Journal for the Education of Gifted Young Scientists, 10(1), 85-97, March 2022
e-ISSN: 2149- 360X
jegys.org

youngwisepub.com

Research Article

Education for sustainable development-based lesson plan validity test for mastery of pre-service science teacher learning outcomes

Nia Erlina[1]*, I Nyoman Suardana[2], Iwan Wicaksono[3] and Paken Pandiangan[4]

Science Education Department, University of Pendidikan Ganesha, Indonesia

Article Info

Received: 12 December 2021
Revised: 21 January 2022
Accepted: 17 February 2022
Available online: 30 March 2022

Keywords:
Education for sustainable developme
Learning outcomes
Lesson plan
Pre-service science teacher
Scale development

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Published by Young Wise Pub. Ltd.

Abstract

Higher education has the responsibility to be a source of development and implementation of education for sustainable development, which is a global issue. This modality can be operationalized through a lesson plan. Education for a sustainable development-based lesson plan is a plan that utilizes project-based learning as part of active learning recommendations for college students. Updating lesson plans is an activity that pre-service teachers must carry out to ensure professionalism that follows the development of science. This study aims to test the validity and reliability of experts and users of updating lesson plans for mastery of learning outcomes, collecting data using documentation and questionnaires on three experts and 40 pre-service science teachers. Validation test using Gregory formula for validity and Cronbach-Alpha for Reliability. The results of the validity assessment are categorized as high validity. The level of agreement reliability between experts and users generates no significant differences in the learning outcome instrument. The development of this lesson plan resulted in 39 items out of 42 items. The reliability of the learning outcomes assessment instrument for pre-service science teacher reached the reliable criteria. Education for a sustainable development-based lesson plan becomes a recommendation to produce a varied and comprehensive lesson plan for natural science learning in schools.

To cite this article:
Erlina, N., Surdana, I.N., Wicaksono, I., & Pandiangan, P. (2022). Education for sustainable development-based lesson plan validity test for mastery of pre-service science teacher learning outcomes. *Journal for the Education of Gifted Young Scientists*, *10*(1), 85-97. DOI: http://dx.doi.org/10.17478/jegys.1055967

Introduction

Sustainable development is a planned effort that combines several aspects, namely social, economic, and environmental aspects, into a development strategy to maintain the integrity of natural resources, environmental sustainability, safety, welfare, and quality of life for present and future generations. Sustainable Development (SD) is an international issue that the United Nations have officially raised since 1987 (Glavic, 2020). To realize the 2030 sustainable development agenda, the United Nations has formulated 17 sustainable development goals (SDGs). These goals are grouped into three main aspects: social goals, economic goals, and environmental goals. One of the 17 sustainable development goals is to ensure that people worldwide receive quality education that is inclusive, equitable, and accessible throughout life. These goals are then integrated into a new idea: education for sustainable development (ESD). ESD is an effort to grow students' knowledge, skills, values, and attitudes (Zguir et al. 2021). They can face global issues and challenges that are interrelated, such as issues of climate change, welfare, environmental damage, inequality, and so on.

1 Lecturer, Science Education at Universitas Pendidikan Ganesha, Indonesia. E–mail: niaerlina@undiksha.ac.id ORCID: 0000-0003-2199-5046
2 Lecturer, Science Education at Universitas Pendidikan Ganesha, Indonesia. E–mail: nyoman.suardana@undiksha.ac.id ORCID: 0000-0001-6683-9042
3 Lecturer, Science Education Universitas Jember, Indonesia. E-mail: iwanwicaksono.fkip@unej.ac.id
ORCID: 0000-0003-0717-1577
4 Lecturer, Physics Education Universitas Terbuka, Indonesia. E-mail: pakenp@ecampus.ut.ac.id
ORCID: 0000-0002-2448-4412

ESD aims to produce individuals who can evaluate and reflect on their actions by considering the impacts that will be caused in economic, social, and environmental aspects in the present and the future. As part of society, an individual must act by considering the principle of sustainability and participating in moving his community towards sustainable development (CebriÃ¡n et al. 2020). ESD integrates learning objectives, content, pedagogy and learning environment, and social transformation into a quality education system that supports SDG creation (Glavic, 2020).

Research on ESD has become a topic of great interest. It is being developed in terms of exploring, implementing, and evaluating innovative pedagogical approaches or curriculum development to promote ESD competence (CebriÃ¡n et al. 2020). ESD can be included in the curriculum at all levels (Purnamasari & Hanifah, 2021). ESD can be integrated into learning in various ways, such as through learning tools, media, and learning models. The ESD educational process can be more directed, systematic, and measurable so that, in the end, there will be awareness and understanding of environmental boundaries, attitudes, views, and behaviors towards environmental management (Emilzoli, 2021).

One of the objectives of learning science is understanding the natural environment and natural resources that need to be protected and preserved. So it is hoped that after studying science, students can contribute actively to environmental conservation efforts (Purnamasari & Hanifah, 2021). This research is certainly in line with sustainable development goals, especially environmental aspects. In this case, there is a link between education for sustainable development (ESD) and science learning. ESD can be integrated into science learning. The integration by raising the issue of sustainable development in all aspects and equipping students with various ESD competencies such as knowledge, skills, values, and attitudes competencies expected to assist students in taking an action that supports sustainable development. The observations show that there is good preparedness for prospective science teachers in developing ESD-based science learning. They have an understanding of ESD (78.9%) and teacher readiness in lesson planning (77.3%) (Erlina, 2020).

An efficient learning process must be planned carefully in advance. The quality of learning will be significantly influenced by the quality of the lesson plans used (Anggraeni & Akbar, 2018). The learning process will be more organized through careful planning so that learning planning is a step that should not be missed before the teacher carries out learning activities (Emiliasari & Jubaedah, 2019). A lesson plan is a list that contains what the teacher must do at a particular time for a specific group of students regarding a specific lesson. Lesson plans help teachers move from one stage of learning to the next smoothly and keep students focused and encouraged to concentrate on each step of the lesson (Ali Bin-Hady & Abdulsafi, 2018).

UNESCO (2017) suggests that a pedagogical approach that fits the characteristics of ESD is learner-centered, action-oriented, and transformative learning. ESD focuses on motivating and empowering students to become community members who can think critically and participate in shaping a sustainable future. In education for sustainable development, this type of encouraging competence through active learning is more recommended. Participatory learning methods can empower students' character to take action in the context of sustainable development. The selection of a learning method must be adapted to the needs of students, learning environment, and available resources, support, facilities (Huang, 2020).

The learner-centered learning approach emphasizes the active development of knowledge rather than just transferring information. Students' initial understanding becomes the starting point to stimulate the learning process and build their knowledge (Ashwin, 2020). The role of educators in learner-centered learning is as a facilitator, not just transferring structured knowledge. Action-oriented learning engages students in action and reflects their experiences into the learning process and personal development. This learning enhances knowledge acquisition, competency development, and value clarification by linking abstract concepts to the learner's personal and life experiences. The role of educators in it is to create a learning environment that encourages student experience and intuitive thinking processes (UNESCO, 2017).

Project-based learning (PjBL) is learner-centered learning based on constructivism and constructionism theories (Aldabbus, 2018). PjBL equips students with content knowledge and develops psychomotor skills and social skills of students, such as seeking information through various sources, solving problems, critical thinking, self-evaluating, summarizing, and presenting. The advantages of this model are attractive to practitioners and prospective practitioners, which can be seen from the response that the readiness of future teachers in implementing project-based learning reaches 78.2% (Erlina, 2020). Project-based learning focuses on real-world issues and problems. Students have responsibility for their learning process. The role of the teacher here is only as a guide, mentor, motivator, facilitator (Jalinus et al. 2017). This characteristic of project-based learning is suitable for integration with education for sustainable development, which recommends a learner-centered and action-oriented learning approach (Bramwell-Lalor et al. 2020). Thus, implementing project-based learning models in universities is a recommendation to support

prospective teachers in designing ESD-based learning plans. This characteristic of project-based learning is suitable for integration with education for sustainable development, which recommends a learner-centered and action-oriented learning approach (Bramwell-Lalor et al. 2020). Thus, implementing project-based learning models in universities is a recommendation to support prospective teachers in designing ESD-based learning plans.

Problem of Study

Some of the problems that underlie this research are that prospective science teachers have limited experience applying ESD in science learning, developing creative science learning plans are still low, and involving PjBL in science learning (Erlina, 2020). Some of these limitations are relevant to previous research, which states that ESD is a challenge, a lack of ESD in universities, and ESD and universities cannot integrate ESD into their curricula (Habib et al. 2021; Maiorescu et al. 2020). One source of challenges to PjBL is limited knowledge as a major reason for difficulties encountered and low confidence in implementing PjBL (Du & Chaaban, 2020; Vembriyanto & Murniarti, 2021).The final stage of the learning process is assessment. Project-based assessment of learning outcomes has a weakness, namely an unfair assessment (Lin et al. 2021). This study focuses on testing the validity and reliability of education-based learning plans for sustainable development. The trial was carried out using the Project-based learning model on prospective science teachers. The formulation of the problem raised in this study are:

- What components of an education-based learning plan for sustainable development for mastery of pre-service science teacher learning outcomes?
- What are the points of the knowledge domain evaluation instrument in the education-based learning plan for sustainable development for mastery of pre-service science teacher learning outcomes?
- What are the points of the skill domain evaluation instrument in the education-based learning plan for sustainable development for mastery of pre-service science teacher learning outcomes?
- What are the points of the attitude domain evaluation instrument in the education-based learning plan for sustainable development for mastery of pre-service science teacher learning outcomes?
- How to validate education-based learning plans for sustainable development for pre-service science teacher learning outcomes?
- How is the reliability of education-based learning plans for sustainable development for mastery of pre-service science teacher learning outcomes?

The long-term goal of this research is to find the right lesson plan in education for sustainable development for mastery of pre-service science teacher learning outcomes. The specific target/short-term goal to be obtained in this research is to develop a valid and reliable ESD-based learning plan for mastering the learning outcomes of prospective science teachers.

Method

Research Model

This research is instrument development research. The focus of the instrument is on the study of the lesson plan. The lesson plan developed is an education for sustainable development (ESD) based learning plan using a project-based learning model in the Science course of the School of Science Education study program. The adaptation of the instrument development stages (Divayana et al. 2020) can be seen in Figure 1.

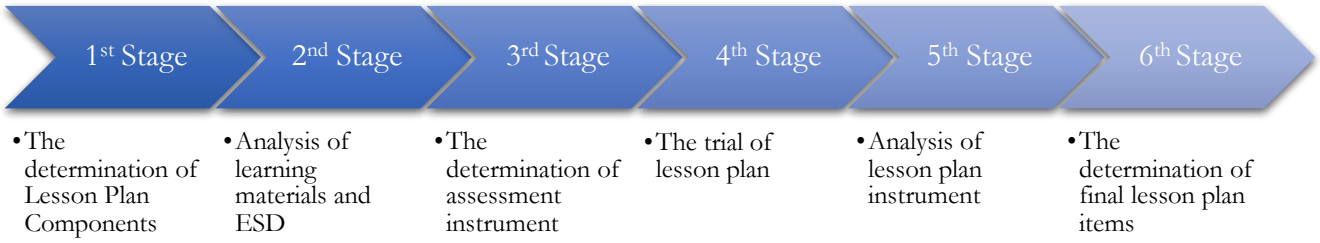

Figure 1

Stages of Developing a Science Learning Plan Based on Education for Sustainable Development

In the first stage, the components of the lesson plan and what tools will be developed are determined. The second stage is the analysis of school science materials and sustainable development issues related to these materials. The issues raised are not only environmental issues but also social and economic issues related to science material. This stage mapped the problems faced by the community, and the solutions can be made in terms of science. In stage 3,

the selection of assessment instruments on aspects of students' knowledge, skills, and attitudes is carried out. The instrument used is self-assessment and peers. In stage 4, the lesson plan was tested to get an expert's assessment of the quality of the lesson plan. In stage 5, the lesson plan analysis is carried out to ensure that the lesson plan is valid and reliable. Stage 6 is carried out to determine the final item ready to be used in the field as a guide for carrying out lectures.

Participants

The participants involved in the content validity test of the instrument were three experts in the field of science education. The trial to support the reliability test of the instrument was 40 pre-service science teachers. The trial was conducted on pre-service science teachers who had learned to use the project-based learning model.

Research Objects and Locations

The object of this research is a set of learning plans for school science courses based on Education for Sustainable Development (ESD). The learning device uses a project-based learning model to master the learning outcomes of pre-service science teachers. The location of this research was carried out in a university located in the province of North Bali.

Data Collection Instruments

The instrument used to obtain data in this study can be in the form of a questionnaire consisting of the lesson plan items developed. In addition to the questionnaire, documentation in the form of photos of the testing process carried out by experts and photos of the lecture process are used as authentic evidence that shows the research process has been carried out.

Data Analysis

The validity of the learning plan in this study was analyzed using content validity techniques through expert testing using the Pearson product-moment correlation formula. The learning plan reliability test in this study used Cronbach's Alpha coefficient because the instrument used was a non-test instrument that used a Likert scale. The categorization of the validity and reliability refers to the Guilford classification, which can be seen in Table 1.

Table 1

Classification of Instrument Validity and Reliability Scores

Validity Category	Reliability Category	Score
Very high	Very high	$.80< r_{xy}\leq 1.00$
Tall	Tall	$.60< r_{xy}\leq .80$
High enough	High enough	$.40< r_{xy}\leq .60$
Low	Low	$.20< r_{xy}\leq .40$
Very low	Very low	$.00< r_{xy}\leq .20$
Invalid	Invalid	$r_{xy}\leq .00$

Results and Discussion

Based on the existing problems and the research methods used to solve these problems, several research results need to be presented and discussed in more depth. The results of this study include several things as follows.

Lesson Plan Components

Learning Media; The learning tools developed are lecture syllabus, lecture contracts, semester lecture plans, material summaries, scenarios, project assignment instruments, and student assessment instruments. The syllabus is a set of plans regarding materials, activities, and learning management and a form of assessment of learning outcomes for each course. In the guideline for developing Undiksha 2016 curriculum learning tools, it is stated that the syllabus at least contains:

a. identity of courses: name, code, credit-weights, prerequisite courses
b. description of the course
c. learning outcomes
d. outline of the learning plan regarding the main learning materials and learning outcome indicators.

Semester lecture plan describes the course syllabus developed by the lecturers independently or together in the expertise group in science and technology in the study program. Following the learning process standards of the National Higher Education Standards, the semester lecture plan shall at least contain a. the name of the study program, the name and code of the course, semester, credits, the name of the supporting lecturer; b. graduate learning outcomes

charged to courses; c. planned final capabilities at each learning stage to meet graduate learning outcomes; d. study materials related to the capabilities to be achieved; e. learning methods; f. the time provided to achieve the ability at each stage of learning; g. the student learning experience is embodied in the tasks that students must do for one semester, criteria, indicators, assessment weights, and a list of references used.

Lecture contracts are key points (summaries) whose scientific content is transferred from the semester lecture plan that individual lecturers and scientific groups have prepared, but technical and normative matters agree with lecturers and students. this lecture contract is given to students and then used as a reference in attending lectures. the lecture contract contains the following points: a. subject identity; b. course description; c. learning outcomes; d. learning methods; e. reading material; f. duties/obligations; g. assessment criteria; h. class schedule.

The summary of the material contains a brief and clear explanation of Sustainable Development and Education for Sustainable Development. In the summary of the material developed, an example of the integration of Education for sustainable development into learning in the form of a concept map that connects issues of sustainable development problems with science material is also provided and how to solve these problems based on scientific studies of science.

In order to make the semester lecture plans easier for lecturers to use, learning scenarios were also developed. This scenario contains instructions that will be carried out by lecturers and activities carried out by students in each phase of project-based learning. In the scenario, time estimates are also given for each learning phase so that lecturers can use lecture time efficiently.

The model used in the lecture is a project-based learning model so that the student assignment instrument is a project-based task. The intended project is for students to analyze school science material and ESD issues, then put them into a mind map. PjBL stages in learning tools (George, 2007; Keser & Karahoca, 2010). namely, phase 1: start with the big question; phase 2: design a plan for the project; phase 3: create a schedule; phase 4: monitor the students, and the progress of the project; phase 5: assess the outcome and phase 6: evaluate the experience. Assessment instrument developed internal judgment (self-assessment) and external judgment (assessment of group friends). on learning outcomes of knowledge, skills, and attitudes. The development of this instrument supports the reliability of peer assessment that can correct the lack of learning outcomes in PjBL implementation. Team members can observe the interactions and contributions of other teams in collaborative projects (Lin et al. 2021).

Science and ESD Material Analysis

Education is one of the most important media to achieve sustainable development, so there is a need for education for sustainable development in the curriculum, namely education that can grow students' knowledge, skills, values, and attitudes in supporting sustainable development. The importance of ESD in sustainable development issues can be described as follows.

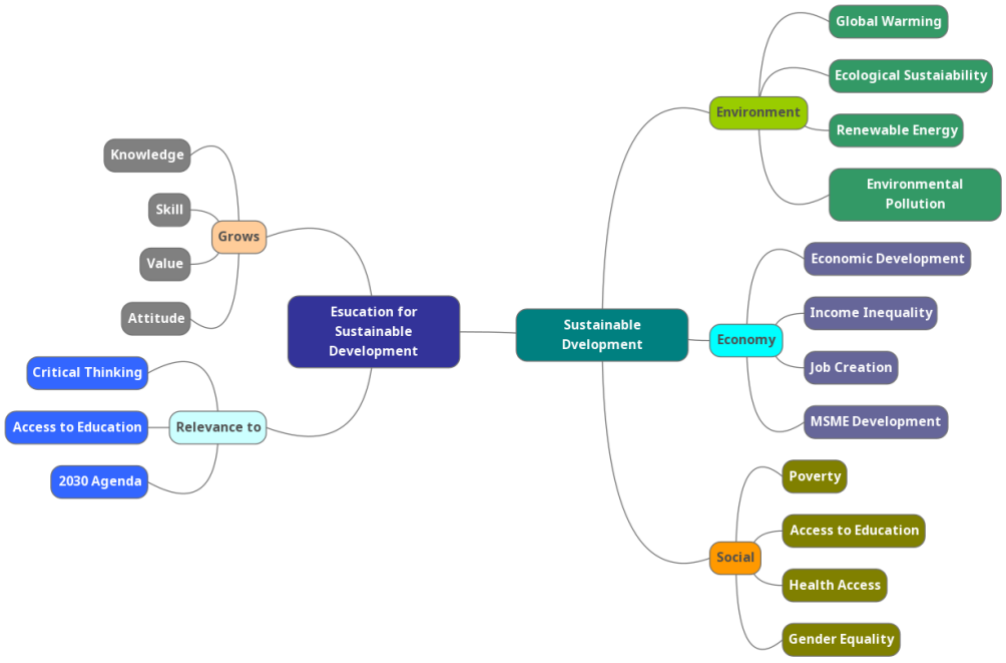

Figure 2

The Link between Sustainable Development and Education for Sustainable Development (Glavic, 2020; UNESCO, 2017)

The school science course discusses the science material taught at the junior high school level. Social, economic, and environmental issues promoted in sustainable development cannot be separated from the scope of natural and social sciences. In science material, there are several topics such as energy, ecosystems, environmental pollution, global warming, sustainability of life, and environmentally friendly technology. There are several appropriate topics in the realm of Social or Social Studies, namely the potential of Indonesia's natural resources, social interactions that include social conflict and plurality, and income redistribution. ESD can integrate science learning with social science learning to achieve sustainable development goals.

Project Evaluation Items

Assessment on project assignments is an authentic assessment carried out by lecturers at each stage of project-based learning, namely the preparation stage, implementation stage, and reporting stage. Project appraisal points are presented in Table 2.

Table 2

Project Assessment Instruments

No	Aspect	Statement item
1	Preparation	Students make schedules and group workflows systematically Students make a mind map design plan clearly and on target Students prepare the complete mind map making tools and materials
2	Implementation	Students carry out activities according to their respective assignments Students carry out group activities independently Students collect data and information through trusted sources Students are able to identify related science materials and Sustainable Development issues Students are able to analyze solutions to problems related to sustainable development in accordance with the study of science material
3	Reporting (Product/Mind Map)	Mind map according to the plan that has been made Mind map is attractively designed Mind maps contain short and clear words The flow in the mind map is clear and easy to understand The material is in accordance with the school's science study The environmental issues raised are related to the study of the material The social issues raised are related to the study of the material The economic issues raised are related to the study of the material The solutions presented are in accordance with the study of the material The solutions presented can solve the problem The presented actions allow to be applied
4	Reporting (Written Report)	Report writing in accordance with systematics Report writing according to improved spelling The contents of the report are clear and easy to understand Science material explained in a detailed and weighty report ESD materials described in detailed and weighted reports There is an explanation of the relationship between science material and every Sustainable Development issue raised
5	Reporting (Presentation)	Students deliver presentations clearly and communicatively Students deliver presentations according to the allotted time The presentation view represents the entire contents of the report Short and clear presentation view Attractive presentation view Students understand the content of the presentation well Students are able to explain the relationship between science material and the issue of sustainable development raised Students are able to answer questions related to the presentation presented
6	Reporting (Video)	The picture in the video looks clear Audio is heard clearly The duration of the video according to the requested time allocation

(Adapted from the Education Assessment Center Team, 2019)

The items for assessing the learning outcomes of prospective science teachers are adapted from the reference achievement indicators for the school's science study subject. This course applies to the bachelor's science education study program.

Knowledge Domain Assessment Items

The assessment of the realm of knowledge is carried out through self-assessment and friends. The points of the statements submitted are presented in Table 3.

Table 3

Knowledge Assessment Instruments

No	Aspect	Statement item
1	Develop correct scientific terms/concepts	I compiled a mind mapping project using scientific concepts correctly
		I develop a mind mapping project by fulfilling all parts of the ESD value, sector, issue, solution, action

Skill Domain Assessment Items

The evaluation of the skill domain is carried out through self-assessment and assessment of friends in groups. Skills assessment instruments are divided into general skills assessment instruments and specific skills assessment instruments. The developed instrument contains statement items related to the skills possessed by students after learning activities. The points of the statements submitted are presented in Table 4 and Table 5.

Table 4

General Skills Assessment Instruments

No	Aspect	Statement item
1	Able to apply logical, critical, systematic, and innovative thinking in the development of Science.	I compiled a mind map of ESD-based Science material that has component linkages based on logical thinking
		I developed a mind mapping of ESD-based Science material critically based on the issues.
		I compiled a systematic mind mapping of ESD-based Science materials based on ESD values, sectors, issues, solutions, actions
		I developed a mind mapping of innovative ESD-based Science materials based on solution and action components.
2	Able to study the implications of the development or implementation of science and technology that pays attention to and applies scientific values following expertise based on scientific principles, procedures, and ethics.	I compiled a mind map of ESD-based Science material on solution components based on clear references
		I compiled a mind mapping of ESD-based Science material on the action component based on the latest findings with reference sources less than the last 10 years
3	Able to make appropriate decisions in the context of problem solving based on the results of information and data analysis through the presentation of solution actions.	I compiled a mind map of ESD-based Science material on the action component based on clear references
		I compiled a mind map of ESD-based Science material on the action component based on the latest findings with reference sources less than the last 10 years.

Table 5

Special Skills Assessment Instruments

No	Aspect	Statement item
1	Able to apply his understanding in the field of school science to solve problems and be able to adapt to the situation at hand	I am able to develop an ESD-based learning plan that has value in supporting environmental sustainability through a comprehensive mind mapping of science material
		I am able to develop an ESD-based learning plan that is valuable in supporting economic sustainability through a comprehensive mind mapping of science material
		I am able to develop an ESD-based learning plan that is valuable in supporting social sustainability through mind mapping of science material comprehensively

Attitude Domain Assessment Items

Evaluation of the attitude domain is carried out through self-assessment and assessment of friends in the group. The developed instrument contains statement items related to the scientific and professional attitudes of students who grow during the learning activities. The points of the statements submitted are presented in Table 6.

Table 6

Attitude Assessment Instruments

No	Aspect	Statement item
1	Contribute to quality improvement and self-quality by complementing each other through interaction in group activities.	I'm taking lessons
		I compile a plan for making a Mind Mapping Project based on the format.
		I carry out activities according to the role
		I do self-evaluation
		I prepare a Mind Mapping Project report in writing
		I compiling a Mind Mapping Project report in the form of a video.
2	Appreciate the opinions/ideas and original findings of others	I agree with the group friends' answers to fill in the mind mapping according to their respective roles before conducting group discussions
		The results of my work were approved by my group friends to be included in the mind mapping according to my role before conducting group discussions.
3	Have sincerity, commitment, and sincerity in work.	I do mind mapping according to the number of tasks in the group
		I do mind mapping assignments according to the objectives of each task
4	Demonstrate the ability to cooperate and have social sensitivity to society and the environment	I organize group collaboration activities
		I have a discussion with the group to evaluate and perfect the mind mapping that has been prepared by each group member
5	Demonstrate a disciplined and responsible attitude in doing the task	I collect assignments in groups on time as planned
		I collect assignments in groups on time as planned
6	Internalizing academic values, norms, and ethics	I compile reports according to assigned components
		I compile reports according to standard Indonesian sentences
		I compiled a mind map based on clear reference sources.
7	Internalizing the values of Tri Hita Karana	I pray before and after study and be grateful
		I have group discussions in a polite and respectful manner
		I compiled a mind mapping task by raising issues about environmental problems
8	Internalize the spirit of independence through self-evaluation based on group work	I did a self-evaluation fulfilling all aspects
		I did an honest self-evaluation.

Education for Sustainable Development-based Lesson Plan Trial

There are two forms of testing carried out on this learning plan to obtain the validity and reliability of the instrument, namely the test of the validity of the content of the lesson plan and the test of the instrument's reliability. The content validity test involved three experts (education experts), while the instrument reliability test involved 40 respondents (pre-service teacher). Complete data on the validity of the lesson plan can be seen in Table 7, while the data on the reliability test results can be seen in Table 9.

Table 7

Validation Test Results by Experts

Validator 1		**Validator 2**		**Validator 3**	
Less relevant (1-2)	Relevant (3-5)	Less relevant (1-2)	Relevant (3-5)	Less relevant (1-2)	Relevant (3-5)
12, 36, 41	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 42	28	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42	12	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42

The results of the validity of the three experts are then summarized in the form of 3x3 tabulated data so that it is easier to calculate content validity. The content validity 3x3 tabulated data by three experts is shown in table 8.

Table 8

3x3 Tabulation Validity Test Results

Validator		V3	
V1	V2	Less relevant (1-2)	Relevant (3-5)
Less relevant (1-2)	Less relevant (1-2)	-	28
	Relevant (3-5)	12	41
Relevant (3-5)	Less relevant (1-2)	-	-
	Relevant (3-5)	-	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 42

From the tabulated data, then the validity of the lesson plan is calculated using the Gregory formula. The process of calculating validity using the Gregory formula can be carried out using the reference data in Table 8. The process of calculating validity can be explained in full as follows.

After calculating the validity of the instrument, then calculating the reliability of the learning plan instrument. The results of the reliability calculation are shown in Table 9.

Table 9

Reliability Test Results

	Item-Total Statistics				Reliability Statistics	
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha	N of Items
V_1	8.36	.869	.771	.86	.890	3
V_2	8.31	.853	.827	.806		
V_3	8.29	1.038	.775	.861		
A_1	34.25	4.397	.000	.656	.661	13
A_2	34.33	3.917	.258	.637		
A_3	34.30	4.164	.205	.644		
A_4	34.30	3.908	.505	.615		
A_5	34.40	3.579	.320	.628		
A_6	34.38	4.189	.070	.663		
A_7	34.30	4.010	.383	.627		
A_8	34.28	4.102	.422	.631		
K	34.43	3.738	.267	.637		
G_1	34.40	4.092	.119	.658		
G_2	34.50	3.436	.392	.611		
G_3	34.50	3.436	.392	.611		
S	34.65	3.156	.487	.588		

Description:

V_1: Validator 1; V_2: Validator 2; V_3: Validator 3

A_1: Attitude 1; A_2: Attitude 2; A_3: Attitude 3; A_4: Attitude 4; A_5: Attitude 5; A_6: Attitude 6; A_7: Attitude 7; A_8: Attitude 8; K: Knowledge; G_1: General Skills 1; G_2: General Skills 2; G_3: General Skills 3; S: Specific Skills

Learning Plan Analysis

The validity test by the expert was carried out on 42 items of the learning plan instrument consisting of 23 items of construct assessment and 19 items of content assessment. The validity test results show that three items are less relevant and 39 items are relevant. In the construction assessment of the semester lecture plan, one of the items considered relevant by all validators was item number 11, namely a statement regarding the comprehensiveness of the indicators and classified according to the domain/domain of attitudes, knowledge, skills that got a score of 4 from each validator. The indicators follow the learning outcomes of study programs based on graduates' vision, mission, and profile. Another relevant item in assessing lecture contract content is item number 29 regarding whether the use of synchronous and asynchronous methods supports learning achievement. During lectures, face-to-face, online using an online meeting platform and asynchronous self-study to complete projects according to individual assignments in groups. Then in the assessment of semester lecture plan content, several items that are considered relevant are items number 32, 33, 36, and 37, respectively, regarding the suitability of learning outcomes with ESD, suitability of the sequence of learning phases, up to date learning media, and rubrics and assessment criteria support authentic assessment. Learning uses the mindmap 2.0 application, which is up to date and supports peer review assessment to get the learning outcomes of prospective science teachers. Self-assessment acts as internal judgment, and peer review assessment as external judgment. In the assessment of project assignment content, items regarding the suitability of written and video report guidelines and learning objectives received a score of 5 out of two validators and 4 out of one validator.

However, the validator considers several items less relevant, namely items number 12, 28, and 41. Item number 12 is an assessment of the construct of the semester lecture plan regarding the suitability of the time allocation with the scenario that gets a score of 2 from two validators. Lectures were carried out for three meetings and were less effective because model students were involved as supporting resource persons. Item number 28 is an assessment of the content of the lecture contract regarding learning resources or materials that can support learning achievement. The summary of the material as supporting learning resources is considered less comprehensive with learning outcomes. The learning process requires science teaching materials integrated with ESD, so that prospective teachers have a clear conceptual understanding. Another item that is considered less relevant is item number 41 regarding the project assignment guide, which is sequentially following the achievements of each phase of the PjBL model. The item is considered less relevant because there are doubts in the preparation of the planning in the table of activities that need to come first. The table is the activity design table or group collaboration activity table.

Based on the calculation of content validity, the result is .929. So it can be said that the overall learning plan instrument is included in the very valid category. However, based on the results of the expert's assessment, three items are declared less relevant, so they must be removed from the instrument or corrected so that they become relevant. The results of the reliability test obtained Cronbach's Alpha value of .661. This value supports the reliability of the assessment instrument on the learning outcomes of prospective science teachers in the form of knowledge, skills, and attitudes. Each item shows reliable results. The lowest Cronbach's Alpha is item S. Item S can improve the editorial score of the assessment item.

Final Lesson Plan

The final result of the learning plan instrument is determined based on the results of the instrument's content validity. Items declared relevant in the validity test by the expert will still be used, while items declared irrelevant will be discarded or corrected so that the item becomes relevant. Based on the validity test results in table 8, 39 items are used without improvement because they are declared relevant, and three items are used with improvements because they are declared irrelevant. The lesson plans developed can be applied in learning ESD-based School Science courses. Learning is carried out using a project-based learning model. Students are given project assignments in mind maps that can map science material and related ESD issues, along with solutions and actions that can overcome the problems raised. Concept maps are an excellent medium to assess students' ability to relate the concept of sustainable development. However, the concept maps are better used as group evaluations, not individual evaluations (Svanström et al., 2018).

The assessments used in the lesson plans developed are authentic in project assessments, self-assessments, and peer assessments. Authentic assessment is a significantly meaningful measurement of student learning outcomes for attitudes, skills, and knowledge. The term authentic is genuine, accurate, valid, or reliable. Conceptually, authentic assessment is significantly more meaningful than standardized multiple-choice tests (Wildan, 2017). Teachers can use authentic assessment results to plan other activity programs such as remedial, enrichment, or counseling services (Ristanto & Djamahar, 2019). Project appraisal is an activity of assessing group project assignments in mindmaps, reports, and presentations in the form of videos that must be completed within a particular time. In project appraisal, the assessed aspects are aspects of planning, implementation, and reporting (Educational Assessment Center Team, 2019).

A student's learning and achievement depend on the teacher's effectiveness (Nousheen et al. 2020). In schools, teachers are one of the main determining factors in improving the quality of education. The process must be designed in such a way as to produce learning outcomes that are as desired (Wibowo & Farnisa, 2018). Therefore, science teachers as mediators and facilitators in science learning in junior high schools are one of the determining factors for the success of ESD (Erlina, 2021). The role of a teacher as a facilitator means to provide services so that students can easily accept and understand the subject matter. So that later the learning process will be more effective and efficient (Yestiano & Zahwa, 2020).

Conclusion and Recommendation

The development of a learning plan based on education for sustainable development produces several components, namely lecture syllabus, lecture contracts, semester lecture plans, material summaries, learning scenarios, and learning assignment and assessment instruments. Learning assessment instruments are categorized into knowledge, skills, and attitudes assessment instruments. The development of this lesson plan resulted in 42 items validated by three experts. After the validation process and content validation analysis were carried out, 39 items were declared relevant, and three items were declared irrelevant so that improvements were needed. However, in general, the validity test states that the lesson plans developed are included in the very valid category. The reliability test was carried out on 40 students, which was then analyzed and resulted that the lesson plans developed were included in the reliable category. So that, in general, the learning plans developed can be used for learning activities in School Science courses based on Education for Sustainable Development. However, there are still some obstacles in the implementation of learning trials using the developed learning plans. Education for a sustainable development-based lesson plan becomes a recommendation to produce a varied and comprehensive lesson plan for natural science learning in schools.

Limitations of Study

The author suggests several important attributes for future studies so that research on development becomes comprehensive. The learning activities carried out in this study used a project based learning model through online learning in the School Science course. There are still other types and models of learning that can be used to develop

students' potential in ESD. It is hoped that further research can investigate the integration of ESD into other courses with the latest approaches more fully.

Acknowledgment

The authors would like to thank the Government of the Republic of Indonesia through the ministry of education and culture for the basic training program for the state civil apparatus to complete this research. [Class III, Batch 42]

Biodata of the Authors

Dr. Nia Erlina, M. Pd. She obtained a Bachelor's degree in Physics Education from Universitas Jember (2010), Masters in Science Education from Universitas Negeri Surabaya (2015) and a Doctor in Science Education from Universitas Negeri Surabaya (2018). He has been a lecturer in Science Education at Universitas Pendidikan Ganesha since 2020. E-mail: niaerlina@undiksha.ac.id Orcid: 0000-0003-2199-5046.

Dr. I Nyoman Suardana, M. Si., He obtained a Bachelor's degree in Chemistry from Universitas Udayana (1991), Masters in Chemistry from Institut Teknologi Bandung (1999) and a Doctor in Science Education from Universitas Pendidikan Indonesia (2010). He has been a lecturer in Science Education Universitas Pendidikan Ganesha. Affiliation: Universitas Pendidikan Ganesha. E-mail: nyoman.suardana@undiksha.ac.id Orcid: 0000-0001-6683-9042

Dr. Iwan Wicaksono, M. Pd.. He obtained a Bachelor's degree in Physics Education from Universitas Jember (2012), Masters in Science Education from Universitas Negeri Surabaya (2014) and a Doctor in Science Education from Universitas Negeri Surabaya (2017). He has been a lecturer in Science Education Universitas Jember since 2016. Affiliation: Universitas Jember. E-mail: iwanwicaksono.fkip@unej.ac.id Orcid: 0000-0003-0717-1577

Dr. Paken Pandiangan, M.Si. He obtained a Bachelor's degree in Physics from Universitas Gadjah Mada (1995), Masters in Physics from Institut Teknologi Bandung (2003), and a Doctor in Science Education from Universitas Negeri Surabaya (2017). He has been a lecturer in Physics Education Universitas Terbuka. Affiliation: Universitas Terbuka. E-mail: pakenp@ecampus.ut.ac.id O: 0000-0002-2448-4412

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