



Implementation and Impacts of Education for Sustainable Development: Experience of Universitas Gadjah Mada

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Abstract A green physical setting would need green behavior and culture to sustain and function properly. Education is a key component to form a sustainable mindset and lifestyle for society, especially youth. As a university with a vision to be a resilient and healthy campus, Universitas Gadjah Mada has actively involved in providing education for sustainable development. The activities have commenced since 2016 through Integrated Smart and Green Building research group and involve participants from both internal and external audiences. Internal target audiences were primarily freshman UGM students and later extended to include primary and high school students. External audiences were the government and stakeholders from the commercial sector. The program was designed to increase awareness on sustainable development and encourage everyone to take part to achieve its goals. Students were educated on the importance of sustainable lifestyle and expected to practice green behavior in their daily life. For stakeholders, a focus group discussion was organized to start a conversation for the formulation of green building regulation. There were observable immediate changes in cognitive and behavioral domain toward sustainable lifestyle. Sustainable development is a long term vision and it needs participation from everyone. Higher education as a center of knowledge should actively provide society with education to achieve sustainable development.

Keyword:

Education, sustainable development, sustainable lifestyle, green building

1. Introduction

A green and sustainable physical setting would need green behavior and culture to sustain and function properly. The built environment is a system and the occupants are part of the systems. Without involvement from the people, a sustainable built environment cannot reach its goal.

Sustainable development is defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs [1] The United Nations has formulated Sustainable Development Goals, a 17-indicators which

including quality education, affordable clean energy and climate action [2].

Education is a key component in building the foundation of all concepts and knowledge, including sustainability. Education for Sustainable Development (ESD) is a learning process in which learners are encouraged to take action for environmental integrity, economic viability, and just society while respecting cultural diversity based on provided information about the issue [3]. The main curriculum is comprised of sustainable development primarily climate change and sustainable production and consumption and the audiences are expected to have systemic thinking, the ability to initiate collaborative decision making, and taking responsibility for today and tomorrow's generations [3].

University as a center of education should have a lead role to educate society in sustainable development. Academics and researchers from various backgrounds have to collaborate in providing the most current information about sustainability issues to the public as well as countering misinformation among the people.

2. Sustainable Development in Academic Institution

The concept of sustainability with an emphasis on energy conservation and environmentally-friendly policy in building, or commonly known as green building, can be traced back to the 1973 oil crisis in western countries, particularly the USA. The crisis changed the paradigm about energy consumption in all aspects, including building.

Implementation of green paradigm in university campus has been started since the 1980s. In 1985, Cornell University implemented Energy Conservation Initiative (ECI), a program to improve the efficiency of campus building through retrofit and new technologies [4] [5]. As climate change issue gained momentum in the early 2000s, a lot more campuses started to implement green policy as well. In 2005, the Association for the Advancement of Sustainable Higher Education (AASHE) was established to encourage higher education to play a lead role in sustainable transformation [6]. AASHE has a rating system called STARS (Sustainability Tracking, Assessment, and Rating System), in which the evaluated aspects, besides efficient operation and governance, are also includes curriculum and research [7].

2.1 Greenmetric and Sustainable Education

Greenmetric World Green University Ranking was established in 2010 by Universitas Indonesia [8]. Along with setting and infrastructure, energy and climate change, waste, water, and transportation, education and research is an important point of evaluation, Indicators for education and research factors are funding, research, publication, and courses related to sustainability. Based on those criteria green universities and higher education should not only focus on how green the physical setting is but also the education and research impact on sustainable development. This is the main difference between green assessment for university campuses and other buildings.

3. Concept of Education for Sustainable Development in Universitas Gadjah Mada

In 2017-2022 Strategic Plan, Universitas Gadjah Mada sought to develop a productive and conducive learning atmosphere. The programs include the development of green, low carbon campus through zero-waste, recycle, reuse, renewable energy utilization, and green behavior habituation [9]. Education for Sustainable Development plays an important role to provide information about green lifestyle.

Education for Sustainable Development in Universitas Gadjah Mada is carried out by Integrated Smart and Green Building (Insgreeb) research group. The program has been organized annually since 2016. Initially, the activity was focused on providing information on sustainable development and lifestyle for freshman students living in the campus dormitory. Later the program was extended to elementary as well as high school students, with learning material and presentation style are adjusted to fit the audiences. The activity also targeted stakeholders from the government and commercial sectors.

The concept of ESD in an academic setting, either university, high school, or elementary school is similar. Information about sustainability and sustainable lifestyle was provided via an interactive presentation by Insgreeb members. Target audiences are expected to gain a correct understanding of green behavior. For the program involving stakeholders, a focus group discussion was employed. The audiences, comprised of officials from the government agency and commercial sector related to green building and sustainability are expected to have in-depth knowledge about sustainability as well as the effect of their policy and action on sustainability.

4. Implementation of Education for Sustainable Development

4.1 Education of Freshman Undergraduate Students

Education about a sustainable lifestyle for freshman students was a part of orientation mandated by the university. Students living in university dormitory was selected because they are under university jurisdiction, therefore, their lifestyle can be studied. In contrast, students living off-campus cannot be tracked and their living behavior cannot be evaluated.

ESD activity in the student dormitory has been implemented thrice in 2016, 2018, and 2019. 2016 program was conducted in female dormitories (Kinanthi 2 and 3) whereas the 2018 program was organized in Darmaputera residence, a male student dormitory. The most recent (2019) ESD session was held in Kinanthi 1 dormitory. The events were held in the dormitory hall and both male and female students are involved.



Figure 1. ESD workshop in UGM Dormitory

Kinanthi female dormitory is a three-tower female dormitory complex located north of the UGM main campus. Tower 2 and 3 are identical five-story housing which was built in 2015. The dormitory consisted of 184 two-bed 4 m x 6 m units which occupy the second to the fifth floor [10]. The dormitory was established as an example of green building and has a set of 5 kWp photovoltaic generators installed on the rooftop as well as 100 unit 13-W led lighting [11].

The ESD session at Kinanthi housing complex was conducted as an interactive presentation with 170 students attended the event. Three presenters are researchers from

Insgreeb with various background. Presentation materials were green concept and examples of green behavior.

Meanwhile, the 2018 ESD event was held at Darmaputera Santren male dormitory. Located northeast of UGM main campus, this five-floor housing was inaugurated in October 2016. ESD activity was attended by 184 freshman students. Information provided at the session were Insgreeb activities, green building concept, and green behavior concept. Participants were actively involved to ask questions and answering quizzes from the presenters. To assess the impact of the session in knowledge of the participants, a pre- and post-test was conducted.

The 2019 ESD session was organized in Kinanthi 1 dormitory, a recently inaugurated seven-story student housing. Information about green building and green behavior was provided to 215 participants by two Insgreeb researchers. Students were enthusiast and several questions were asked to the speakers. Similar to the 2018 ESD, an evaluation was done through questionnaires given to participants before and after the event.

4.2 Education of Elementary Students

ESD activity for elementary students was held in 2017 for third- and fifth-grader of Al-Azhar 31 Islamic Elementary School in Yogyakarta. In an event attended by about 306 students, participants are invited to watch a video about green behavior narrated by researchers from Insgreeb. Afterward, games were organized for the pupils, in which third-graders are challenged to put different types of colored balls with labels as a representative of various types of waste, into their respective containers to teach them on waste classification. Meanwhile, five grade students were encouraged to play guess the movement game, in which the movements were related to green behavior. At the end of the event, students were invited to join drawing and coloring competition for fifth-grader and third-grader, respectively.

4.3 Education of High School Students

The first ESD program for high school students was held in 2017 at Karimunjawa 1st State Vocational School (SMK N 1 Karimunjawa) as a part of community service. The school building is located at Karimunjawa islands, an archipelago situated north of mainland Java. The presentation about green behavior was delivered by a young Insgreeb researcher and at the end of the session, students were prompted to deliver a summary of the presentation.

As the presenter himself was a vocational school graduate, he also shared his experience and encourage all of the participants to pursue their highest aspirations.



Figure 3. ESD for Elementary Students.



Figure 4. Science Project for High School Students.

Another ESD in the high school setting was organized in 2018 at two different schools, Yogyakarta 3rd State Senior High School (SMA N 3 Yogyakarta) and Yogyakarta 6th State Senior High School (SMA N 6 Yogyakarta). The event, which was held separately in each school, consisted of presentations followed by a Q&A session. Aside from green behavior information, the presentation also provided students with basic knowledge of research methodology and process. Participants of this program were eleventh-grade students and about a total of 361 students attended the event, 150 in SMA N 3 and 211 in SMA N 6.

Following the event, students from both schools are challenged to compete in a small project competition related to sustainability. Students from both schools are grouped into a 3-person team and prompted to provide abstract of their proposed mini-projects. Interested students in four teams from SMA N 6 and two teams from SMA N 3 were advised by Insgreeb research assistant for about a month in carrying out their research. Those six teams were invited to UGM campus to present their research in front of judges comprised of UGM and 'Akprind' Institute of Science and Technology.

4.4 Discussion with Stakeholders

A workshop and focus group discussion entitled Building Regulation toward Implementation of Green and Smart Building was held on August 20, 2016, at UGM Campus. Participants include UGM students and academics, professionals, government officials, and building owners. The purpose of the workshop is to provide information to the stakeholders, particularly building owners, about opportunities and challenges of green building issues in Indonesia as well as disseminate knowledge about the potential implementation of building energy management systems (BEMS). Meanwhile, the objective of the focus group discussion (FGD) is to promote research in smart and green buildings and to initiate discussion in formulating Standard Operating Procedure in achieving a green rating of commercial buildings.

5. Assessment of Impacts of Education for Sustainable Development

Assessment of ESD impact on the audiences is necessary to evaluate the effectiveness of the ESD and its role in achieving Sustainable Development Goals. UNESCO set out three specific learning objectives for ESD which are cognitive domain, socio-emotional domain, and behavioral domain [12]. The cognitive domain encompasses knowledge and thinking skills, socio-emotional domain comprised of social skills to collaborate, and behavioral domain consisted of action competencies,

The initial concept of Universitas Gadjah Mada's ESD program was to provide information to the audience. The 2016 ESD event, which was held in Kinanthi student dormitory gave a significant impact on the energy consumption of Kinanti dormitory. However, the trend was diminished and energy consumption climbed back to the pre-ESD level. This phenomenon drove Insgreeb researchers to conduct pre- and post-test on the subsequent UGM residence ESD events in 2018 and 2019 to assess the impact on student knowledge and attitude on green behavior.

For ESD events organized at elementary and high school, the goal was to blend knowledge about sustainable development into the current curriculum. Therefore, there was no specific impact assessment instrument and the evaluation was conducted by observation. Elementary school event was at the introductory level and the impact was observable on how students could participate well in the sustainability-themed games.

Meanwhile, the impact of high school ESD events could be evaluated on how enthusiasts the students in joining science project competition and the abstracts submitted to the organizers.

As for the workshop event involving stakeholders, the purpose was to inform the participants about smart and green buildings. The expected observable impact is the initiation of discussion about green building regulation This is important as a gateway to the much longer process of formulation and subsequent ratification of green building regulation.

5.1 Impact of ESD on UGM Freshman Students

In 2018 and 2019 ESD event held at the student dormitory. participants were prompted to fill out a pre- and post-test questionnaire. This was done to assess the impact of ESD informational sessions on students' knowledge about sustainability and sustainable development. Questions in the test were about green building and green behavior as well as building appliances. The questions are shown in Table 1.

Table 1. Green concept questionnaire

Question	Answer choice	2018 ESD	2019 ESD
Have you heard and understand green building?	<input type="checkbox"/> Never heard of <input type="checkbox"/> Have already heard but did not understand <input type="checkbox"/> Understand a little <input type="checkbox"/> Understand well	Only asked on pre-test	Asked on both pre- and post-test
Do you know what green building is?	<input type="checkbox"/> Yes <input type="checkbox"/> No If yes, give one example	Asked on pre test with a different question	Asked on pre-test
Do you know what green behavior is?	<input type="checkbox"/> Yes <input type="checkbox"/> No If yes, give one example	Not asked	Asked on pre-test
What is the most important green behavior?	<input type="checkbox"/> Turning off AC when leaving <input type="checkbox"/> Turning off light when leaving or in the daytime <input type="checkbox"/> Using water efficiently <input type="checkbox"/> Unplugging charger when not in use <input type="checkbox"/> Disposing waste properly	Asked on pre-test	Not asked

For the basic concept questions, both 2018 and 2019 pre-test result shows a similar trend that the majority of the students have already heard of the green building concept but did not understand or understood a little. For the green building question, 51% of 2018 participants could tell what green building is, however only 36% of 2019 participants could do so. 2019 post-test shows that the percentage increases drastically to 82% after the presentation.

The green behavior concept question is slightly different between 2018 and 2019 ESD. In 2018, properly disposing of waste was the most important green behavior, followed by turning off AC while going outside and unplugging cellphone charger while not in use is

considered as the least important behavior. Meanwhile, in the 2019 green behavior question, 61% of the participants could tell what green behavior is in the pre-test and this number increases to 96% in the post-test.

Table 2. Result of green concept questionnaire.

Have you heard and understand green building?	2018	2019	
	Pre-test	Pre-test	Post-test
Never heard of	18%	13%	1%
Have already heard of but did not understand	31%	27%	3%
Understand a little	38%	40%	13%
Understand well	13%	20%	82%

Pre-test questionnaire asked the students about their daily behavior. However this was only informational since evaluation of the behavior would only possible in longer time period, not immediately after the event.

Table 3. Green behavior questionnaire

Question	Answer choice	2018 ESD	2019 ESD
I turn off the light before leaving	<input type="checkbox"/> Never <input type="checkbox"/> Seldom <input type="checkbox"/> Often <input type="checkbox"/> Always	Asked on pretest	Asked on pretest
I open the curtain in the daytime			
I leave the light turned on when I go to bed			
I turn the light on in the daytime			
I turn of the AC/Fan before leaving		Not asked	
I open the window when stay inside		Asked on pretest	
I unplug cellphone/laptop charger when not in use			
I use plastic bag rather than reusable bag			
I put my laptop on hibernate/sleep mode rather than shut it down		Not asked	
I leave my laptop being recharged when I go to bed			

Participants were also asked five questions, in which the questions were multiple choice and students were prompted to choose the best answer that fit the question. The questions were asked in both pre-test and post-test at 2018 and 2019 ESD event.

Table 4. Green appliances questionnaire.

Question	Answer choice
Which appliance consumes energy the most?	<input type="checkbox"/> Lighting <input type="checkbox"/> AC <input type="checkbox"/> Water <input type="checkbox"/> Electronics
Which type of lighting is the most	<input type="checkbox"/> Incandescent

efficient?	<input type="checkbox"/> Halogen <input type="checkbox"/> CFL <input type="checkbox"/> LED
Which one is better?	<input type="checkbox"/> Take a bath <input type="checkbox"/> Take a shower
Which one is better?	<input type="checkbox"/> Plastic bag <input type="checkbox"/> Reusable bag
Which one is better for laptops?	<input type="checkbox"/> Stand by <input type="checkbox"/> Switch off
Which one is better, leave the charger plugged or unplug it when not in use?	<input type="checkbox"/> Unplug charger <input type="checkbox"/> Leave charger plugged

For the question about appliances, the evaluation shows a similar trend between 2018 and 2019. Majority of the participants chose either AC or electronics as the most energy-consuming appliances. In the post-test, some of the students change their mind from choosing electronics to AC.

Table 5. Result of the most energy-consuming appliance question.

Which appliance consumes energy the most?	2018		2019	
	Pre-test	Post-test	Pre-test	Post-test
Lighting	3%	2%	5%	2%
AC	51%	61%	45%	75%
Water	5%	5%	6%	2%
Electronics	41%	32%	44%	20%

Table 6. Result of the most energy-efficient lighting question.

Which lighting type is the most efficient?	2018		2019	
	Pre-test	Post-test	Pre-test	Post-test
Incandescent	7%	3%	6%	5%
Halogen	9%	4%	2%	1%
CFL	15%	3%	10%	2%
LED	69%	90%	82%	91%

In the most efficient lighting type question, the pre-test result shows that majority of the students have already aware that LED is the most efficient, with 15% (2018) and 10% (2019) of the participants thought that CFL is the most efficient. After the event, 90% of the students chose LED as the most efficient lighting.

Meanwhile, the other three questions asked students which one is better among two choices. In both 2018 and 2019 ESD, majority of the students chose reusable bag over plastic bag and switching off appliances rather than put it on standby. The percentage of respondents' opinion remain unchanged between pre- and post-test. For a question about which one is more efficient among taking a bath and taking a shower, the trend between

2018 and 2019 event is similar. In the pre-test, slightly more than half (59% in 2018, 57% in 2019) of the participants chose shower and in the post-test, the number increases to 90% for 2018 and 75% for 2019 event. As for the remainder of the question, more than 80% of the participants chose switch off and unplug charger when not in use as well as reusable bag. The number increases slightly in the post test evaluation.

6. Conclusion and Future Works

Sustainable development is a long term vision and it needs participation from everyone. Higher education as a center of knowledge should actively provide society with education to achieve sustainable development. Universitas Gadjah Mada through Insgreeb research group has organized a series of Education for Sustainable Development (ESD) event annually since 2016. The event targeted various participants in academics and wider society. Expected outcome of the program is that the audiences gain more knowledge in sustainable concept and behavior. The impact of the program was an immediate observable change in cognitive and behavioral domain toward sustainable lifetsyle. For ESD events in UGM residences, a set of assessment criteria has been developed and implemented to evaluate the program.

In the future, there should be a set of an assessment instrument for various audiences for both immediate and long term impact. An in-depth study of ESD delivery methodology and learning outcomes should be performed to select the best way of learning method for participants from different backgrounds. Meanwhile, to formulate the impact assessment criteria, a wider collaboration with researchers and scholar, particularly from pedagogical background, should be conducted.

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