

Dissemination of SDGs 4, 9, 13 through Strengthening Curriculum for Senior Vocational High Schools

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ABSTRACT

Education for Sustainable Development (ESD) plays a vital role in achieving the 17 Sustainable Development Goals (SDGs) and simultaneously addressing today's global challenges. The development of ESD in Senior Vocational High Schools (SMK) provides opportunities for teachers and students to contribute to achieving these goals. SMKN 1 Nanggulan was chosen as this study's object as it promotes a program and curriculum that aligns with Kulonprogo's necessity to prepare future leaders with technological and agricultural-based expertise. To obtain further information as a sharpening strategy for SDGs (4,9,13) diffusion strategies in SMKN 1 Nanggulan, data collection methods were carried out: (1) surveys; (2) in-depth interviews with the teachers and students; and (3) Focus Group Discussion (FGD) with teachers, groups of farmers, Fablab UGM, and policy implementers (Department of Education). Purposive sampling (non-probability sampling) was conducted to identify learning outcomes for 97 students who took IPAS (Ilmu Pengetahuan Alam dan Sosial, Natural, and Social Science course) about sources of information on SDGs. Three main activities have been communicated and evaluated with the teachers of SMKN 1 Nanggulan to sharpen and diffuse learning resources and increase awareness to implement the SDGs, especially regarding quality education (SDG 4), innovation for creative industries (SDG 9), and climate change mitigation (SDG 13). In addition, implementing digital literacy usage and supervision for media learning must be improved to enhance learning outcomes.

Keywords: Climate Change, Innovation and Creative Industries, Quality of Education, Senior Vocational High Schools, Sustainable Development Goals.

1 Introduction

Indonesia is committed to controlling climate change as targeted to reduce carbon emissions by 29% in 2030. This is considered concerning as Indonesia is one of the countries that will face the most significant risk of climate change, even almost in all sectors. Hence, Indonesia has signed the Paris Agreement, a global agreement to reduce emissions by 2030 [1]. The countries as members of the Paris Agreement's commitment in 2015 is to ensure that the increment of the earth's surface average temperature does not exceed two degrees Celsius.

A special report was published in 2018 by the Intergovernmental Panel on Climate Change (IPCC), which stated that each country could keep or suppress the earth's temperature by up to 1.5 degrees Celsius. Indonesia is committed to preventing this agreement by 2100 in the 2021st World Climate Change Conference COP26 in Glasgow [2].

Moreover, as shown in Figure 1, Indonesia is one of the biggest polluters in the world, which is why the Indonesian government is committed to contributing to reducing carbon emissions in 2030. This



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commitment emphasizes two sectors, which are (1) Forestry, which contains more than 50% of the government's target, aiming to reduce around 500 million tons of CO₂; and (2) Energy and Transportation, aiming to reduce around 300 million tons of CO₂ [3]. Although the government attempts to achieve emissions reduction in 2030 by these sector targets, this program will need a lot of effort, especially since electricity usage is up to 65% from coal, where Indonesia is the largest coal maker and exporter worldwide [4, 5].

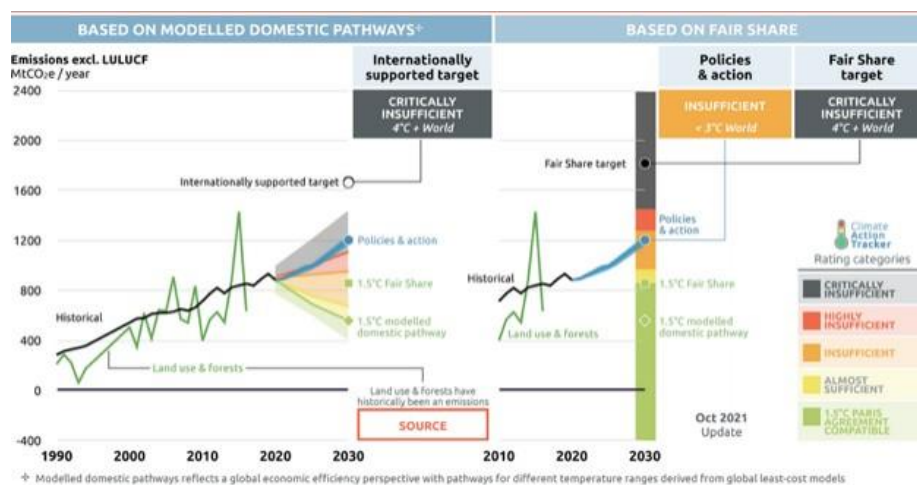


Figure 1: Indonesia's Overall Rating Highly Insufficient Based on Paris Agreement [1]

To attain goals regarding climate and education (SDG 4 and 13), we must work jointly across industries with open innovation (SDG 9)—as climate change is considered a big problem, along with challenges regarding sustainable educational development, which we must solve as soon as possible. Through collaboration, we can progress toward meeting climate goals and securing a more sustainable future [3].

AGRICULTURE
 The agricultural sector contributes 13% of greenhouse gas emissions to total greenhouse gas emissions in Indonesia, yet it is the most vulnerable and sensitive sector to climate change. Greenhouse gas emission projections from the agricultural sector compared to greenhouse gas emissions in Indonesia are estimated at 478,303.66 Gg CO₂ eq. in 2030. The potential reduction in greenhouse gas emissions in the agricultural sector in 2019 is 13,395.76 Gg CO₂ eq.

The agricultural sector is one of the national priority sectors in the RPJMN 2020-2024. In the RPJMN 2020-2024, to reduce emissions in the sector, the Ministry of National Development Planning (BAPPENAS) committed to reducing emissions from the land sector (including agriculture) by 38.3% (in 2024). In 2020-2024, the decline in rice production due to climate change is forecasted to be increased in all provinces of Indonesia. High to very high levels of rice production decline occurred in several provinces in the east-north. Emissions reduction also considers the development sector, particularly the agricultural sector. The main goals are food production and maintaining food security. In food production and maintaining food security, the most important thing is the availability of agricultural land.

Mitigation activities targeted by the agricultural sector in PERPRES 61/2011 for land optimization, application of crop cultivation technologies, use of organic fertilizers and biopesticides, and development of plantation land (oil palm, rubber, cocoa) on non-forested/abandoned/degraded land/APL, use of livestock manure/urine and agricultural waste for biogas.

POLICY RECOMMENDATIONS
 Policy recommendations for the agricultural sector are:
 Increasing agricultural land productivity by 4.4% per year, while expanding the area of sustainable agricultural land to 45% of the total agricultural land.
 The PPRK targets up to 2024 in sustainable land restoration efforts are as follows:



INDICATOR & TARGETS		
Indicator	2020 Targets	2024 Targets
Percentage of area of Sustainable Food Agricultural Land (LP2B) to the need for agricultural land (percent)	60	100

Figure 2: Agricultural Land Functional Shift Contribution on Greenhouse Gas Emission in Indonesia [6]

Accelerating the development of vocational education through vocational schools is focused on the four leading sectors: maritime (fisheries and maritime affairs), tourism, agriculture, and the creative industry sector, which can open business opportunities and high-quality labor if the potential is adequately managed. Vocational High School graduates are expected to encourage the involvement of an active role and increase community capacity in managing the local area potential. Thus, it might encourage innovations to benefit and strengthen existing creative industries. For example, Sustainable Development Goals (SDGs) for

vocational schools require the involvement of various parties (cross-sectors) such as local government, industry, university, and society (GIUC) continuously.

Agricultural growth based on a linear economic model is not feasible with the actual condition as our resources are considered very limited, as stated in Figure 2 [6]. Moreover, a limited capacity for an available land shift at agricultural business continuity also puts more pressure on governments. This model transformation is urgently needed as resources will be managed better, and agricultural material flow and waste elimination will be considered through supply chains [7].

SMKN 1 Nanggulan is located in the working area of the Kulonprogo regional government, which raised awareness of environmental preservation as a form of institutional strengthening related to mitigation, adaptation, impact reduction, and early warning of climate change. Whether the curriculum is just beginning its sustainability journey or looking to strengthen its approach, climate transparency matters must be prioritized now. This activity is carried out in SMKN 1 Nanggulan through observation and discussion related to knowledge, mastery in implementation, and the SDGs' accomplishment [8]. Therefore, the study and practice to socialize the 17 SDGs' accomplishment require attempts to diffuse it into the curriculum. Local-based case studies (surrounding SMKN 1 Nanggulan) will underline the SDGs implementation diversity (especially SDG 4-9-13) in student assessment (majoring in both social or natural science) with learning management and academic atmosphere considerations. Lecturing, mentoring, and discussing activities were provided to improve the relationship between learning objectives and SDGs targets [9].



Figure 3: *SDGs 4,9,13 Implementation Scheme [8]*

The scenario for disseminating sustainable development goals through curriculum enhancement in vocational schools is conducted by linking SDG 4, SDG 9, and SDG 13 and involving teachers as facilitators (Figure 3). In the implementation of learning, both in the classroom and outdoor activities/practices, teachers need to encourage students' contributions to actively respond to the exploration of their prior knowledge and prior experience in formulating concrete actions related to the issues being discussed that support sustainable development goals. By integrating SDG issues into the curriculum, organizing capacity-building-based activities, awareness of the school environment and community, and establishing collaboration with external parties, we can help students develop a deep understanding of the importance of quality education, innovation, sustainable infrastructure, and action on climate change.

The vocational high school (SMK) educational learning process requires industry-standard facilities to minimize the gap between the high school study materials and the reality that SMK graduates will experience at work. The learning process trains students' preparedness to perform real jobs provided by

industry to schools. In this workshop, students are asked to work according to customer demands. Thus, task-based assessment and instruction, problem orientation, inter and transdisciplinary, and digital tools usage and approaches are indispensable for competency development in promoting sustainable development [3, 8].

2 Research Methodology

This study is a part of the Education for Sustainable Development (ESD) program, collaborated with Senior Vocational High School (SMKN) 1 Nanggulan. The ethnographic method was used to collect empirical data about the dominant local system, educational culture, and the academic atmosphere of SMKN 1 Nanggulan. Data were collected by observing teaching and learning activities in class and field studies (laboratory practice or field observation), interviews with teachers and students, questionnaires, and assignments. The resulting output aims to explain learning outcomes related to the SDGs (4,9,13) for education implementation, innovation towards industrialization, and awareness for climate change action [10]. Target competency accomplishment in managing the socialization and integration of SDGs was delivered in the workshop between the ESD UGM team and SMKN 1 Nanggulan teachers. The core activities are conducted during July - October 2021 in offline and online Zoom meetings through the University-Industry-Government-Community (UIGC) synergy concept.

3 Theory and Calculation

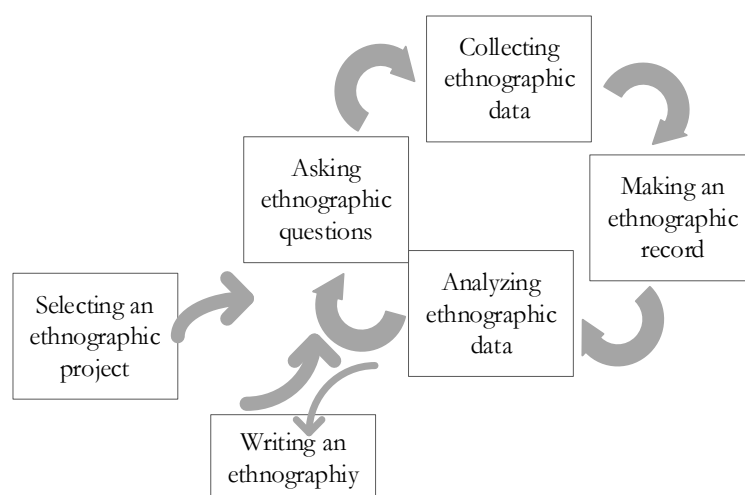


Figure 4. Ethnographic Scheme Cycle for this Study [11]

Figure 4 shows a research flow including determining research respondents, respondents' interview scenarios, preparing interview notes, drafting descriptive questions, interview results and domains analysis, structured questions submission as a complement, and taxonomic analysis [11].

4 Results and Discussion

As a vocational education institution overseeing the Kulonprogo agricultural sector, SMKN 1 Nanggulan needs to sharpen students' abilities to make agricultural resources efficient, such as planting land and water resources and agricultural waste management. The fertilizers and pesticides' appropriate doses usage and the introduction of environmental quality standards play an essential role in maintaining the sustainability of agricultural ecosystems. Thus, curriculum enrichments need to be linked to a scheme toward a more sustainable consumption pattern as shown in Table 1 below.

Table 1: *Feedback Implementation Activities from Student and Teacher*

Student	Teacher	Students
Knowledge and definition of SDGs	50% Know; 25% Know most; 25% Don't know	28.9% Know; 34% Knowsome; 37.1 Don't know
Sources of Information or learning about SDGs	37.5% from digital platforms; 37.5% through social media; 12.5% from printed media; and 5% from other non-educational sources, courses, or scientific meetings.	54.6% from social media; 21.6% from digital platforms; 10.3% from subjects in class, and the rest from other sources.
Opportunities for capacity building include environmental maintenance, waste management, energy saving, and others.	25% of teachers have received dissemination for the SDGs implementation through MGMP (Subject Teacher Consultation) meetings and waste handling technology; 75% of teachers have yet to receive capacity-building programs (especially expertise) to disseminate SDGs to students and the community.	34% of students have received SDGs dissemination; 66% never have.
Forms of training or capacity-building Activities	75% lectures and discussions; 25% waste handling training	100% assignments in class
Impact of capacity-building activities results in the school environment	67.7% waste handling; 33.3% preparation of teaching materials by incorporating SDGs points	64.2% utilization of waste for compost; 21.7% reducing the use of plastic; 14.1% keeping the school environment clean
Impact of capacity-building activities results in the Community	Waste handling; community service; and socialization of SDGs	52.4% community service to keep the environment clean; 27.8% waste segregation; 19.8% reduction in plastic use
Impact of capacity-building activities results at home or family	Waste handling; handicrafts from scrap materials; and SDGs dissemination to families	83.2% community service at home; 16.7% household waste sorting

The teachers' and students' commitment to supporting the 4,9,13 SDGs is through education, infrastructure strengthening, and family and community involvement. In addition, SMKN1 Nanggulan has the potential to demonstrate models of learning outcomes related to energy saving, energy calculation, waste management, and environmentally friendly products that utilize biomass around the school environment [9]. These efforts are expected to encourage entrepreneurship media learning (profit or economic) and preserve nature (planet) for future generations' benefit and future. This commitment is realized through various activities aimed at supporting the achievement of SDGs 4,9,13.

SMKN 1 Nanggulan displays local resources (school gardens, livestock, waste, etc.) management as well as programs that lead to green and affordable activities, which can be intensified in various subjects and will have a positive impact through enrichment assessment, effective communication, and affordable and stable internet availability for all. Education for sustainable development (ESD) implementation allows teachers and students to contribute to this goal by promoting ability changes as learning outcomes which is shown

in Table 2 below. In addition, the transformation of student behavior needs to be guarded by creating a possible academic atmosphere.

Table 2: Measure Assessment Rubric

Indicators	Indicators of the continuing education implementation	Indications of the continuing education implementation	Appropriate curriculum related to SDGs and their benefits	Analysis of external and internal factors for the SDGs 4-9-13's adoption	Follow-up strategy SDGs 4-9-13's adoption to strengthen sustainably agroindustry
Activity	Identify appropriate curriculum and lessons for assessing the SDGs 4-9-13 learning implementation in SMK	Use ICT-based and other resources effectively in implementing SDG 4-9-13.	Select the appropriate SDGs 4-9-13 the implementation model for the required accuracy	Applying the principles of implementing SDGs 4-9-13 in agribusiness or agroindustry	Assessing approaches to solving problems in implementing SDGs 4-9-13 more effectively
Non-Acceptable	The techniques and tools used to handle or analyze the implementation of SDGs 4-9-13, in particular learning, are inappropriate	Unable to use Computer based and other resources in implementing SDGs 4-9-13	Discrepancies in choosing the SDGs 4-9-13 implementation from a system or process	Don't know the difference between SDGs 4-9-13 Implementation	Identify topics or examples of problems implementing SDGs 4-9-13 to choose a more practical approach
Below Expectation	Able to choose the proper techniques and tools for implementing SDGs 4-9-13 in learning but unable to compare results fairly with alternative tools or techniques	Able to use computer-based and other resources in implementing SDGs 4-9-13 even though there are discrepancies	Able to choose the implementation of SDGs 4-9-13 from a system or process without proper consideration	Able to apply the principles of implementing SDGs 4-9-13 even though there are still discrepancies	Able to take a simple approach to SDGs 4-9-13 implementation problems effectively with limited logical considerations
Meet Expectation	Able to choose the proper techniques and tools for implementing SDGs 4-9-13 in learning and compare the results from	Able to use computer-based and other resources effectively in implementing SDGs 4-9-13 with minor	Be able to choose the proper implementation of SDGs 4-9-13 from a system or process with an acceptable level of accuracy	Able to apply the principles of implementing SDGs 4-9-13	Able to examine more effective problem-solving for implementing SDGs 4-9-13 with logical considerations

	alternative tools or techniques with additional analysis	errors and limited analysis			
Exceed Expectation	Able to choose appropriate techniques and tools for implementing SDGs 4-9-13 in learning and compare results with alternative tools or techniques with excellent analysis	Use computer-based and other resources effectively in implementing SDGs 4-9-13 with comprehensive student outcomes	Be able to choose the proper implementation of SDGs 4-9-13 of a system or process for the required accuracy with complete and logical reasons	Applying the implementation principles of SDGs 4-9-13	Able to review SDGs 4-9-13 implementation approaches and choose a more practical approach with complete and comprehensive logical considerations

The module compiled by the ESD Team and the SMKN 1 Nanggulan teacher team contains points on developing sustainability competencies for vocational schools following the conditions for each SDGs in the long term. Integrating ESD into vocational high school is strategic and offers opportunities for achieving the SDGs (Figure 5).



Figure 5: ESD Modules to Enhance IPAS Curriculum

SMKN 1 Nanggulan's teachers and instructors push their students to adapt to labor market developments that emphasize new processes and services, which require specific knowledge and skills that are still unavailable in public education institutions and practices [12]. The collaboration between government, university, community (including vocational high school), and industry will provide an opportunity assure the milestone for sustainable development activities, as well as research and practical projects which may contribute to the sustainable development implementation as a whole in pursuing sustainable future scenarios (Figure 6) [10]. The global urgency for sustainable development directly proposes the need for laborers with enabling skills to build and sustain industries and services and adapt to new environmental

practices [11]. Vocational skills development programs are essential to respond to this growing labor market.

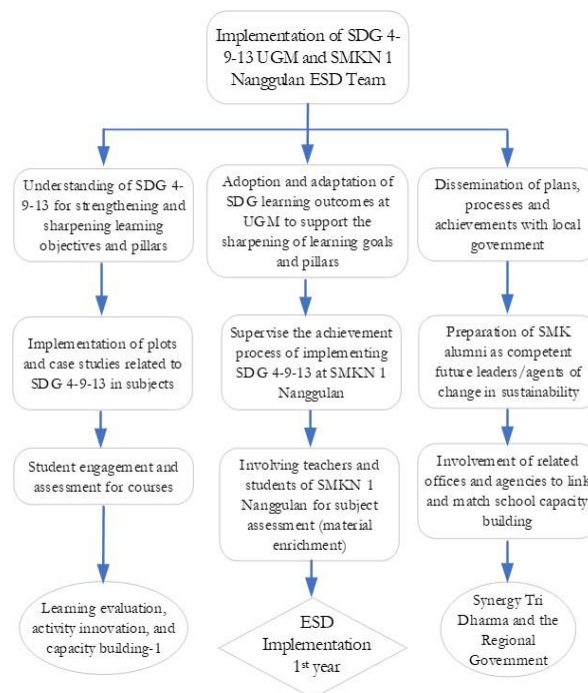


Figure 6: Diffusion concept to vocational high school in pursuing sustainable future scenarios.

SDGs 4-9-13 prioritize strengthening business in the creative industries to fill the global funding gap in financing this goal. The increasing public demand for corporate sustainability reporting influenced how companies act and behave. Companies consequently recognize the strengths and opportunities in investing meaningfully in training their employees as a long-term workforce investment strategy that offers a competitive advantage in the marketplace [12]. Small and medium enterprises (SMEs), alums of this school, are innovative, challenging, and have science and technology in increasing efforts to coordinate related project resources.

5 Conclusion

The attempts to achieve the 17 SDGs required the involvement of various parties to answer the challenge of following up on socialization in the education sector and community strengthening. Increasing school capacity through synergy is the main agenda for the government, academia, companies, and the community. Therefore, material enrichment to strengthen the curriculum is an effective medium to implement sustainable development at SMKN 1 Nanggulan.

Visual media such as videos about SDGs, introduction to ecosystems, energy-saving campaigns, energy calculations, waste management, and poster or demonstration design competitions for students are essential in conveying and involving teachers and students. In addition, validation for learning outcomes and evaluation for updating modules must be included in school programs that work jointly with the UGM ESD team.

In this aspect, teachers' and students' perceptions of outcomes or answers towards the leading sector are attempted to include the role and initiation of activities (ideation phase). Furthermore, it is necessary to emphasize the existence of design and development that provides direction and coordination in synergy between local governments, universities, industry or practitioners, and elements of society jointly to enrich

the curriculum or extracurricular activities at SMKN 1 Nanggulan, which will later become a mainstay of the road map (design and development phase).

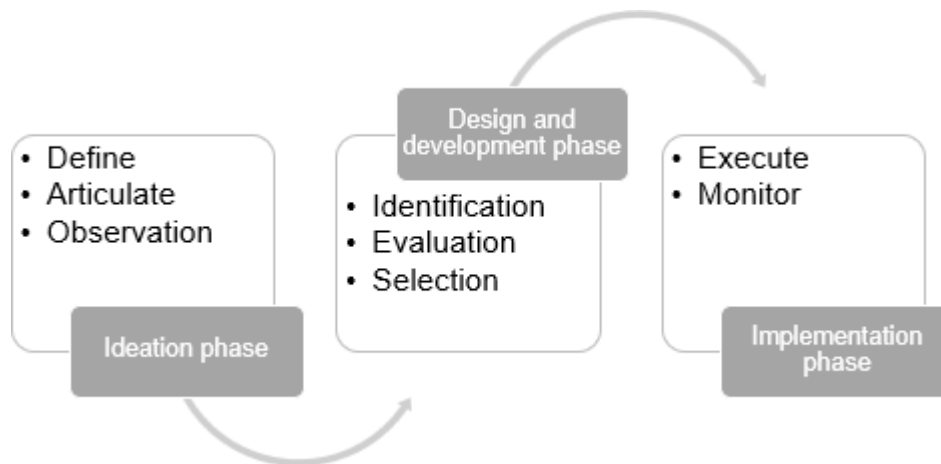


Figure 7: *ESD Implementation*

In addition, ESD implementation needs to involve parties who understand educational issues and field conditions to contribute to the curriculum, local wisdom, and manners of SMKN 1 Nanggulan's students as future leaders (implementation phase) as shown in Figure 7.

6 Declarations

6.1 Study Limitations

The limitation of this study is the determination of variables as parameters for the achievement of SDGs implementation within the scope of the Senior Vocational High School, which still needs to have standard and procedural references beyond the researcher's control.

6.2 Acknowledgments

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6.3 Funding Source

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6.4 Competing Interests

The authors declare no competing interests.

6.5 Publisher's Note

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