

Supplementary Material

No	Domain	Science Teacher Competencies to Teach ESD Indicator	Item Test Code	Statement	Loading Factor
1	Pedagogical Content Knowledge	Understand the ESD content in the science curriculum.	CK1	I can understand the principles of sustainable development related to science.	0.75
			CK2	I can relate the concept of sustainable development to the science curriculum.	0.79
		Understand science concepts and the application of sustainability.	CK3	I can explain the application of sustainable development issues in the science field.	0.77
			CK4	I can explain the relevance of science concepts to the application of sustainable development principles.	0.82
		Apply science concepts to solve problems related to sustainability issues.	CK5	I can use science concepts to find alternative solutions to sustainable development issues	0.75
		Develop ESD-enriched science content by considering the science curriculum.	CK7	I can design science teaching materials and their application to sustainable development issues	0.80
			CK8	I can develop sustainable issue-based science teaching materials under the science curriculum	0.76
		Explain science knowledge systematically and its implication on ESD by considering the level of students' abilities and competencies	CK9	I can explain science teaching materials and their application in sustainable development systematically	0.79
		Demonstrate a critical understanding of ESD	CK11	I can demonstrate a critical understanding of sustainable development in the science curriculum	0.80

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		developments in the science curriculum.			
		Demonstrate science knowledge to creatively and innovatively presents ESD content.	CK12	I can create science content related to sustainable development issues creatively and innovatively.	0.78
		Set learning objectives for science learning towards sustainability.	CP1	I can make learning objectives for science learning toward sustainability	0.82
			CP2	I can determine sustainable learning objectives according to the science curriculum.	0.83
		Plan appropriate science teaching strategies and application on sustainability.	CP3	I can design appropriate learning strategies in science learning and their application in sustainable development.	0.84
		Plan ESD-enriched science lessons by considering the level of students' abilities and competencies.	CP4	I can design science learning that integrates sustainable development according to the abilities and competencies of students.	0.87
		Plan well-structured activities for exploring science concepts and their application to sustainability.	CP5	I can design student-centered learning activities in science learning toward sustainability	0.82
		Align the learning objectives and assessment type to evaluate ESD-enriched science lesson.	CP7	I can adapt the learning objectives to the type of assessment used in science learning related to sustainable development	0.84
		Integrate specific technologies in ESD-enriched	CP8	I can use various technologies in science learning related to sustainable development.	0.82

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		science learning to support students' conceptual understanding	CP9	I can use the right technology to help students understand science material and its application in sustainable development.	0.81
		Understand the student's background and characteristics to teach meaningful science lessons in the context of ESD.	CP10	I can understand the background and characteristics of students to create meaningful science learning in the context of sustainable development.	0.82
			CP11	I can organize meaningful science learning using the context of sustainable development.	0.84
		Modify science lessons for sustainability when faced with unexpected conditions.	CP12	I can adjust the lesson plan with the implementation of science learning activities for sustainable development.	0.84
			CP13	I can modify science learning for sustainable development according to classroom conditions.	0.84
2	Inquiry	Provoke students' curiosity related to sustainability issues and engage students to solve them by doing scientific investigations.	I1	I can raise sustainability issues that students can solve.	0.79
			I2	I can engage students in ongoing problem-solving through scientific inquiry.	0.85
		I3	I can stimulate students to make hypotheses about sustainability issues in science learning.	0.83	
		Guide students to plan and conduct scientific investigations to solve ESD problems.	I4	I can facilitate students in planning scientific investigations to solve problems of ongoing issues.	0.87
			I5	I can facilitate students to carry out scientific investigations in solving sustainable issues.	0.87

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		Promote engineering practices to support scientific investigations in solving ESD problems.	I6	I can direct students to conduct scientific investigations to solve ongoing issues.	0.87
			I7	I can help students use engineering practice in solving sustainable issues	0.80
		Develop students' scientific thinking competence and students' scientific problem-solving competence for lifelong learning.	I8	I can develop students' scientific thinking skills in learning science in the context of sustainable development.	0.88
			I9	I can develop students' problem-solving skills in learning science in the context of sustainable development.	0.88
		Lead students in making evidence-based scientific explanations.	I10	I can lead students to describe scientific explanations using data from science experiments related to the context of sustainability.	0.85
			I11	I can show appropriate scientific evidence for science experiments in the context of sustainable development.	0.85
		Manage class discussions to draw conclusions from the investigation.	I12	I can facilitate students to discuss the results of their scientific investigations related to sustainability issues in science learning.	0.85
			I13	I can facilitate students to conclude the results of their scientific investigations related to sustainability issues in science learning.	0.86
		Guide students in making reports of their scientific investigations	I14	I can facilitate students to make reports on the results of their scientific investigations related to sustainability issues in science learning.	0.86
		3	Professional Practice	Encourage students to take responsibility for maintaining ways to solve ESD problems in science learning.	PP14

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		Practice a sustainable way of life by managing behavior effectively in science lessons	PP15	I can show examples of sustainable behavior in science learning.	0.85
			PP16	I can practice how to manage sustainable behavior in science learning.	0.87
		Pay attention to all learners in learning science by embedding ESD	PP17	I can respond quickly to students in science learning in the context of sustainable development.	0.87
			PP18	I can pay attention to all students in learning science in the context of sustainable development	0.84
		Challenge students to optimize the strategy for maintaining sustainability in science learning	PP19	I can challenge students to solve sustainable issues in science learning.	0.86
			PP20	I can optimize students' abilities in making strategies for solving sustainability issues in science learning.	0.86
		Facilitate students to demonstrate safe techniques, ethics, and safety.	PP21	I can help students perform environmentally safe work techniques	0.80
			PP22	I can facilitate students to carry out preventive and conservation efforts to avoid damage to the ecosystem.	0.77
			PP23	I can demonstrate safe work in an effort to utilize existing natural resources.	0.81
		Cultivate students' critical awareness about the social changes	PP24	I can cultivate students' critical awareness to adapt to socio-cultural changes.	0.80
			PP25	I can raise students' critical awareness to face new trends related to sustainability issues in the community.	0.84
4			EA1	I can determine the appropriate assessment with the sustainable learning objectives in science learning.	0.86

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	Assessment and Evaluation	Develop assessments appropriate for science lessons that integrate ESD	EA2	I can develop appropriate assessments in science learning in the context of sustainable development.	0.83
		Monitor students' understanding of ESD-enriched science lessons by using different types of assessments.	EA3	I can monitor students' understanding of sustainability issues in science learning.	0.85
			EA4	I can use various types of assessments to check students' understanding when learning science in the context of sustainable development takes place.	0.88
		Implement various types of assessment based on learning objectives in ESD-enriched science lessons.	EA5	I can use various types of assessment according to the sustainable learning objectives in science learning.	0.85
		Use formative and summative assessments to evaluate student's progress in science learning and its implications on sustainability.	EA6	I can use formative assessments to evaluate students' understanding of sustainability issues on certain science topics.	0.89
			EA7	I can use summative assessments to evaluate students' progress in understanding the context of sustainable development in science learning.	0.89
		Assess students' prior knowledge of students according to ESD issues in science lessons.	EA8	I can evaluate students' prior knowledge about sustainability issues in science learning.	0.89
		Engage in continuous critical reflection to improve ESD-enriched science teaching and learning.	EA9	I can reflect on an ongoing basis to improve science learning.	0.83

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		Analyze and evaluate the practice of integrating ESD in science learning.	EA10	I can analyze the implementation of science learning in the context of sustainable development.	0.85
		Provide feedback to help students understand ESD-enriched science learning.	EA11	I can provide input on students' understanding of sustainability issues in science learning.	0.83
		Analyse and evaluate the results of the ESD-enriched science learning assessment to plan a follow-up to the next lesson.	EA12	I can evaluate the results of science learning in the context of sustainable development as a follow-up plan for the next lesson.	0.90
5	Professional Development	Participate in professional development to deepen and expand science content knowledge and ESD practices.	PD1	I can improve my professional competence in teaching science in the context of sustainable development.	0.80
			PD2	I can actively participate in science teacher professional development training in teaching sustainable issues.	0.81
		Become an agent of change by promoting ESD-based science learning	PD3	I can be a master teacher to introduce issues related to sustainable development in science learning.	0.78
			PD4	I can be a role model promoting science learning in the context of sustainable development.	0.79
		Collaborate with peers and stakeholders to improve the quality of ESD-based science learning.	PD6	I can collaborate with schools or other institutions in the success of sustainable development-based science learning	0.87
		Collect student feedback on ESD-enriched science	PD7	I can accept student input to improve science learning that addresses sustainability issues.	0.89

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		teaching and learning to improve and follow up on future lessons.	PD8	I can use student input as a follow-up plan for learning the next sustainable issue.	0.90
		Develop action plans for continuous improvement in the integration of ESD in science learning	PD9	I can make a follow-up plan for the next science lesson related to sustainability issues.	0.89
		Communicate effectively with stakeholders to support ESD-based science teaching and learning.	PD10	I can communicate the results of ESD-based science learning to the stakeholders.	0.88
6	Attitude	Respond to social, economic, and environmental changes by being involved in communities and society	A1	I can be actively involved with the community in organizing science lessons that discuss sustainability issues	0.81
			A2	I am aware of social, economic, and environmental changes related to sustainability issues	0.88
		Have tolerance for students	A3	I can tolerate students with different abilities and backgrounds.	0.88
		Demonstrate a consistent and positive attitude and lifestyle	A5	I can show a positive attitude in learning science that discusses sustainability issues	0.91
			A6	I can demonstrate a consistently positive lifestyle	0.89
		Cooperate with students and communities across different cultures.	A7	I can show good cooperation with students in science learning that addresses sustainability issues.	0.91
			A8	I can establish good cooperation with local people from different cultural backgrounds.	0.87
		A9	I have high hopes for personal and family well-being.	0.84	

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		Have work discipline in achieving personal and family well-being	A10	I can build good work discipline.	0.83