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Blended Learning in the Implementation of Environment Dimension of ESD Infused into Junior High School Science

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Abstract: This study addresses the problem of the extent to which Blended learning is effective for developing Junior High School (JHS) students' knowledge and attitude toward environment conservation as an ESD dimension. The main objective of this study is to examine the effectiveness of Blended Learning, as a type of delivery system, for developing the JHS students' knowledge and attitude toward environment conservation as an ESD dimension. This problem is considered a unique novelty in its focus on ESD engagement, which is emphasized not only changing the students' knowledge but also attitude, more specifically concerning environment conservation as one of the main ESD dimensions. The study employs a quasi-experiment using a control group with a pre-test and post-test design conducted in Bandung JHSs. The subjects involved in this study are 216 grade eight students of three JHSs in the city of Bandung as the purposive sample. The subjects are assigned into two groups, the treatment, and the control groups. Data collection uses an achievement test and an attitude scale. The data is analyzed using descriptive statistics and one-way analysis of covariance (ANCOVA). Based on the data analysis, it is concluded that Blended learning on the environmental dimension of ESD infused in JHS science significantly affects the students' knowledge and attitude toward the importance of environment conservation.

Keywords: blended learning, environment ESD dimension, junior high school, blended learning for developing knowledge and attitude.

混合式学习在可持续发展教育融入初中科学的环境维度实施中

摘要：本研究探讨了混合式学习在多大程度上有效培养初中学生对环境保护的知识和态度作为可持续发展教育维度的问题。本研究的主要目的是检验混合式学习作为一种交付系统在培养初中学生对环境保护的知识和态度作为可持续发展教育维度的有效性。这个问题被认为是其对可持续发展教育的独特创新，它不仅强调改变学生的知识，而且强调态度，更具体地说，将环境保护作为可持续发展教育的主要内容之一。该研究使用了一个准实验，使用一个对照组，在万隆初中进行了前测和后测设计。本研究涉及的对象是以万隆市三所初中的216名八年级学生为目的样本。受试者被分为两组，治疗组和对照组。数据收集使用成就测试和态度量表。使用描述性统计和协方差的单向分析来分析数据。基于数据分析得出结论，初中科学融入可持续发展教育环境维度的混合学习显着影响学生对环境保护重要性的认识和态度。

关键词：混合学习，可持续发展环境教育，初中，混合学习发展知识和态度。

1. Introduction

The problem of environmental damages has become a serious global community concern. Some problems are mainly caused by increasing the world's population and unwise human behavior. The world population is likely beyond the capacity of the Earth, and its exploitation of the environment for its need fulfillment, mostly in underdeveloped and developing countries, threatens environment conservation.

In 2010, the world population was 6.9 billion. Recently, the world population is 7.8 billion, and it is forecasted to become 8.5 in 2030, 9.1 in 2040, and it is going to become 9.7 in 2050 [1]. Meanwhile, data on the environment indicates 29% of Earth soil has become a desert, 6% of which is categorized as severe.

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Tropical forest, which is 6% of the Earth's surface and its biodiversity consists of 50% of the world's species, is risky. The uncontrolled decrease of tropical forests around 7.6 million through 10 million hectares each year negatively affects the carbon cycle, biodiversity damage, and the disappearance of some biospheres in the habitat. The use of fossil fuel energy by vehicle and industry produces the emisfundion of carbon have threatened the atmosphere and created global warming and climate change. The Earth's surface's average temperature has increased by 1.5^{o} through 4.5^{o} celsius. That increases the sea surface level at an average of 10 through 15 cm due to the Arctic Pole's ice melting in the summer season. These have influenced the frequency of hurricanes, the decrease of sea resources, the destruction of coral reefs, and the disappearance of species sensitive to the temperature [2].

Environment education is essential to overcome environmental problems. Through education, the related competencies, i.e., knowledge, attitude, and skill concerning environmental conservation, are cultivated and developed so the people will be aware and change their behavior upon the importance of environment conservation. The attempt to overcome environmental problems connects with human life sustainability because the environment, as a system, has interrelated and interdependent components that every living creature needs. Its implementation is at all education levels for sustainable development (ESD).

Sustainable development (SD) is a concept of national development of a given country in fulfilling the needs and improving the welfare of its people in the present time while considering future generations' needs [3]. The concept has become the buzzword in development discourse, associated with different definitions, meanings, and interpretations. Mensah & Casadeval [4] argue that the concept has been defined from various perspectives and looked at from various angles. They further explain: *"Although definitions abound with respect to SD, the most often cited definition of the concept is the one proposed by the Brundtland Commission Report. The Report defines SD as development that meets the needs of the current generation without compromising the ability of future generations to meet their own needs"* [4]. That is in line with Franco et al. [5], who argue: the Brundtland concept has become the baseline of many sustainable development approaches to date.

Development in many underdeveloped and developing countries has various positive impacts, such as economic growth and welfare improvement. However, it also has negative impacts such as deterioration and destruction of the environment. When the quality of human resources, as the development agents, is low, it will overlook many negative impacts of the development, resulting in an imbalance between the benefit of the development and the damages on the environment [6].

ESD means education regarding following SD pillars as independent and interrelated dimensions, i.e., socio-cultural, economic, and environmental, to improve quality of living. It is a process of learning how to make decisions that consider the long-term future of the economy, ecology, and equity of all communities [7]. It is a dynamic concept and a collective attempt to look into the future when everyone reaps benefit from the opportunity to obtain an education and learn about important lifestyles, behavior, and values to create a sustainable future. One of the essential indicators of the quality of the human resources is their competencies which include knowledge, attitude, and skill. ESD aims at developing competencies that empower individuals to reflect on their actions, taking into account their current and future social, cultural, economic, and environmental impacts from a local and a global perspective [8].

Human behavior includes several aspects, among which is attitude. A person tends to accept or reject a stimulus. Concerning the environment-related issue, attitude toward environment conservation means a person's tendency to accept or reject it. That is essential for every person to possess because it will impact not only his/her activity concerning the environment conservation but also will strike against others' activity of doing damage in the environment. Conceptually, we can develop and cultivate this kind of attitude earlier through JHS education. In that case, this hypostatically will impact their environment conservation behavior when he/she enter adult life in the community.

Law number 20, the year 2003, on the Indonesian National Education System, stipulates that every citizen must undertake 9-year basic education [9]. The basic education includes primary school (6 years) and juror high school (3 years). JHS is the terminal unit of basic education every individual citizen must complete. It plays an essential role in developing a foundation for every individual's capacity, later developed through further education. That implies developing knowledge and attitude towards environment conservation at JHS is considered strategic because whether or not the student continues the study, he/she, as a young generation, possesses the needed attitude toward environment conservation [10].

Regarding the situation of Junior high school curriculum not including environmental education or ESD as a subject, Cebrian et al. [8] argue that all educational institutions from preschool to higher education in non-formal and informal education should foster the development of ESD-related competencies. To overcome the absence of this subject, which is one of the UNESCO's agenda every member country should take into action it needs a certain strategy. The strategy is engaged by infusing the environment dimension of ESD into JHS Science. In its engagement, the environmental dimension of ESD needs an effective mode of the delivery system so students can

develop an attitude toward the importance of environment conservation regarding ensuring that its exploitation for fulfilling the present generation needs will not sacrifice the future generation's. Among the mode of delivery systems assumed effective for engaging the environmental dimension of ESD infused in JHS science is Blended Learning. This mode of delivery system is a mix or a blend of classroom teaching processes and e-learning. This study addresses a major problem of the extent to which blended learning in the engagement of the environmental dimension of ESD infused in JHS Science concerning is effective for developing the students' knowledge and attitude toward environmental conservation. The main objective of this study is to examine the extent to which Blended learning on the environmental dimension of ESD infused in JHS Science has a significant effect on the students' knowledge and attitude toward the importance of environment conservation.

The findings of this study are expected to give a significant contribution to the application of the ESD concept and its implementation at JHS concerning developing knowledge and attitude toward the importance of environment conservation as one dimension of ESD. The study is also meant to significantly contribute to blended learning effectiveness for implementing ESD, particularly related to the environment conservation dimension in JHS Science. The paper is also expected to attract other researchers to explore economic and socio-cultural dimensions of ESD, available to be included in the school curriculum, and explore more effective modes of the delivery system for implementing ESD at JHS.

2. Literature Review

Blended learning is a mode of delivery system which blends a traditional classroom teaching-learning process with online learning. In general terms, Castro [11] explains that blended learning integrates traditional, face-to-face classroom instruction with online digital learning. It is a teaching-learning process that combines the best aspects of online learning, structured face-to-face activities, and real-world practice. Online learning systems, classroom training, and on-the-job experience have major drawbacks by themselves. The blended learning approach uses the strengths of each to counter the others' weaknesses [12]. Thus, its learning environment combines face-to-face classes with online learning activities. It has been shown to increase learning effectiveness [13]. Its benefits may include facilitating flexible learning, improved student engagement, and improved self-regulated learning [14]. "*Thus, we can conclude that there is general agreement that the key ingredients of blended learning are face-to-face and online instruction or learning"* [15].

In its practice, the regular teaching-learning process, on the one side, can use any standard teaching method, such as lecture, question-answer, discussion, and inquiry. Its process may use one of two modalities: a regular or a virtual classroom face-to-face interaction. On the other side, online learning usually uses a learning model system (LMS) in e-learning which greatly affects the students' academic performance. It has emerged as a powerful medium of learning, particularly using internet technology as a mode of deliverance [16]. It is also a medium of creating, managing, and distributing information by utilizing ICT, internet, or audio-visual aids [17]. In recent decades, the use of ICT for educational purposes has increased, and the spread of network technologies has caused e-learning practices to evolve significantly [18]. The blending of two modes of a delivery system in the learning process can strengthen one another's effect on students' learning achievement. Halverson & Graham [19] argue that engaging in blended learning can involve countless possible combinations of human and technology-mediated instruction neither conceived nor implemented unilaterally.

There are features of blended learning as a mode of a delivery system that will support the performance of blended learning., namely:

1. Synchronous instructor-led instruction or a face-to-face teaching-learning process either in a real classroom or in a virtual classroom will be more meaningful for students' learning if combined or blended with any other mode of the delivery system.
2. There is e-learning as a complement of a real or a virtual classroom teaching-learning process designed for every student to self-learn or learn a subject matter independently. This way enables the duration of every student's learning process to achieve a mastery level of his/her learning is following his/her intellectual capacity. Since e-learning is designed either in the form of a modular text-based or a multimedia-based instruction (still picture, video, animation, or simulation), this also enables students to learn anytime and anywhere, individually and independently.
3. The content of blended learning, specifically designed for individual learning, either in text-based or multimedia-based instruction, can be delivered online or offline. When it is delivered online, it should be accessible either by utilizing a desktop computer, a laptop, or a smart mobile phone in the form of audio-streaming, video-streaming, or a book. When it is delivered offline, it can use CD or printed text.
4. Blended learning enables the teacher or student/s to collaborate with other teacher/s or student/s of the same school or other school/s. The collaboration is engaged through a chatroom, a discussion forum, email, website, or blog utilizing a smartphone. This collaboration will make the students' achievement is strengthened and more comprehensive.
5. In blended learning, the teacher better not use a single assessment technique, such as a test, but rather he/she better use an exact test, portfolio, or a

combination of test and non-test techniques. The assessment is better administered online and offline to make the students flexibly undertake it.

6. The implementation of blended learning needs supporting materials, such as digital technology devices, to support virtual learning (when the virtual classroom is applied). Other learning materials could be in the form of CD, MP3, or DVD accessible either online or offline by every student who undertakes the class. The other supporting material is an application the e-learning uploaded in LMS also accessible by every student [20].

In its application, a teacher should prepare a plan of a certain subject matter, but he/she should also prepare a module for being developed in the form of LMS type of e-learning. The lesson plan's preparation is engaged in making the regular teaching-learning process in the real or virtual classroom facilitate students to learn the lesson. The preparation of e-learning as a complementary teaching-learning process is made by developing a module for being uploaded in modular object-oriented dynamic learning environment (MOODLE) application of LMS. As one of the lessons learned from the teaching-learning process in the Covid-19 pandemic, virtual classrooms have substituted the regular direct teaching-learning process. The process is engaged through a virtual platform, such as zoom meeting, WebEx, or google meet. That enables a teacher to communicate virtually with students, just like a physical communication engagement in a real classroom. The lesson plan can also apply to the virtual teaching-learning process using this platform.

When it applies a blended learning model of instruction, e-learning as the complement of the regular teaching-learning process is considered essential for strengthening the students' learning achievement. Besides, e-learning also serves as a medium for the teacher and students in facilitating the students to ask for more clarification from their teacher when they find something that needs more explanation from the teacher through question and answer. By using e-learning, students can learn individually, independently and the pace of its mastery level depends on every student (self-paced earning). This way enables the learning achievement to be strengthened and reinforced. As a complementary blended learning modality, e-learning is an effective learning medium for developing learners' attitudes and behavioral traits. It is a medium of creating, managing, and distributing information by utilizing ICT. In recent decades, the use of ICT for educational purposes has increased, and the spread of network technologies has caused e-learning practices to evolve significantly [18].

Developing youngsters' knowledge and attitude concerning environment conservation is among the attempts in the ESD engagement. It must begin as early as possible from primary and junior high schools or early childhood education. In this regard, the related-subject matters are better included in a relevant subject: Science. The attempt is a part of micro curriculum development [21]. In this attempt, it needs to: 1) conduct need assessment, 2) formulate competencies the learners should achieve, 3) formulate objectives, 4) define learning materials and resources, 4) plan a proper mode of the teaching-learning process, and 5) plan a proper assessment strategy.

Most environmental problems are caused by human behavior, called biological imperialism. When those who occupy the environment cannot wisely manage the environment, it is predicted that it will give more severe damage in the future. Therefore, the commitment to conserve the environment is needed. The commitment is the implication of awareness upon the importance of wise usage and management of the natural resources and environment to contribute to sustainable human life needs. However, there are constraints in implementing environmental education, namely:

1. It is not that easy to develop environmental education content since it should apply a multidisciplinary approach.
2. Including environment education in the curriculum implies more students' burden when the education system is centralistic.
3. Environment education should have been an integral part of value education, but both are taught separately in its implementation.
4. The content of environment education is only a small part of the school instruction program, so it is not easy to expect to cultivate value, awareness, and attitude toward environment conservation responsibility.

The new paradigm of environment education indicates that it tends to change its direction towards making the learners environmentally literate. It aims to educate the learner to treat the environment to fulfill human needs and be conserved. Thus, environmental education should be implemented as education for the environment. That implies in its implementation that it gives the learner's opportunity to conserve and improve the quality of the environment. Therefore, the approach is within the classroom and in the real environment to acquire real solutions. It will develop their knowledge, attitude, and environmental conservation skills [22]. The constraint in using this approach is the teachers' understanding of the nature of the environment education as a transfer of knowledge, so the students only acquire knowledge instead of attitude and behavior.

From the sustainable development concept perspective, environment conservation is one of its dimensions. Conceptually, development is a continuous, systematic process aimed at life betterment not only in the economic and physical aspects, such as facility and infrastructure, but also in the psychical

aspect. Development is a process of improving the quality of human life that the environment must support. The environment is an essential resource in supporting the development in space, agriculture, mining, fishery, tourism, etc. The intensity of its exploration, which puts economic growth as the priority, could destroy the environment, such as forest destruction and water and air pollution.

The concept of education for sustainable development includes a new education vision to empower people of all ages to create a sustainable future. Its basic vision is to achieve a world where everybody has equal opportunities to benefit from education for social transformation. One of its goals is to develop strategies at all levels to strengthen ESD's capacity. In enacting the resolution, UNESCO was assigned as the key organizer of ESD, and it has to work closely with its partners, including the United Nations Environmental Program [23].

Theoretically, the implementation of ESD can be integrated into all school subjects [24]. The integration is done in the form of themes, and each includes various subjects such as education to eradicate poverty, human rights, gender equality, democracy, and good governance. Since the EE can be viewed as one of the ESD dimensions, this also can be included in a particular school subject curriculum in the form of themes related to the environmental problems to be solved.

In planning the inclusion of the environmental dimension of ESD into JHS Science, it needs to design an effective teaching-learning strategy and its assessment. Its implementation should emphasize practical experience to cultivate awareness, attitude, and value system toward environment conservation. It is in line with the concept formulated by Cincera: "*According to our experience, it seems to be reasonable to use experiential education as a theoretical background for ESD programs"* [25]. Furthermore, according to Baiquni and Astuti [26], the key to teaching and learning success is critical learning, joyful learning, and competitive learning on environment betterment; and these need long-term and various learning processes.

Initially, the emergence of the sustainable development concept was the environmental damages incurred due to the implementation of development which disregarded its negative impacts on the environment [6]. Most environmental issues occur due to a lack of education on the environment and how to achieve sustainable living. Intending to enforce such a concept, in 2002, the UN held the World Summit on Sustainable Development (WSSD) in Johannesburg. Its results were the principles of sustainable development as a new approach based on the considerations of association and dependency between three pillars: (1) economic development, (2) social development (3) environmental development [6, 23].

Sustainable development states that cultural diversity is as important to humans as biodiversity is essential to nature. Therefore, development is regarded as economic growth and the means to achieve intellectual, emotional, moral and spiritual satisfaction'. In this perspective, cultural diversity is the fourth policy pillar of the sustainable development policy sphere.

We must be aware of the importance of sustainable development since the damage inflicted on the environment due to economic development is already alarming: climate change, global warming, drought, natural disasters, etc. This paradigm is a collective awareness of all nations implementing their development programs. Concerning this issue, the 58th UN General Assembly in December 2005 agreed on the application of the Decade of Education for Sustainable Development (ESD Decade) starting in the year 2005 [23]. Education is a critical component for promoting SD and improving the capability of people to address environmental and developmental issues [7].

By 2030, every country is targeted to achieve sustainable development goals (SDGs) 2030 [27]. It focuses on five priority action areas. Namely, advancing policy, integrating sustainability practices into education and training environments, increasing the capacity of educators and trainers, empowering and mobilizing youth, and encouraging local communities and municipal authorities to develop community-based ESD programs. Its implementation needs to identify the type of education and instruction that improve this particular competency. It should also emphasize practical experience to cultivate awareness, attitude, and value system toward sustainable development. In this regard, the curriculum should be formulated in thematic that can be included in related subjects.

The implementation of ESD can be integrated into several school subjects [24]. Among studies in which ESD is integrated into a relevant subject is mathematics [28]. The integration is done in themes; each is infused in the relevant subject matter. Its teaching-learning engagement is focused not only on transferring knowledge but also on behavior change. ESD is concerned with developing an attitude toward environment conservation as part of sustainability, including the importance of taking care of other creatures and being responsible for conserving them. Therefore, by practicing blended learning, it is expected that the teaching-learning process can result in the students' knowledge and attitude development.

3. Research Method

This study employs a Quasi-experimental method in the city of Bandung's selected Junior High Schools (JHSs). The quasi-experiment uses pre-test and post-test control group design. This study involves the JSS's science teachers. In this regard, the team gave a short training to the teachers on implementing blended

learning to develop the students' knowledge and attitude through the teaching-learning process of the ESD's environment dimension infused in JHS Science. The quasi-experiment used in his study is the Control Group with Pre-test and Post-test design. The design is represented as follows.

O1 X O2

O1 O2

Both the experimental and control groups were given a pre-test (O_1). After the pre-test, the experiment group was given a treatment (X) of Blended learning while the control group was not. After the treatment was completed, all subjects involved in the treatment and the control groups were given a post-test.

The study began by choosing two intact groups, each consisting of 3 classes of grade two students; one group was assigned as the experimental group, and the other was assigned as the control group. Before the execution of this study, the teachers involved in his study were given training on the use of Blended learning in the environmental dimension of ESD infused in JHS science. After the training, they are assigned to engage the quasi-experiment at the schools where they were employed.

Due to the Covid-19 pandemic, the regular teaching-learning in the blended learning of this study, both in the experimental and the control group, was engaged using the platform of online synchronous class via Zoom meeting. The experimental group got complimentary pre-recorded videos on YouTube individually, while the control group did not. The independent variable of this study is Blended learning, and the dependent variable is learning output in the form of knowledge and attitude.

This study involves six parallel classes of three JHSs, namely SMP Lab. School of UPI, SMPN 12, and SMPN 15 are purposive samples. The sample classes were divided into two groups. Three classes were assigned into the experimental group with a total number of students 109, and the other ones were assigned into the control group with a total number of students 107. It means the total number of sample subjects is 216 JHS students.

The data was collected using a test of knowledge and a Likert type of attitude scale constructed to measure the students' knowledge and attitude toward environmental conservation. The students' attitude scores collected from the pre-test and post-test results were analyzed using Descriptive Statistics and Analysis of Covariance (ANCOVA).

4. Results and Discussion

This study indicates the JHS students' knowledge and attitude toward the importance of environment conservation as a dimension of ESD, both prior to and after their involvement in the teaching-learning process of science with infused environmental ESD dimension. Table 1 represents the descriptive statistics of the students' knowledge, both in the experimental group (blended learning) and the control group (non-blended learning) prior to and after their involvement in the teaching-learning process. Table 2 represents the descriptive statistics of the students' attitudes, both in the experimental and control groups, before and after involvement in the teaching-learning process.

Table 1 Descriptive Statistics of Knowledge's Pre-test and Post-test Scores

Students group Pre-test & Post-test	N	Mean	Std Deviation	Variance	Minimum	Maximum
Blended, Pres-test	109	7.0519 8.3455	1.10114	1.213	3.67	9.00
Post-test	109		.93554	.875	5.33	9.67
Non-blended, Pre-test	107	6.9661	1.18122	1.395	3.00	9.00
Post-test	107	7.5169	1.12767	1.272	3.00	9.33

Table 2 represents the descriptive statistics of the students' attitudes, both in the experimental and control groups, before and after involvement in the teaching-learning process.

Table 2 Descriptive Statistics of Attitude's Pre-test and Post-test Scores

Students group Pre-test & Post-test	N	Mean	Std Deviation	Variance	Minimum	Maximum
Blended, Pres-test	109	4.0839	.30241 .46279	1.213	3.27	3.30
Post-test	109	4.4109		.875	5.33	5.00
Non-blended, Pre-test	107	4.0304	.33020 .48372	.109	3.07	4.73
Post-test	107	4.2203		.234	2.97	5.00

To examine whether or not there is a significant difference between the means of the students' knowledge based on their post-test scores by taking into account the scores pre-test s statistical analysis method of one-way analysis of covariance (ACOVA) was used. The result of the analysis is represented in Table 3. Table 3 describes the result of the statistical analysis that shows there is no significant difference in the covariance of the pre-test score [F(1, 216)=0,308, p=0,579] between the two groups. It can be concluded that there is a significant difference in the mean of knowledge score [F(1,215)=35,798, p=0,000] between students who were taught with blended and non-blended learning while adjusting for pre-test scores.

Table 3 ANCOVA Effect Method on of Knowledge (R Squared = .211; Adjusted R Squared = .204)

Source	Sum of Squares	Df	Mean Square	F	Sig
Corrected Model	56.935[a]	2	269.285	28.822	.000
Intercept	206.926	1	206.926	209.508	.000
Knowledge	19.514	1	19.514	19.757	.000
Method	35.357	1	35.357	35.798	.000
Error	212.351	215	.988		
Total	13982.317	218			
Corrected Total	269.285	217			

From the ANCOVA, it can be concluded that there is a significant difference in the mean of knowledge score [F(1,215)=35,798, p=0,000] between students who were taught with blended learning and non-blended learning while adjusting for pre-test scores. It can be seen that a higher score was related to the blended learning method used in the experiment group with the effect size for behavior score is small, 0,143.

In terms of the JSS students' attitude toward the importance of environment conservation as one of ESD dimensions, the analysis results are represented in Table 4.

Table 4 ANCOVA Effect of Method on Attitude

Source	Sum of Squares	Df	Mean Square	F	Sig
Corrected Model	18.183	2	9.091	60.706	.000
Intercept	.849	1	.849	5.672	.018
Knowledge	16.202	1	16.202	108.186	.000
Method	1.127	1	1.127	7.523	.007
Error	32.199	215	.150		
Total	4110.494	218			
Corrected Total	50.381	217			

This study indicates that blended learning is effective in improving JHS students. Are there any significant differences in students' behavior scores on Science tests between students who taught using the blended learning method and the non-blended learning method? It is in the means of students' attitude toward the importance of environment conservation between students who taught using blended learning and non-blended learning methods.

The results demonstrate that the experiment group who taught using the blended learning method had a higher mean score [mean = 4,4109] than their peers who taught using the non-blended method [mean = 4,2203]. The ANCOVA results show the significant difference in attitude score between experiment and control groups while controlling for pre-test score [F(1,215)=7,523, p=0,007]. It can be concluded that the higher attitude score obtained by the experiment group was related to the blended learning method, despite a small effect size [effect size = 0,034] (Table 4).

This study indicates that blended learning in implementing the environmental dimension of ESD infused into JHS science is effective for developing JHS students' knowledge and attitude concerning the importance of environment conservation. The findings of this study are considered interesting in terms of:

1) The absence of ESD subjects in the JHS curriculum needs to overcome this issue to implement the UNESCO program.

2) An attempt to find an effective delivery system model in teaching-learning engagement, particularly for implementing ESD, is needed.

Concerning the issue of the absence of ESD subjects in the JHS curriculum, an attempt to infuse the ESD-related subject matter into a relevant subject, such as Science and Social study subjects, can be considered reasonable. Concerning this attempt, the teachers can apply the concept of micro curriculum to planning the teaching-learning process engagement. Applying this concept can identify competencies the students should acquire to become knowledgeable and possess a positive attitude. Once they have identified the competencies, they use them as the reference for formulating the teaching-learning objectives. Once the objectives have been formulated, they can decide on the themes of the environmental dimension of ESD as the subject matter and look into the science subject matters where the themes need to be infused. The following step the teachers should do is planning the teaching-learning process of the subject matters. Concerning this step, they have to consider the learning results they emphasize their students to acquire by looking into the formulated competencies and objectives. The last step is planning and assessing to ensure that the students achieve the objectives. In this study, it has been proved that the teachers can implement ESD at JHSs, specifically the environmental dimension of ESD, in the absence of its specific subject by infusing its related subject matters in the form of themes into the JHS science.

The implementation of ESD at the schooling system units, including at JHS, should not only focus on developing the students' knowledge or just emphasize the cognitive domain. O'Flaherty & Liddy [29] suggest

developing solution-oriented skills such as critical and creative thinking, decision-making, and empowerment, essential for the planet's sustainable future. It is also strengthened by guiding the students on how to learn. The combination of cognitive and affective engagement may influence the way of thinking about sustainability Baiquni & Astuti [26] argue that it must be regarded to change the students' behavior and attitude. Hence, they suggested the importance of experiential learning in ESD implementation. In this study, ESD engagement at JHS develops the JHS students' knowledge and attitude on the importance of environment conservation as a dimension of ESD. Therefore, a considerably innovative delivery system needs to be explored; among them is blended learning [12]. In this regard, theoretically blending a traditional teaching-learning process with digital technology can achieve the objective above. This study proved the effectiveness of blended learning for developing the students' knowledge and attitude toward the importance of environment conservation as one of the ESD dimensions. This evidence has two significant impacts: 1) In terms of its implication in meeting a need to find a solution to implement ESD at JHS by infusing its themes into the school's subject such as science. 2) In terms of finding the effective mode of the delivery system, that is, blended learning, in the teaching-learning process of the infusion of environment dimension of ESD into JHS science.

The findings of this study imply that regarding implementing ESD at JHS or any other schooling levels, in the absence of its specific subject in the curriculum, the teacher can be infused the related themes or subject matters of ESD into any relevant subject of the school's curricula. That can be applied not only in implementing the environmental dimension of ESD but also in implementing the other dimensions: the economic and socio-cultural dimensions of ESD. The subject into which ESD-related-subject matters are infused may vary, such as mathematics, as long as it is relevant [28, 30]. This way enables the students involved in the teaching-learning process engagement of ESD as the global action program (GAP) UNESCO mandated every country to implement in its schooling system. The other implication is that the teacher could use blended learning as an effective delivery system in implementing ESD at school, including at JHS. Using this delivery system model enables the teachers to develop the students' knowledge and attitude as expected by the implementation of ESD in the schooling system.

5. Conclusions

Environment conservation education is essential to overcome environmental problems, and it is one of the ESD dimensions. The attempt to overcome environmental problems has a connection with human life sustainability because the environment, as a system, has interrelated and interdependent components which every living creature needs. In this study, environmental education is discussed as one of the ESD dimensions regarding making the students aware of the importance of its conservation so that the future generation can enjoy and benefit; and finding an effective delivery system for its engagement is considered its novelty. From the perspective of education for sustainable development (ESD), its implementation is at all education levels. Based on this study, the Junior High School students have relatively similar knowledge and attitude towards the importance of environment conservation prior to their involvement in the teaching-learning process on the environmental dimension of ESD infused in JHS Science. The study proves that Blended learning on the environmental dimension of ESD infused in JHS Science significantly affects the development of the student's knowledge and attitude toward the importance of environment conservation.

Major limitations of this study lie in the duration of the treatment being studied, a sample of subject matter, and the use of a limited number of sample subjects. In terms of the duration of treatment, it just takes six weeks, each taking two course hours which means it takes 12 course hours. The duration of treatment is associated with the number of subject matters being experimented which cover only those infused in the Subject of Natural Science. There are many more subject matters concerning all dimensions of ESD that can be infused in the JSS curriculum other than the subject of natural science. The sample subjects are also the other limitation of this study because it only involves 6 intact groups of students representing 3 JHSs with the number of students in 2016. Therefore, we are encouraging other researchers to address this focus by increasing the duration of treatment, the number of subject matter associated with other ESD dimensions, and the number of intact groups selected from a larger number of JHS school variations.

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