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Transformation of Education for Sustainable Development through Low Carbon Schools Community Program

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ABSTRACT

In line with the aforementioned functions and role of schools, Education for Sustainable Development (ESD) is seen as a starting point in the formation of a low-carbon society among children and teenager. Therefore, this article aims to discuss the approach of the Education for Sustainable Development through Low Carbon Schools community program. The sample community involved in this program consisted of students, aged 14–16, from one of the schools in Selangor, Malaysia. The execution of the program was divided into three phases: the first phase involved a pre-test and observations of sustainability practices in school; the second phase focused on the action plan and low-carbon sustainability activities; and the third phase was comprised of a post-test and the establishment of a low carbon school model. The assessment of the study was based on the pre-test and post-test, which measured the levels of environmental literacy and students' low-carbon practices. The findings of the pre-test and post-test showed an increase in the level of the greenhouse effects sub-variable for environmental literacy. However, the other sub-variables of environmental literacy and students' low-carbon practices did not show any significant changes. This proves that sustainable development education has been successfully transformed by the Low Carbon Schools program and, as a result, improved students' environmental literacy knowledge. The results of this study are expected to be used as an initial backup to assist in the establishment of the Low-Carbon Schools model at secondary-school level in Malaysia.

Keywords: Sustainable development education, low carbon society, low carbon school, environmental literacy, low-carbon practices.

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INTRODUCTION

Sustainable development is a broad discipline that encompasses three main pillars as social, economic, and environmental domains. In the context of sustainable development, the definition of sustainability is a development that meets the needs of the present without compromising the ability of future generations to meet their needs (World Commission on Environment and Development (WCED), 2003). The sustainable development was first endorsed at the United Nation General Assembly in 1987. The parallel concept of education has also been explored to support sustainable development. These efforts can also be furthered through educational exposure, known as Education for Sustainable Development (ESD) or Environmental and Sustainability Education (ESE) (Naomi, Jada & Alexandria, 2018). It is now generally accepted in worldwide as the basis for teaching education for sustainable development including in Malaysia.

Education is an essential tool for achieving sustainability in terms of sustainable development. For more than half a century the international community of nations has recognized education as a fundamental human right. In 2000, it agreed to the Millennium Development Goals which acknowledged education as an indispensable means for people to realize their capabilities and prioritized the completion of a primary school cycle (UNESCO, 2014). Education through ESD is a learning process or approach for teaching based on the principles that underlie sustainability at all levels and multidisciplinary area of knowledge (UNESCO, 2009). Subject content for ESD typically focusing on inter-relationships between environmental, economic and social factors, complex and value-laden, and the included terms open to various interpretations. Initial distinction can be made between "sustainable development" as a process and "sustainability" as the goal (Stephen & Scott, 2003). There were also three perspectives on environmental education; knowledge bias, need of society bias and critical enquiry bias that are necessary for ESD (Webster, 1989). Furthermore, Geiser (2006) stresses that ESD should involve environmental awareness with respect to the components of ecosystems and natural resources, ESD interests and limitations, the threat of human activities on ecosystems, and developing the skills of monitoring, analysis, and involvement. This is supported by Cheong (2005) and Leite, Dourabo, Morgano and Antunes (2019) who states that ESD can be divided into two types of ability, namely cognitive ability and affective ability, which involves, investigation and research; lateral, analytical, and creative thought; collaboration; communication; literacy; and observations. According to Hanifah, Yazid, Mohmadisa, and Nasir (2016), ESD is implemented in a structured program has a positive impact on the practice of sustainability. Moreover, Joshi (2009) recognizes the positive impact of ESD, which clearly contributes to the improvements in values, behavior, and ways of life, as well as increased concern for social change and a sustainable future. The educational sustainability approach is commonly delivered as part of specific subjects, such as Geography and Science, through cross-curricular activities and special programs (John, 2012).

The sustainability approach in education has also been discussed at the international level in an attempt to increase public awareness of the need for environmental care in solving current global problems such as climate change and sometimes education is both part of the problem and the solution (Huckle & Sterling, 1996). Kagawa and Selby (2010) stated that the current formal institutions of education and learning such as schools and universities are not "fit in purpose" for life and learning in a climate changed world. The education and learning of these issues need to be completely interdisciplinary and comprise variety of knowledges, including traditional and non-Western, non-scientific knowledges, experiences and practices where the ideas are more active forms of learning, doing and learner communities. The education materials used in training or development environmental program can be in form of

books, lesson plans, activity guides, environmental interpretation resources, or extension service documents (Shankar, 2007).

In Malaysia, ESD has been implemented formally and informally through the Sustainable Schools Program Environmental Award (SLAAS) which has been in charge since 2005. The ESD, implemented through SLAAS, is a whole-school community movement in the field of management, curriculum, co-curriculum, and greening. The ESD aimed at achieving the two main objectives which are to foster environmental values in school community and to raise awareness about the importance of environmental preservation and conservation (Department of Environment, 2007; Shaharudin, Abdul Samad, Ahmad Fariz, Siti Nashroh, &Mazlin, 2011). This clearly shows that the Ministry of Education (MOE) in Malaysia, together with the Department of Environment (DOE), tried to provide exposure to ESD in a non-formal format, through this SLAAS program, in order to create public awareness and commitment to participate in the sustainable development agenda.

In addition, there are also activities carried out by governmental and non-governmental organizations, such as Green Schools, Eco Schools and Low Carbon Schools, which have been implemented in Malaysia (Shaharudin, Abdul Samad, & Ahmad Faiz, 2010). The approaches are different according to the programs. However, they all share the same objective which is improving students' and school communities' interests for the environment. The Green Schools Campaign (GSC) in Malaysia is a Corporate Social Responsibility (CSR) initiative by Penjana Bebas, the Association of Independent Power Producers in Malaysia in partnership with the Malaysia Building Integrated Photovoltaic (MBIPV) Project Team that began in 2009. The program is a comprehensive educational initiative focusing on energy efficiency in schools. While Eco School in Malaysia was nationally operated by WWF-Malaysia in 2010. The implementation of the program in Malaysia is supported by a National Eco-Schools Committee along with the partners such as ministries, government agencies, universities and organizations. Therefore, this article will discuss the implementation of The Low Carbon Schools community program that premier was held in this country, which is smaller in scope than the sustainable school program which implemented at the national level in Malaysia.

Low Carbon Schools Community Program

Schools are formative educational institutions because they can change the thoughts, behavior, and attitudes of students, and produce a generation that is spiritually and mentally balanced (Surendran &Norazlinda, 2014). In Malaysia, schools play an important role in the realization of the National Education Philosophy, which aims to develop the potential of individuals in a holistic and integrated manner, in order to produce individuals who are intellectually, spiritually, emotionally, and physically balanced and harmonious, based on a firm belief and devotion to God (MOE, 2016). The functions of school are also seen to be able to help in integrating ESD among students and the school community (Hanifah, Shaharudin, Mohmadisa, Nasir &Yazid, 2015).

Furthermore, expecting a child or student to solve environmental problems without proper regard for their infinite complexities is setting up potential failure for them (Jickling, 1991). Governance of children's moral behavior appears to require some stability in the moral framework through their sense of sustainable actions that are related to an ideal or perfect version of the same action (Johan, 2013). Therefore, school administrators and teachers also play an essential role in leading change in schools (Sammons, 2007).

In line with the aforementioned functions and role of schools, the Low Carbon Schools Program is seen as a starting point in the formation of a low-carbon society. This means a society that reduces carbon energy use to prevent climate change (Suziana, 2013). Apart from that, by definition, a Low Carbon School is a school that emits carbon at a zero level or at the

lowest level in which the energy consumption is at a normal level, and where the school community applies low-carbon practices to balance the carbon cycle (Al Ghamdi & El-Hassan, 2019). Through the implementation of Low Carbon Schools, the community residing in a school can adapt their lifestyles by using alternative renewable energy sources, becoming less dependent on fossil fuels, and practice the 3Rs; Reuse, Reduce, and Recycle. In fact, through this program, the energy literacy of the students can be improved by Low Carbon Schools Program (Mageswary, Jamunah, & Ahmad Nurulazam, 2015). A study by John, Sandy, and Peter (2016) on primary schools in New South Wales, Australia showed that the Climate Clever Energy Savers (CCES) program was effective in helping the students to identify ways to reduce electricity consumption and in improving students' environmental literacy.

Through Low Carbon Schools Program, indirect participation of students in activities inside and outside the classroom will increase their substantial experiences and soft skills (Reaves, Hinson, &Marchant, 2010). According to the involvement theory (Astin, 1984), involvement is defined as the use of physical and psychological energy that occurs during the entire activity and can be measured qualitatively and quantitatively. According to Fredericks, Blumenfeld, and Paris (2004), involvement is made up of three forms, namely emotional, behavioral, and cognitive. Involvement is also seen to be able to increase leadership potential in each student (Elizabeth & Michael, 2013).

If viewed in the context of the environment, students' involvement in hands-on activities outside the classroom is able to enhance students' knowledge and practices (William, 2019). A study by Karpudewan, Roth, and Chandrakesan (2015) showed that students' active involvement in the class has improved their understanding about global warming, greenhouse effects, acid rain, and ozone depletion. Access to the natural environment outside the classroom can also build self-confidence, responsibility, pride, cooperation, problem solving in the classroom, and the relationship between students and teachers (Seyedehzahra, Tawil, Abdullah, Surat, & Usman, 2011). However, students' positive knowledge about environmental protection is also influenced by the practices of their family, teachers, and the media, as well as what they read and environmental aspects of the school curriculum (Zarrintaj, SharifahZarina, Abdul Samad & Mahyar, 2013). In addition, an effective teaching approach can also help to increase the level of environmental literacy among students (Mageswary, Jamunah, & Ahmad Nurulazam, 2016). The involvement theory (Astin 1984) also states that active involvement of students in an integrated academic field in school can increase their knowledge and develop their skills (Figure 1). This means that the activities carried out in schools can influence and improve students' knowledge and skills based on the focus and attention given.

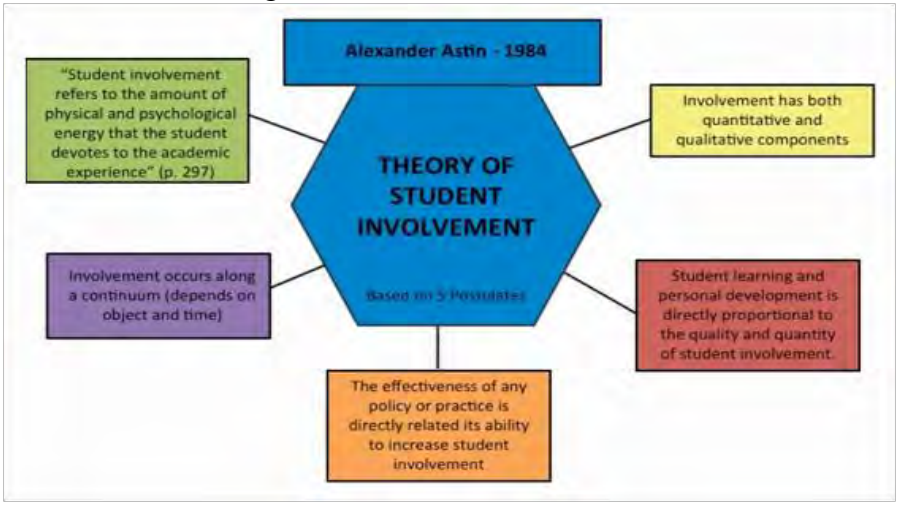

Figure 1. Student involvement theory. Source: Astin (1984)

In line with this, a program has been implemented in 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. It is in a rural area that is surrounded by residential areas. The school had 635 students of whom 305 were boys and 330 girls, while the number of teachers was 50 (Selangor State Education Department, 2016). The main objective of this program was to build an actual low carbon model school which involved students' participation. The objective of the implementation of this program was to assess the level of environmental literacy and low-carbon practices among students and to form a "Low Carbon School". The implementation process of the low carbon school model was modified based on the seven major steps of the Eco-Schools process (Figure 2), namely establishing a low carbon club, conducting field studies, developing an action plan, monitoring and re-evaluating the plan, developing links to the curriculum, involving the school community, and implementing a low carbon code (Figure 3).

Figure 2. Seven process of Eco Schools formation. Source: National Wildlife Federation (2017)

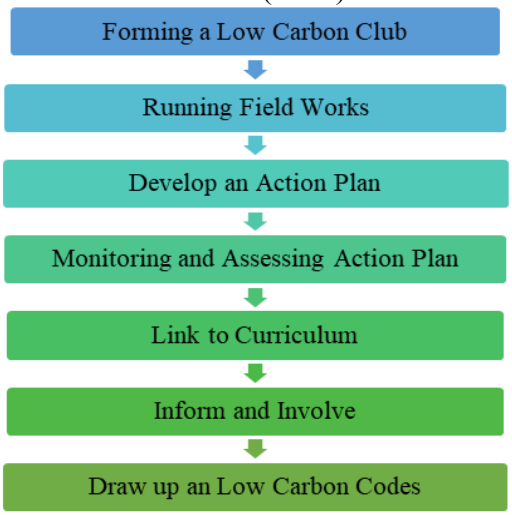

Figure 3. Seven process of Low Carbon Schools formation

Therefore, this article discusses the implementation of activities throughout the Low Carbon Schools community program, in terms of the way in which it transforms ESD. The discussion will cover the study method, which consists of three phases, and the study results, in the form of pre-test and post-test.

METHODS

a) Research design

The study included a pre-test and post-test experimental approach for comparing the program's effects on a control group (Chua, 2006) to see the difference in system results between the two sample groupings. Descriptive analysis used to see the similarities between two classes at a time. This design is helpful by noticing only the mean, one does not consider the details about the rest of the values and it is important to use dispersion measures to understand that group data whether is equal or not.

In the initial stage, which was the first phase of the study, three methods were involved; a pre-test to measure the students' initial level of environmental literacy and low-carbon practices and observations of the school area. The second phase was to build an action plan based on the findings of the pre-test and observations. Next, in the third phase, a post-test was conducted to re-evaluate the students' environmental literacy and low-carbon practices, and a Low Carbon Schools model school will be established based on the information from the findings (Figure 4).

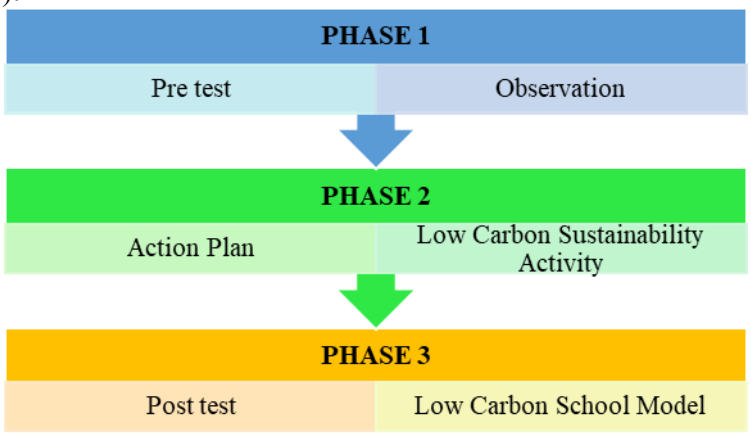

Figure 4. Research phases

b) Research sample

The sample community involved in this program consisted of students, aged 14–16, from one of the schools in Selangor, Malaysia. 224 students were selected among 635 students in the school using simple random sampling method.

c) Research ınstrument and procedure

The constructed instrument had four parts: respondents' background, environmental literacy, low-carbon practices, and open-ended questions. The content of each variable and the measurement scales for each variable of this study are described in Table 1. For each item, participants were asked to respond using a 5-point Likert scale, with the variables for environmental literacy being 1=Strongly disagree, 2=Disagree, 3=Somewhat agree, 4=Agree 5=Strongly agree; while, for low-carbon practices, the variables were 1=Never, 2-Sometimes, 3-Occasionally, 4-Always and 5-Very often.

Table 1. *Research ınstrument*

Part	Details	Variables	Sources of Items
A	Respondents' Background	Gender Form Ethnic	Guided by the purposes of the study itself
B	Environmental Literacy Knowledge	Energy Saving Recycle Activities	Fostered by custom and refer to KeTTHA

		Transportation's Mode Carbon Footprint Air Pollution Green House Effect	(2015)
C	Low-Carbon Practices	Energy Saving Recycle Activities Transportation's Mode	Fostered by custom and refer to KeTTHA (2015)
D	Open Questions	Comments	

FINDINGS and DISCUSSION

a) Background of respondents

The discussion on the findings is divided into two parts. The first part was about respondent's background. And, the second part was comprised respondents' level of environmental literacy and low-carbon practices. Respondents' background consisted of 224 secondary school students of SMK Kalumpang, Selangor. A total of 78 (34.8%) Form 1 students, 98 (43.8%) Form 2 students, and 48 (21.4%) Form 4 students participated in this study.

b) Pre-test findings

Analysis of environmental literacy levels and low-carbon practices of the students involved descriptive analysis, which enabled calculation of means, percentages, standard deviations, and mean levels. The levels in this study are based on cut-point values which are divided into three levels, namely low level (score 1.00-2.33), medium level (score 2.34-3.66), and high level (score 3.67-5.00).

Table 2 shows that the variable of environmental literacy is at a high average level overall. Similarly, the sub-variables of energy saving, recycling activity, mode of transport, and carbon footprint also show a high average level. However, the sub-variables of air pollution and greenhouse effects are at a medium average level.

Table 2. *Pre-test findings for carbon literacy knowledge*

Variables	Low Level		Medium Level		High Level		Mean	SD	Mean Level
	N	%	N	%	N	%			
Carbon Literacy Knowledge	4	1.8	98	43.8	122	54.4	3.71	0.50	High
Energy Saving	4	1.8	70	31.3	150	67.0	4.04	0.68	High
Recycle Activities	4	1.8	81	36.2	139	62.1	3.90	0.67	High
Transportation's Mode	7	3.1	98	43.8	119	53.1	3.74	0.81	High
Carbon Footprint	8	3.6	56	25.0	160	71.4	4.01	0.79	High
Air Pollution	12	5.4	122	54.5	90	40.2	3.54	0.79	Medium
Green House Effect	28	12.5	118	52.7	78	34.8	3.25	0.88	Medium

Meanwhile, the findings regarding the level of low-carbon practices among the respondents show that the overall low-carbon practices level and all of the sub-variables are at a high average level (Table 3). This is in line with the initial pro-natural behavior model of

Kollmuss and Agyeman (2002), which states that the level of practice is in line with the level of knowledge.

Table 3. Pre-test findings for low-carbon practices

Variables	Low Level		Medium Level		High Level		Mean	SD	Mean Level
	N	%	N	%	N	%			
Low-Carbon Practices	3	1.3	86	38.4	135	60.3	3.86	0.72	High
Energy Saving	6	2.7	75	33.5	143	63.8	3.90	0.80	High
Recycle Activities	9	4.0	80	35.7	135	60.3	3.85	0.87	High
Transportation's Mode	14	6.3	79	35.3	131	58.5	3.81	0.87	High

After the pre-test was conducted, the findings showed that the environmental literacy level of the students, in terms of air pollution and greenhouse effects were still at a medium level. Thus, an action plan has been developed together with the school management, which included the activities shown in Table 4.

Table 4. Low carbon sustainability activities

Step	Activity	Description
1	Establishing Low Carbon Club	• A total of 20 Form 4 students of SMK Kalumpang are appointed as members of the Low Carbon Club. • The members of Low Carbon Club are the leaders of Low Carbon Schools program. • The field study is a school audit which covers the Low Carbon Schools theme.
2	Conducting field study	• This study is designed to give a realistic overview of the school's current environmental performance in forming a community that applies low-carbon practices. • This study helps in the construction of an action plan and acts as a guide for the school to decide which changes should be implemented in accordance with the objectives of Low Carbon Schools.
3	Building an action plan	• Information and issues gained from field studies are brought forward through an action plan. • The produced action plan consists of a series of scheduled targets aimed to achieve the goals identified by the field study.
4	Monitoring and re-evaluating the plan	• Thorough monitoring and measuring the actions that are conducted to ensure the goals outlined in the action plan being implemented and achieved. • This assessment takes into account whether or not the activities implemented will succeed and the new measures that need to be taken to deal with problems during the execution of the program.
5	Links to curriculum	• Links to the existing curriculum are important to ensure the program which are circulating within the school community. • Teachers introduce the principles of low-carbon-practices during the education in certain aspects of the curriculum.
6	School community involvement	• Involvement is a key component in the implementation of Low Carbon Schools (Figure 4, Figure 5, Figure 6 and Figure 7). • Activity involvement and the dissemination of information throughout the school, students, and local community, via notices and social media, such as Facebook (Figure 8). • This idea aims to inform as many people as possible about Low Carbon Schools and to encourage active involvement of

		individuals in this process whether formally or informally.
7	Low Carbon Code	• The Low Carbon Code is the school's mission statement and expression of its commitment to improve performance towards being a Low Carbon School. • The low Carbon Code for SMK Kalumpang is placed on the notice board at the school that includes pictures of Low Carbon Club activities, school activities towards the establishment of a Low Carbon School, and information pertaining to low-carbon practices.

Figure 4. Patching consciousness sustainable practices poster

Figure 5. Planting and greening activity in school area

Figure 6. Recycle activities competition

Figure 7. Lecture and exhibition (booth) of consciousness about preserving nature

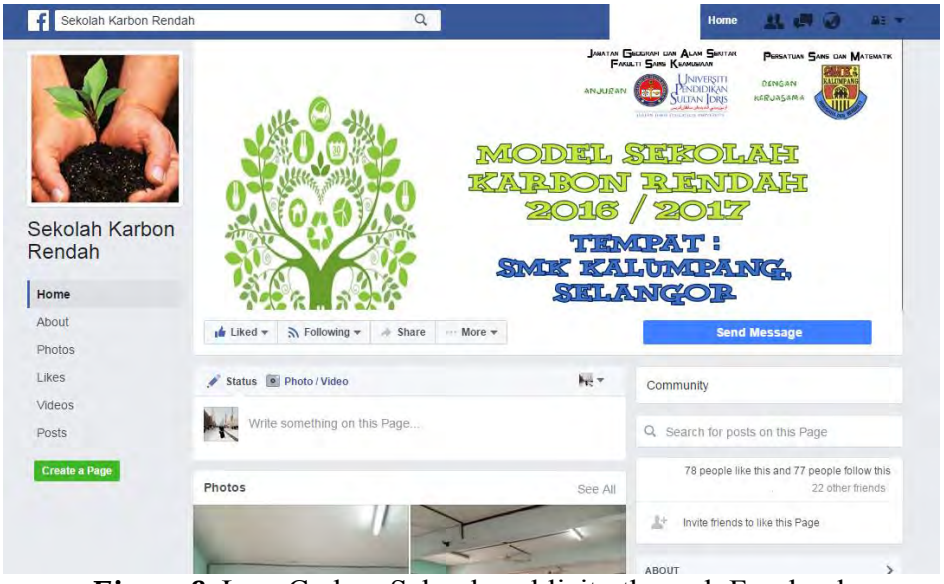

Figure 8. Low Carbon Schools publicity through Facebook

c) Post-test findings

After the completion of Phase 2 of the program, a post-test was conducted in the form of a questionnaire to reassess the levels of environmental literacy and students' low-carbon practices as a result of their involvement in the activities under the Low Carbon Schools program. Table 5 shows the variables of respondents' environmental literacy levels which is at a high average level overall. This is similar the sub-variables of environmental literacy, which include energy saving, recycling activity, mode of transport, carbon footprint, and greenhouse effects, also show a high average level, however the air pollution sub-variable is at a medium average level.

Table 5. Post-test findings for carbon literacy knowledge

Variables	Low Level		Medium Level		High Level		Mean	SD	Mean Level
	N	%	N	%	N	%			
Carbon Literacy Knowledge	8	3.6	66	29.5	150	67.0	3.81	0.55	High
Energy Saving	11	4.9	52	23.2	161	71.9	4.06	0.89	High
Recycle Activities	5	2.2	90	40.2	129	57.6	3.74	0.66	High
Transportation's Mode	3	1.3	67	29.9	154	68.8	3.94	0.74	High
Carbon Footprint	11	4.9	63	28.1	150	67.0	3.88	0.82	High
Air Pollution	5	2.2	147	65.6	72	32.1	3.39	0.69	Medium
Green House Effect	5	2.2	111	49.6	108	48.2	3.75	0.71	High

The findings regarding levels of low-carbon practices show that all of the sub-variables are at a high average level as shown in the post-test findings (Table 6). This shows that there are no differences in the levels of low-carbon practices for the pre- and post-test.

Table 6. Post-test findings for low-carbon practices

Variables	Low Level		Medium Level		High Level		Mean	SD	Mean Level
	N	%	N	%	N	%			
Low-Carbon Practices	9	4.0	85	37.9	130	58.0	3.84	0.73	High
Energy Saving	15	6.7	72	32.1	137	61.2	3.91	0.87	High
Recycle Activities	9	4.0	73	32.6	142	63.4	3.81	0.79	High
Transportation's Mode	13	5.8	73	32.6	138	61.6	3.77	0.83	High

Changes in the levels can also be seen from the post- and pre-test on the greenhouse effects sub-variables (Table 7). This shows that low-carbon activities and the curriculum adopted in the Low Carbon Schools program can improve students' knowledge of greenhouse effects. This is in line with a study by Karpudewan, Roth, and Chandrakesan (2015), which showed that students' active involvement in classroom activities enhanced their understanding of global warming, greenhouse effects, acid rain, and ozone depletion. In fact, the studies by Hanifah et al. (2016) also revealed that students engaging in sustainability activities has a positive impact on their sustainability knowledge and practices. In addition, students' positive knowledge about environmental protection was also strongly influenced by the cooperation of surrounding individuals, such as teachers and parents (Zarrintaj, SharifahZarina, Abdul Samad, &Mahyar, 2013). Students' low-carbon practices before and after the program shows no changes in the test results (Table 8).

Table 7. Differences of carbon literacy knowledge before and after program

Variables	Before Program			After Program		
	Mean	SD	Mean Level	Mean	SD	Mean Level
Carbon Literacy Knowledge	3.71	0.50	High	3.81	0.55	High
Energy Saving	4.04	0.68	High	4.06	0.89	High
Recycle Activities	3.90	0.67	High	3.74	0.66	High
Transportation's Mode	3.74	0.81	High	3.94	0.74	High
Carbon Footprint	4.01	0.79	High	3.88	0.82	High
Air Pollution	3.54	0.79	Medium	3.39	0.69	Medium
Green House Effect	3.25	0.88	Medium	3.75	0.71	High

Table 8. Differences of low-carbon practices before and after program

Variables	Before Program			After Program		
	Mean	SD	Mean Level	Mean	SD	Mean Level
Low-Carbon Practices	3.86	0.72	High	3.84	0.73	High
Energy Saving	3.90	0.80	High	3.91	0.87	High
Recycle Activities	3.85	0.87	High	3.81	0.79	High
Transportation's Mode	3.81	0.87	High	3.77	0.83	High

CONCLUSION

Based on this study, it can be concluded that the Low Carbon Schools community program has clearly raised the students' awareness of low-carbon knowledge and practices. The execution of this program was divided into three phases: the first phase involved a pre-test and observations on the sustainability practices in the school; the second phase involved developing an action plan as well as low-carbon sustainability activities; and the third phase included a post-test and the establishment of a low carbon school model. The level of environmental literacy and low-carbon practices of the students showed increases with respect to the greenhouse effects sub-variable but no changes in the levels of environmental literacy and students' low-carbon practices sub-variables. This shows that ESD is successfully transformed by the Low Carbon Schools community program so as to improve students' environmental literacy. It is hoped that this article can serve as an initial backup to assist in the formation of the key elements for the Low Carbon Schools model at secondary-school level. In addition to the planning of this program, this study may also help to ensure future curriculum development can be improved and can upgrade the existing study aids. To further improve the quality of future research, participation of all parties, including the upper levels, the schools, and the parents, is necessary for the implementation of a low-carbon school program, thereby giving exposure to the community outside the school.

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