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Collaborative Problem-Solving in Sustainable Introductory Physics with Peatlands-Smart Project Course Semester Learning Plan

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Abstract: Education is one of the factors that prepare societies to handle climate change. Humanity must step up efforts to reduce greenhouse emissions and prepare humanity for future crises. The development and validation the SLP of the SIP-SPP course is an effort to mitigate climate change through physics learning. The Plomp development design with three main stages: preliminary research, prototyping, and assessment to produces valid, practical, and effective semester learning plan products. The characteristics of the resulting semester learning plan product are the learning objective of adopting the thirteenth SDGs is climate change mitigation, adopting EfSD competencies are CPS, assessment learning objectives with environmental literacy questionnaires and CPS performance observation rubrics in groups, learning activities based on peatland-smart projects, learning content heat and thermodynamics, peatlands, climate change, and region. SLP is valid and reliable according to experts and practitioners, practical and easy to use, and can improve the CPS of prospective physics teacher students. SLP of SIP-SPP needs to be developed and validated to make it easier for lecturers and science lecturers, especially physics, to adopt SDGs and EfSD in learning. Environmental literacy of prospective teacher students will be a mitigation of climate change.

Keywords: Collaborative Problem-Solving; Peatlands-smart Project; Sustainable Introductory Physics; Semester Learning Plans

Introduction

Climate change is the principal issue of our times, with environmental, social, economic, and educational consequences (IPCC, 2022). Peatlands are damaged as one of the emitters of CO_2 and CH_4 to nature (Sangok et al., 2017). Indonesia's peatlands (Sumatra and Kalimantan) emitted around 119.7 million tons annually in 2015 (Miettinen et al., 2017). Education is one factor that prepares societies to handle climate change (UNESCO, 2017). Humanity must step up efforts to reduce greenhouse emissions and prepare humanity for future crises (Klenert et al., 2020; Verlie, 2019). Climate change is one of the world's most complex challenges due to its global nature, intergenerational impacts, and significant environmental risk (Uitto et al., 2017).

Quality education should foster students' ability to face the challenges of the 21st century and encourage participation in sustainable development issues (Felicia & Innocent, 2017). Science education is essential as a joint effort to promote sustainable development through education for sustainability (EfSD) (Akpan, 2017). Sustainable development can be an action against climate change (Zulkarnaini et al., 2020). Education must include climate mitigation (Jorgenson et al., 2019). Adopting SDGs means classroom learning aligns with SDG goals (Pradhan et al., 2017). Physics teaching supports the achievement of SDGs (Costa et al., 2023). Physics is a branch of science that is the basis for technological developments and life concepts that align with nature.

Integrative problem-solving is a crucial sustainability competency critical to thinking and acting for sustainable development (UNESCO, 2018). Collaborative and problem-solving are among 21st-

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century skills that must be cultivated in the face of environmental problems (Felicia & Innocent, 2017). Collaborative Problem Solving (CPS) is one of the thinking skills to face and provide solutions to environmental problems. CPS is a joint activity in which a small group takes several steps to change the state into a desired state according to the objectives (Griffin & Care, 2015). CPS competencies include building and maintaining mutual understanding, taking appropriate action, and building and maintaining team organization (Griffin & Care, 2015).

Higher education has an essential responsibility and role in contributing to sustainable development education (Cörvers et al., 2016). Universities must act as agents of change by promoting the principles of sustainable development within institutions and communities. Course design as an implementation of EfSD to achieve SDGs is not only the integration of content in the curriculum. However, it creates interactive, student-centered learning, transformative pedagogy oriented to action or behavior, independent learning, collaboration, problem-oriented, intercultural, and transdisciplinary (UNESCO, 2017). In Indonesia, though training materials are currently oriented toward the environmental context, provided training focuses on imparting knowledge on environmental education. It has not yet expanded to include raising awareness or fostering sustainable action (Eliyawati et al., 2023). To contribute to the achievement of SDGs, physics learning is designed by the competence of EfSD to the level of action.

Project-based learning is an example of such pedagogical approaches that have been gaining popularity in addressing education for sustainability (Hayashi et al., 2023; Monroe et al., 2019; Taheri, 2018). Project-based learning allows learners to explore and discover knowledge (Hanklang & Sivasan, 2020) and focuses on product creation or performance (Boyers, 2018). Characterized as a constructivist pedagogy, with learners mobilizing theoretical and technical knowledge to solve practical problems, it is learner-centered and involves a dynamic classroom approach (Arcidiacono et al., 2016). Project-based learning allows students to practice soft skills like collaboration and problem-solving to succeed in future careers (Boyers, 2018). Project-based learning challenges learners to construct the meaning of science concepts, connect classroom learning with life beyond, and address real-world problems (Felicia & Innocent, 2017).

Interdisciplinary learning (IL) can integrate specific learning with environmental concepts (Santiani et al., 2023; Tripp & Shortlidge, 2019). IL of science and conservation means learning with science and conservation content and an IL process (Santiani et al., 2023). IL is implemented through a project-based learning model in higher education (Braßler & Schultze, 2021). Adding IL to project-based learning in EfSD means focusing on the sustainability product entails applying different information, data, techniques, tools, perspectives, and so forth toward an innovative and effective product.

Effective lesson plans and teaching can lead to better learning of core competencies (Jammeh et al., 2022). The science lesson plan is the primary support for the success of science class management in improving the quality of learning and assessment (Iqbal et al., 2021). There are still many problems faced by teachers in preparing lesson plans. The teacher still experienced difficulties developing authentic mathematics assessments (Pardimin, 2018).

The management of environment-based learning is still very limited due to many obstacles. The implementation of physics learning to achieve the SDGs goals is still very limited because appropriate learning planning is still very minimal. The adoption of SDGs in learning is still quite new in Indonesia so it requires examples of how to adopt SDGs in physics learning. Physics learning at universities based on peatland projects is also still quite rare. Introductory physics learning based on smart peatland projects in Palangka Raya has never been carried out even though the development of CPS is very important to do. Sustainable basic physics learning with smart peatland projects to form collaborative thinking skills problem solving can be an example for physics teachers and lecturers to manage classes. The student-teacher candidates must enhance their PCK dimension in the lesson plan for teaching science (Maryati et al., 2019).

Development of semester learning planning equipped with the outlines learning goals, constructs instructional activities, and creates evaluations (John, 2015; Chizhik & Chizhik, 2018) which is complete will make it easier for lecturers to manage environment-based physics classes. Physics learning is one of the efforts to achieve SDGs and form students who are competent in EfSD by having the ability to think CPS. A key of SLP in the SIP-SPP course is based on interdisciplinary heat and thermodynamics, religions, SDGs, and EfSD competencies to improve CPS.

Method

This research and development were carried out with the Plomp development design with three main stages: preliminary research, prototyping, and assessment (Plomp & Nieveen, 2013). The development stages are presented in Figure 1.

Preliminary research consists of three activities: CPS-level analysis, needs analysis, and curriculum analysis. CPS level analysis was conducted by observing the basic physics practicum activities of 30 physics and biology tadris department IAIN Palangka Raya students in the even semester of the 2022/2023 academic year. Three CPS competencies (Griffin &

Care, 2015) are observed with twelve group problem-solving performance indicators. The indicators are active in problem identification, problem definition, actively examining solutions with groups, actively implementing problem-solving, actively testing impact, and actively overcoming conflicts and obstacles in the group to achieve goals. The CPS observation rubric uses scores of 1-4, meaning 1 low, 2 medium, 3 good, and 4 very good. Five primary physics practicum assistant students made the observations.

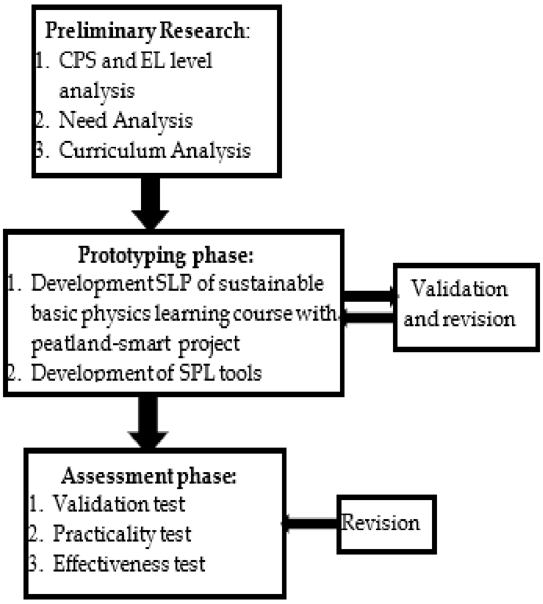

Figure 1. The development stages

A needs analysis was carried out using a survey method using a questionnaire to a physics lecturer at the university in Palangka Raya City. Needs analysis aims to find empirical facts about lectors' needs for adopting SDGs and implementing EfSD in physics learning at universities. Data was collected using a Likert scale 1-4 questionnaire with a choice of responses from strongly agree to disagree. The data obtained were analyzed descriptively to find the percentage of lectors' needs for adopting SDGs and implementing EfSD in physics learning at universities.

The preliminary research was followed by curriculum analysis. Curriculum analysis is carried out by determining the SDGs goals to be adopted. Analysis of EfSD competencies that will be used as learning outcomes. Analysis of science learning objectives in EfSD. Analysis of the curriculum of the study program. Analysis of the course curriculum. Analysis of course material. Analyze environmental materials and determine material integration strategies. Analyze learning experiences to achieve outcomes—analysis of the evaluation and assessment.

The research continued with the product development phase. The product development phase consists of two activities: the development of prototypes and product validation. Developing the course design prototype SLP form includes outcomes, learning activities, and assessment strategies. After the draft SLP course are completed, validation is carried out. The validation phase involved three physics learning experts and four physics lecturers (seven raters). The validator also suggests a course design and tool improvements in this stage. Validity data was collected with a 4-scale Likert questionnaire with very good to poor response options. The collected data is analyzed with Aikens value (Aiken, 1985) as in equation (1)—determination of validity by comparing V count and V table. If V count > V table, it is considered valid (Aiken, 1985).

$$V = \frac{(\sum S)}{[n(c-1)]} \quad (1)$$

The reliability of validation is determined from the intra-class correlation coefficient (ICC) (Brookhart & Chen, 2015) as a degree of correlation and agreement between measurements (Perinetti, 2018). Reliability criteria are determined according to the criteria in Table 1.

Table 1. Reliability Coefficient Criterion of Value ICC (Perinetti, 2018)

ICC	Criterion
< 0.50	Poor
0.50 – 0.75	Fair
0.75 - 0.90	Good
> 0.90	Very good

After the validation and revision processes were completed, the research continued in the practicality test. At this stage, a trial of the SLP was carried out by implementing project-based learning using one group pretest and posttest design. Practical data and student responses to the learning design were collected at this stage. Test the practicality of using SLP by collecting practical data through observation of learning implementation and student response questionnaires (Nieveen & Folmer, 2013). Data analysis techniques for response questionnaires and learning implementation with formulas such as equation (2).

$$P = \frac{\sum x}{\sum x_i} x\ 100\% \quad (2)$$

The questionnaire uses a 4-scale Likert with very good to poor response options. At this stage, lecturers and students also suggested improving the SLP. The data that has been collected is then analyzed to find the percentage of practicality and student responses. Practical category and student responses refer to Table 2.

Table 2. Criteria of Practicality and Student Responses

	Percentage	Descriptions
Practicality / students responses	75.50 -100%	Very practical/very good
	50.50 - 75 %	Practical / good
	25.50 - 50 %	Less practical/ fair
	0 – 25 %	Impractical/ poor

The data were analyzed for the effectiveness of the SLP to improve the students' CPS. The effectiveness analysis was done by a one-group pretest-posttest research design (Creswell & Creswell, 2018) to compare the average value of CPS in the pretest and posttest. The difference between pretest and posttest is assumed to be an effect of implementing SLP.

Test the hypothesis with *an independent sample t-test* (Creswell & Creswell, 2018) with SPSS 18. There was a remarkable difference in the average CPS between pretest and posttest if the independent sample t-test satisfies sig.2-tailed < 0.05. The hypothesis of this study is presented as follows:

H_0: There is no notable difference in students' CPS scores between the pretest and posttest

H_1: A notable difference in students' CPS scores between the pretest and posttest.

The population of the research object to analyze the effect of SLP was the students of physics and biology education study program in the even semester of the academic year 2023/2024 who take introductory physics courses. The entire population was sampled: 60 students. The study was conducted for three months, from July to September 2023, at IAIN Palangka Raya. The sample consisted of 42 women and 18 men

Result and Discussion

Preliminary Research

The preliminary study found that CPS studies from 30 prospective teacher students in introductory physics practicum in the educational physics department IAIN Palangka Raya showed an average score of 1.43 with a low category. Six indicators indicate a low category. These results are appropriate with the PISA assessment of CPS students in 2012, that 29% of students scored at the lowest levels (OECD, 2017b). CPS skills in school activities are expected to improve students' college and career readiness and benefit society (Fiore et al., 2018; OECD, 2017b). School systems have no widely accepted CPS curricula or standards (Scoular & Care, 2018). These results suggest that CPS should be developed in physics learning.

Lecturers perceive that SLP of the SIP-SPP is necessary to be developed to improve the CPS of prospective teachers and students. The learning course is essential to interdisciplinary physics learning with peatland conservation. Furthermore, respondents revealed that learning approaches have yet to accommodate these needs significantly. Based on these findings, the SLP of the SIP-SPP was developed. This finding is also supported by previous researchers, stating that implementing interdisciplinary project learning better supports aspects of student learning (Vogler et al., 2018). IL can integrate specific learning with environmental concepts (Santiani et al., 2023; Tripp & Shortlidge, 2019). IL of science and conservation means learning with science and conservation content and an IL process (Santiani et al., 2023).

Curriculum Analysis

The preliminary research was followed by curriculum analysis. The curriculum of IAIN Palangka Raya has yet to adopt SDGs and EfSD, so the curriculum in study programs and courses is also the same. The SLP of the SIP-SPP adopted SDGs, and EfSD started with content analysis of heat and thermodynamics. This is to the pattern of adoption of SDGs and EfSD by Jegstad et al. 2018 (Jegstad et al., 2018).

Introductory physics courses contain matter quantities and units, mechanics, work and energy, momentum and impulse, equilibrium of objects, and heat and thermodynamics. All matter is related to the physical properties of the universe, but not all can be interdisciplinary with peatlands. Materials that are directly related and easy enough to integrate with peatlands are heat and thermodynamics. The selected scientific content knowledge is heat and thermodynamics. The thermal properties of peat soils are essential in mitigation activities, conservation, and utilization (Gnatowski et al., 2022; Helbig et al., 2020; Kurnain, 2019; Kurylyk et al., 2016). Curriculum analysis is carried out by determining the SDGs goals to be adopted. SDGs have 17 goals; the thirteenth is climate change mitigation (UNDP, 2023). Climate change is one of the world's most complex challenges due to its global nature (Uitto et al., 2017), and humanity must step up efforts to reduce greenhouse emissions (Klenert et al., 2020; Verlie, 2019).

CPS of EfSD competencies have been included in the SLP as learning objective. Analysis of the learning objectives of climate change mitigation SDGs that can be adopted in sustainable essential physics learning is related to cognitive, social-emotional, and behavioral learning objectives (UNESCO, 2017). Cognitive learning aims to understand the causes and consequences of climate change. Social and emotional goals are related to the social skills that make it possible to achieve the SDGs. Behavioral learning objectives are related to action (UNESCO, 2017).

The outcome of the SLP of the SIP-SPP is CPS and EL so that the learning experience can be used in project-based learning related to peatland. Project-based learning is an example of such pedagogical approaches that have been gaining popularity in addressing education for sustainability (Hayashi et al., 2023; Monroe et al., 2019; Taheri, 2018). The sustainable introductory physics course is designed with a smart peatland project—achievement of heat and thermodynamics learning objectives for climate change through learning activities on peatland-smart projects. Project-based learning challenges learners to construct the meaning of science concepts, connect classroom learning with life beyond, and address real-world problems (Felicia & Innocent, 2017). Project-based learning allows learners to explore and discover knowledge (Hanklang & Sivasan, 2020) and focuses on product creation or performance (Boyers, 2018).

Prototyping

Prototyping the SLP contains the identity of the course, the achievements of graduates from the study program curriculum, the achievements of the courses, and the sub-achievements of the courses. The SLP is also equipped with learning assessment instruments. A module for sustainable introductory physics courses with a peatland-smart project was prepared as a learning aid. SLP contains the main aspects of a lesson plan, namely learning goals, instructional activities, and evaluation (John, 2015; Chizhik & Chizhik, 2018).

The adoption of SDGs and the implementation of EfSD in SLP are arranged in the form of sub-learning outcomes or learning objectives. Sub-learning outcomes of courses are derived from the learning goals (Rodriguez & Albano, 2017) of study program graduates. Learning objective 1 (LO1) of the SLP course contains knowledge of physics, peatlands, and the Quran measured by a test. LO1 contains aspects of cooperation and environmental care measured by performance observations and questionnaires. LO2 contains aspects of CPS thinking skills measured by performance observation. LO3 contains the project creation process skills measured with a project monitoring sheet. LO of the SLP course contains three aspects (knowledge, attitude, skill) that must be formed in students' learning. LO is a performance that can be related to performance measuring instruments or tests. The LO aspect is the requirements of a good LO (Rodriguez & Albano, 2017)—sub-learning outcomes of courses as adoption SDGs dan EfSD as shown in Table 3.

Table 3. Adoption of SDGs and EfSD in Sub-learning Outcomes of Courses

Sub-learning Outcomes/Learning Objectives of Courses	Information
Having an attitude of mutual respect, cooperation, and care for the peatland environment through the process of integrating thermodynamic content, magnetic electricity, and modern physics with the Quran (LO1)	SDGs and EfSD competencies
Able to solve simple problems of thermodynamic matter, magnetic electricity, modern physics, and peatlands (LO2)	EfSD competencies
Able to plan and create IoT-based in peatland-smart projects (LO3)	SDGs

Prototyping of SLP comes with task plans, assessment plans, and assessment instruments and rubrics. The task plan makes the plan assessed with the project planning monitoring sheet. Problem formulation performance sheets assess the formulation of problems in groups. The CPS assessment plan uses the CPS assessment instrument in the project working group. CPS assessment instruments use grading rubrics. Assessment indicators and assessment techniques for the stage of making peatlands-smart projects are shown in Table 4.

Table 4. Assessment Indicators and Techniques of the SLP

Steps	Assessment techniques
Problem formulation	CPS rubric
Project planning	Performance planning
Project creation	Observation with monitoring sheet
Project presentation	Performance presentation
Project reporting	Performance process and product
CPS	CPS Rubric
EL	P-PSEL questionnaire

This course is described as forming CPS and EL of students through activities making smart peatland projects as interdisciplinary heat, thermodynamics, peatlands, and climate change. Described of course achieved through learning materials: Heat and Quran surah Al Kahf verse nine six, An-Naml verse seven, Al-Waqiah verse seventy one to seventy three, Yasin verse eighty, Yunus verse five, Fatir verse thirteen, Al-Furqon verse sixty one, Nuh verse sixteen. Gas and Thermodynamics and quran surah Ar Rahman verse nine. Student Peatland-Smart project related to thermal and electrical properties of peatlands. Stages are the introduction of IoT and sensor systems, project planning, project implementation, project presentation, and project reporting.

Sub-learning outcomes of courses are achieved through learning activities for making smart peatland projects. Students in groups create peatland conservation projects through smart peatland projects by utilizing IoT and WSN. The indicators to be achieved in learning are by the stages of project-based learning.

Learning activities to achieve CPS and EL outcomes are by creating smart peatland projects.

Learning activities are by the stages of project-based learning, namely the pre-preparation stage, preparation for the project stage, planning for the project, project implementation, and post-project stage (Hugerat, 2016). Learning activities at each project stage can be seen in Table 5.

Table 5. Learning Activities on SLP of the SIP-SPP

Project Stages	Learning Activities
Pre-preparation	IoT training and system coding
Preparation for the project	Problem formulation with group
Planning for the project	Planning for the project with a group
Project implementation	Collecting data and information
Post-project stage	Presentation and class discussion
Assessment and evaluation	Preparation report

The instrument used to assess CPS outcomes is the CPS rubric in the project working group. The CPS rubric is developed by analyzing collaborative and problem-solving dimensions and indicators. The CPS indicator has 12 and 4 dimensions of problem solvency and 3 dimensions of collaboration (Griffin & Care, 2015).

Assessment Phase

The experts in peatlands, physics lecturers, and practitioners in learning physics and environment validated the SLP of the SIP-SPP course. The SLP has met the average overall validity of 0.77 with valid criteria for nine aspects. However, product revisions are needed based on expert input. Experts suggest adding the practical concept of interdisciplinary heats and peatland to the module so lecturers can more easily integrate it into the learning process. Furthermore, content integration is not a valid criterion and needs revision before implementation. Validation SLP includes several learning aspects, which are detailed in Table 6.

SPSS 18 output in the ICC table for seven raters with an ICC average measure value of 0.852 in the good reliability category. This result means that the degree of relationship and agreement between the seven raters is good (Perinetti, 2018) for the SLP of the SIP-SPP course.

The assessment phase was conducted to determine the practicality, student and lecturer responses, and effectiveness—lecturers'. The SLP is categorized as practical with a percentage of 72.5%. This practical category illustrates that each component of the course design can be applied, and its characteristics in the learning process are observable. The practical category shows that all stages of the SLP are implemented. responses to SLP of the SIP-SPP course as in Table 7.

Table 6. Validation SLP of SIP-SPP Course

Evaluated Aspects	Aiken's Value	Criteria
Rational development of course design by environmental conditions and education program	0.86	valid
Adoption of SDGs dan EfSD in sub-learning outcomes of courses suitability with the university and study program curriculum	0.76	valid
Learning outcomes can be achieved	0.81	valid
Learning outcomes contain content, attitudes, and thinking skills	0.95	valid
Content is an integration of physics, peatlands, and religious materials	0.43	invalid (Revision)
Content according to the basic theory from heat, thermodynamics, peatlands, and religion	0.33	invalid (Revision)
The suitability of the outcome learning with the learning principle	0.95	valid
The suitability of the learning activities with the learning outcome	0.90	valid
The suitability of the assessment strategies with the outcome learning	0.90	valid
Aiken's V Table 0.76		
Average validity (%) 0.77		Valid

Table 7. Lecturers' Responses to SLP of SIP-SPP Course

Aspect (Lecturers' responses to)	Practicality (%)	Criteria
Learning outcome and sub-learning outcome	81.25	Very Practical
Learning activities	75	Practical
Instructional stages of project-based and interdisciplinary learning	62.5	Practical
Learning assessment strategies	68.75	Practical
Average	72.5	Practical

Students' responses to the SLP design presented in Table 9 show a very good category with a percentage of 83.08%. The very good category shows that the SLP of the SIP-SPP has to learn aspects, including activity, students' involvement and motivation, learning resources, learning stage, and heat linked to peatlands and climate change effects that improve student learning performance. Students also provide input on implementing the SLP of the SIP-SPP course, simplifying the systematics of reports or final learning projects.

Table 9. Students Responses Towards SLP of SIP-SPP Course

Aspects	Practicality (%)	Criteria
Learning activities	83	Very good
Engagement in learning activities	86	Very good
Learning motivation	88.5	Very good
Interesting learning resources	85.5	Very good
Interesting learning stages	76.5	Very good
Heat linked to peatlands, climate change	79	Very good
Average	83.08	Very good

CPS analysis of students before and after implementing the SLP of the SIP-SPP course design was conducted by testing the Ho and H1 hypotheses. There were twelve indicators observed by seven observers (five essential physics practicum assistants and two lecturers) who had been trained previously. Observations can only be made to 35 students. The appearance of the CPS indicator in students is assessed by setting the frequency of occurrence. Score 4 for performance indicators that appear very frequently (75-100%), score 3 for appear frequently (76-50%), score 2 for infrequent occurrences (45-25%), score 1 for performance that never appears (< 24.5%). The CPS performance observation score before implementing the SLP course was 36.37%. The average frequency of performance of the CPS indicator category is rare because it is below 45%. Observation of the performance of CPS indicators after the implementation of SBP-PSP course design, namely in introductory physics practicum activities, was 68.04% with category three or often.

Analysis of the hypothesis of the effectiveness of SLP the SIP-SPP course to improve CPS performance in the project group was carried out with the independence sample t-test SPSS 18. The SPSS 18 output shows the value of Levene's Test for Equality of Variances Sig. 0.713 > 0.05; hence, the CPS performance data is homogeneous. The value of equal variances assumed Sig. (2-tailed) 0.000 < 0.05, then Ho is rejected, and H1 is accepted. This means that the hypothesis is accepted or there is a significant difference in CPS performance in the project group before and after learning with the SLP of the SIP-SPP course. SPSS 18 output for group statistics and independent sample test as shown Table 10 and 11.

Table 10. SPSS 18 output for group

	N	Mean	Std. Deviation	Std. Error Mean
Pretest	35	17.4571	3.45852	0.58460
Posttest	35	32.6571	2.98962	0.50534

Table 11. SPSS 18 output for independent sample test

Levene's test for equality of variances		t-test for equality of means
F	Sig.	Sig. (2-tailed)
0.137	0.713	0.000
		0.000

Conclusion

The development and validation process produces the SLP of SIP-SPP course products with particular characteristics. The characteristics of the SLP of the SIP-SPP course are as follows: The learning objective of adopting the thirteenth SDG is climate change mitigation. The learning objectives of adopting EfSD competencies are CPS. Assessment of climate change mitigation learning objectives with environmental literacy questionnaires and CPS with CPS performance observation rubrics in groups. Learning activities to achieve environmental literacy and CPS goals with learning based on peatland-smart projects Material content to achieve learning objectives, namely heat and thermodynamics, peatlands, climate change, and interdisciplinary religion. SLP is valid and reliable according to experts and practitioners. SLP is practical and easy to use. SLP can improve the CPS of prospective physics teacher students. SLP of SIP-SPP needs to be developed and validated to make it easier for lecturers and science lecturers, especially physics, to adopt SDGs and EfSD in learning. Environmental literacy of prospective teacher students will be a mitigation of climate change. This research will be very good if data analysis of the relationship between environmental literacy and CPS is added. The relationship between EL and CPS will show closely interrelated indicators and should be developed. The characteristics of SLP of SIP-SPP become easy to use

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Conceptualisation, methodology, validation, S.S; formal analysis, J.A; review and editing; W.W. All authors have read and agreed to the published version of the manuscript.

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The authors declare no conflict of interest.

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