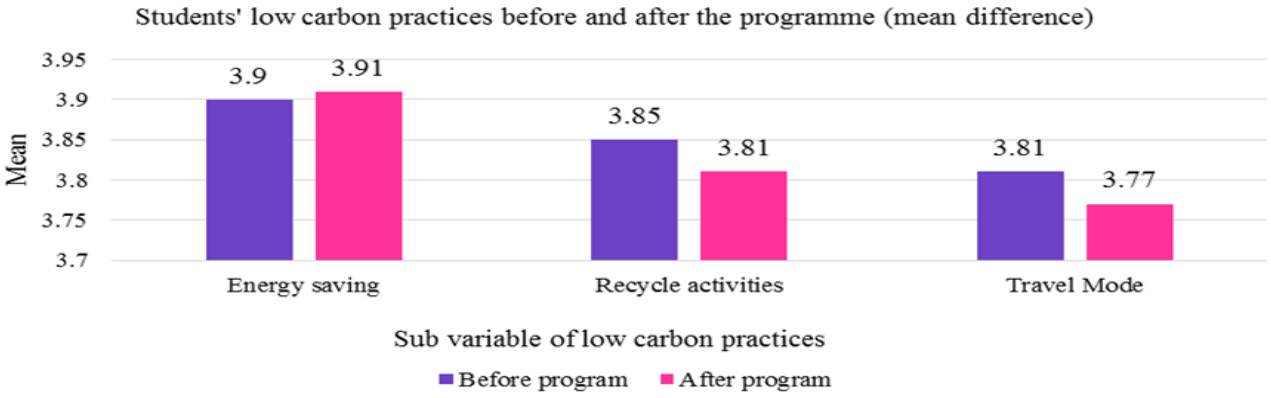

Figure-13. Students' Low Carbon Practices Before and After the Programme (Mean Difference)

Source: Hanifah *et al.* (2016)

3.4. Low Carbon Schools Model

Figure 14 shows the actual model of Low Carbon Schools implemented through the approaches and exposure to education on sustainable development. The approach used was the sustainability practices instilled by the seven low carbon school building processes, adapted from the seven processes for the establishment of Eco Schools namely to establish low carbon clubs, conduct field studies, build action plans, monitor and re-evaluate plans, develop curriculum links, encourage school community involvement, and develop a low carbon code. Its impact on the educational institution, which is the school, can be divided into two parts; the students and the school

environment. The results of this are that the school students will experience an increase in carbon footprint knowledge, low carbon attitudes, carbon literacy values, and low carbon practices. While, for the school environment, it resulted in a low carbon environment, optimum temperature, and energy saving.

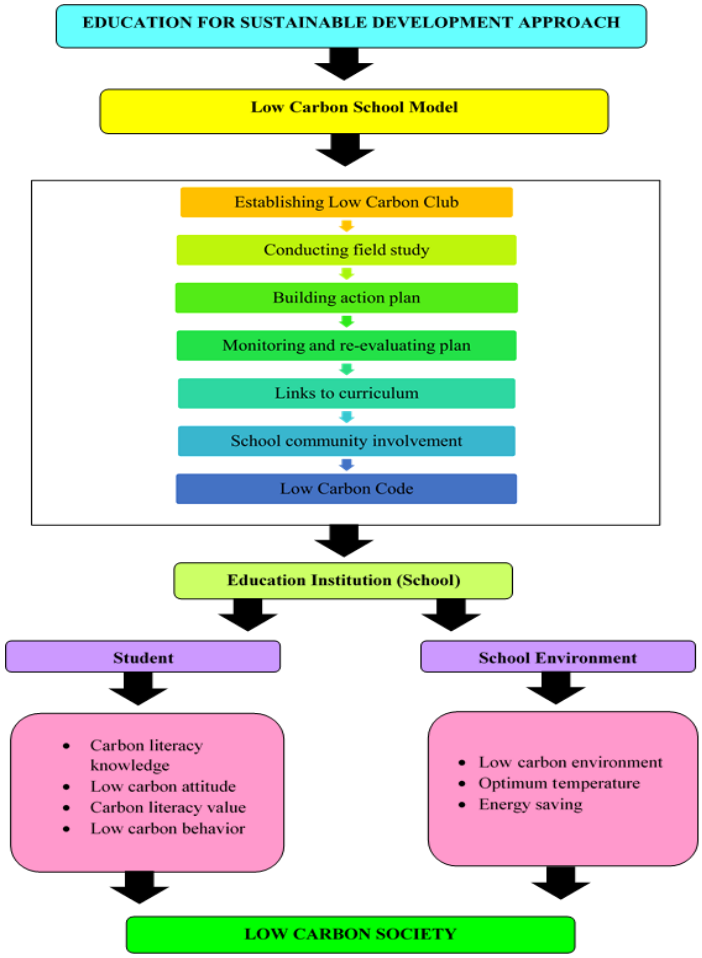

Figure-14. Low Carbon School Model

Source: Hanifah *et al.* (2016)

4. CONCLUSION

The construction of the actual Low Carbon School model in this study involved the seven steps of the Low Carbon Schools framework, which include setting up low carbon clubs, conducting fieldwork, forming action plans, monitoring and revising plans, developing links to the curriculum, encouraging school community involvement, and developing a low carbon code. The results of the Low Carbon School programme show that there has been an increase in the level of carbon literacy knowledge, low carbon attitudes, carbon literacy values, and low carbon practices among the school students involved, before and after the programme. This shows that ESD is successfully transformed into a Low Carbon Schools programme. The writing of this study is hopefully able to be a guide in helping interested parties in the implementation of the programme, which has had a positive effect on the students' inner self, while also providing a positive impact on the school by reducing electricity consumption. To further improve the quality of future studies, involvement of all parties from the Ministry of Education and the school, as well as the teachers and parents are indispensable in the implementation of the Low Carbon Schools programme, while, at the same time, giving exposure to the community outside the school.

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