

Profile of potential prospective biology teachers designing SDGs-Based Teaching Modules on learning planning courses to realize quality education

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Abstract. Integrating the material of the Sustainable Development Goals (SDGs) includes the values of sustainability needed for quality education. In the Learning Planning course, prospective biology teachers learn to compile biology learning modules. Currently, there is limited information about the profile of potential biology teachers in developing learning modules. The study aims to describe the profile of potential biology teachers in developing learning modules that support the SDGs and provide sustainability values. The research uses descriptive methods and instruments to assess the suitability of learning modules for integrating sustainable values, implementing biological learning contextually, innovative learning, developing 21st-century skills, using appropriate technology, evaluating and reflecting on activities, and collaborating with relevant communities and stakeholders. The study focuses on 12 learning modules developed by 25 students in a learning planning course. Data analysis used qualitative descriptive analysis. The results show that prospective biology teachers can develop modules that provide sustainable values, but collaboration with the appropriate community and stakeholders is needed for improvement. The conclusion shows the profile of prospective biology teachers who have been able to develop learning modules so that they can support the realization of quality education by the SDG 4 target.

1 Introduction

The Sustainable Development Goals (SDGs) are a set of goals set by the United Nations (UN) for a better and more sustainable life for all inhabitants of the planet. There are 17 goals and 169 SDGs that are interrelated and mutually supportive to address global challenges. Education in the SDG is part of Objective 4 of Quality Education, aimed at ensuring inclusive, quality, equal education and supporting opportunities for all to learn throughout life [1-3]. Higher education institutions play a critical role in sustainability. They play an important role in the education of future leaders, which will contribute to the successful

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execution of the United Nations SDGs [4]. Universities may help educate students about the SDGs by including the SDGs and Education for Sustainable Development (ESD) concepts in all undergraduate and graduate courses, including graduate research training [5, 6].

Learning planning as part of quality education is an organized and methodical process involving analysis of learning needs, identification of goals, selection of methods and media, and evaluation of learning success [7, 8]. Biology, as one of the subjects studied by the students, needs to be well-planned. Mastering the concepts of the essence of learning planning and understanding the state-of-the-art issues related to learning planning in the context of the SDGs is essential for achieving quality biology education [9].

Several studies have been conducted to determine the ability of teachers to develop learning plans. The research included teachers' profiles in education for sustainable development: interests, instructional beliefs, and instructional practices [10]; knowledge in Sustainable Development Goals of teacher education students in Isabela State University [11]; analysis of understanding of future IPA teachers in setting up teaching modules (Pancasila Student Profile Strengthening Project) on the Merdeka Curriculum [12]; The Future Biology Teachers Training for the Implementation of Sustainable Development Ideas in Ecological Education [13]; the readiness of potential science teachers to construct learning plans based on education for sustainable development [14]; and the analysis of the capability of biology teacher students in developing a learning implementation plan [15].

According to research on the construction of teaching modules, the research profile of prospective biology teachers in the curriculum of learning planning was still restricted; thus, further study is needed in this area. The goal of this research is to characterise the profile of future biology teachers in order to create learning modules that provide long-term value for learning planning courses. This study is important in supporting the achievement of quality education by SDG target 4.

2 Methods

This research method is a descriptive method that describes the ability of prospective biology teachers to develop biology learning modules by providing sustainability values in Learning Planning courses. The research was conducted in June 2024 with respondents of 25 students who are conducting a learning planning course at a state college in Surabaya.

Students' assignments are carried out according to the following provisions: 1) Assignments are carried out in groups (1 group consists of 2-3 students); 2) The teaching module can be developed with the ATM System (Amati-Tiru-Modifikasi/Observe-Imitate-Modify). Students do not need to develop the module from the beginning, but they can use the existing modules that are not based on the SDGs as the starting material. 3) Each group can search for the Merdeka Curriculum module for the biology lessons at the high school. Choose one of the biological materials that correspond to the agreement of the group and is integrated with the goals of the SGDs. Students can choose one or more of the goals that are of interest to them. Each group should choose a different biological material. 4) Students observe the modules and imitate the parts that they think are already suitable; 5) The most important stage is for students to discuss with group members the modification of the teaching materials that have been observed and imitated to become SDG-based teaching modules.

There were 12 learning modules generated for analysis. The research instrument was an assessment sheet of the suitability of the biology learning module developed by prospective teachers with the criteria of the SDGs-based teaching module to provide sustainability values. The assessment includes the suitability of learning modules in integrating sustainable values; implementing biological learning that integrates SDGs contextually; carrying out innovative learning; developing 21st-century skills (critical thinking, collaboration, communication,

creativity – 4C); using learning media supported by appropriate technology; including evaluation and reflection of activities, collaborating with relevant communities and stakeholders. The ability profile of prospective biology teacher students to produce SDG-based teaching modules that provide sustainability values is obtained from the results of quantitative descriptive analysis based on the suitability between the module components produced and the module components in the assessment instrument.

3 Result and Discussion

This study assesses the ability of prospective biology teachers based on 12 teaching modules that have been produced by 25 students who formed 12 groups, with each group consisting of 2-3 students who attended the lesson planning lecture. Some examples of teaching modules produced by students are shown in Figure 1. The prospective biology teachers also create worksheets for the instructional module's instrument (Figure 2). In general, the worksheets created serve as a guide for pupils to carry out activities based on biology instructional materials and are related to the SDGs and their values. The results of the suitability of the developed teaching module with the criteria for SDG-based teaching modules that provide sustainability values are shown in Table 1.



Fig 1. Some examples of teaching modules



Fig 2. Some examples of student's worksheet

Table 1. Suitability of biology learning modules developed by prospective biology teachers with SDGs-based learning module criteria to provide sustainability values

No	Statement	Compatibility (%)	
		Suitable	Not Suitable
1	Integrate the values of sustainability (system thinking, anticipation, normative, strategy, collaboration, critical thinking, self-awareness, and integrated problem solving) in the implementation of biology learning.	100	-
2	Implement biology learning that integrates the SDGs contextually and is relevant to the everyday lives of learners.	91.7	8.3
3	Implement biology learning with PjBL, PBL, or other innovative learning models.	100	-
4	Develop the skills of the 21st century (critical thinking, collaboration, communication, and creativity) within the pupils while conducting biological explorations.	100	-

No	Statement	Compatibility (%)	
		Suitable	Not Suitable
5	Using technologies and learning media that match the selected biology material.	100	-
6	Conducting evaluation and reflection based on sustainability values in biology learning.	91.7	8.3
7	Collaborating with communities and stakeholders in implementing biological learning related to achieving the goals of the SDGs.	8.3	91.7

Table 1 shows that all of the teaching modules designed have included sustainability concepts, including cooperation and critical thinking, in the implementation of biology instruction. This is consistent with the use of Pancasila's student profile for Gotong Royong and criticism. The implementation of such sustainability ideals is consistent with the Pancasila student profile. Unfortunately, this material is not included in the teaching module that has been prepared. The researchers proposed that these elements be added so that students understand that when they are exposed to gotong royong values and critical values, they develop into people who fit the profile of Pancasila students who support sustainability ideals. The results of this study indicate that the provision of Pancasila student profile values is in line with the provision of SDGS-based sustainability values. Some research results that support this include based observations of Pancasila student profiles of students engaged in ESD-oriented natural and social science project learning in the critical reasoning dimension, it is clear that some students in all elements of critical reasoning can advance to the developing category as predicted by the phase. These findings indicate that the ESD approach for studying natural and social science projects may effectively meet the Pancasila student profile's critical thinking requirements [16]. Increased teacher competency in carrying out projects to strengthen Pancasila student profiles—which included comprehending, designing, documenting, reporting, evaluating, and following up on projects—was made possible by the implementation of these projects as a service activity within the independent learning curriculum [17].

Implemented biology learning that integrates the SDGs contextually and is relevant to the everyday lives of the pupils has been carried out by most candidate students (98.7%). Only one group does not associate the material discussed with the SDGs. The researchers suggested that the material could be associated with a number of specific SDG targets, according to the discussion of the material. Complete data for selected material information along with integrated SDG targets are listed in Table 2.

Table 2. The biology lesson material developed with the integrated SDG targets

Group	Lesson Material	Discussion	SDGs
1	Ecosystems	Ecosystem components and inter-component interactions	SDGs target 15 (Life on land)
2	Biotechnology	Conventional and modern biotechnology	SDGs target 2 (Zero hunger)
3	Blood circulation system	Blood circulation system: constituent components, functions, mechanisms	SDGs target 3 (Good health and well-being)
4	Digestion	Abnormalities and disorders in the digestive system.	SDGs target 3 (Good health and well-being)
5	Human excretion	Excrete system: constituent components, functions, mechanisms	SDGs target 3 (Good health and well-being)
6	Biotechnology	Conventional and modern biotechnology	SDGs target 15

Group	Lesson Material	Discussion	SDGs
			(Life on land)
7	Respiratory system	Respiratory system: constituent components, functions, mechanisms	SDGs target 3 (Good health and well-being)
8	Structure and development of plants	Bryophyta (moss)	SDGs target 15 (Life on land)
9	Immune system	The immune system: constituent components, functions, mechanisms	SDGs target 3 (Good health and well-being)
10	Viruses	Role of viruses in life	SDGs target 3 (Good health and well-being)
11	Environmental Change	Environmental pollution	SDGs target 15 (Life on land)
12	Environmental Change	Global warming	SDGs target 13 (Climate action)

Table 2. shows that a significant amount of biological content is relevant to SDG goal 3 (excellent health and well-being); other subjects are related to target 2 (zero hunger), target 13 (climate action), and target 15. (Life goes on.) When SDG 15 aims for life on land, it is related to ecosystem materials, plant growth patterns, and environmental degradation, which create intriguing biological materials. The achievement of SDG Target 3 on health and well-being in life is extremely relevant to the material on the circulatory system, digestion, human excretion, respiratory systems, immune systems, and the role of viruses in life because these topics are contextualized so that students are familiar with the cases presented. Biotechnologies can cope with a variety of different food sources; they might be considered a solution to hunger. Now that we are all aware of global warming, we must communicate about how to address it. Four of the 17 SDGs are still linked to the biology curriculum in this research, and there is still plenty of room to incorporate other SDG objectives. According to the explanation, biological material contains several fascinating topics that can be linked to SDG goals. This is advantageous in biology learning since, not all educational resources can simply be assigned to the various SGD aims [18]. There are explanations for each biology topic such as ecology, genetics, botany, zoology, and physiology, has interesting studies when linked to the SDGs and their sustainability values [19].

A worksheet created by the students (Figure 2) was created to support educational activities. The creation of this lesson plan is fascinating since the students made changes to the pre-existing lesson plan. Prior to its modification by the students, the teaching module that served as a reference was not based on the Sustainable Development Goals (SDGs). Instead, it provided sustainability ideals. Table 3 displays the learning activities that students created based on the SDGs.

Table 3. SDGs-based learning activities on worksheets developed by prospective biology teachers

SDGs target	Students Worksheet Activities
SDGs target 15 (Life on land)	Discusses to determine the environmental components involved in larvicide attempts (controlling mosquito larvae), which include several biotic aspects (water, environmental conditions such as temperature, pH, and oxygen content) and abiotic aspects (aquatic vegetation consisting of various types of plants, natural larval predators such as fish, water beetles, tadpoles, microorganisms, and humans) that interact with one another.
	Discussing to determine plant tissue culture in biotechnology can prevent the extinction of plant species.
	Discussing to determine the role of bryophytes in maintaining the balance of the ecosystem on land.
	Discussing changes in land ecosystems and environmental pollution issue that develop in the students' surroundings in order to identify solutions for environmental sustainability.

SDGs target	Students Worksheet Activities
	Discussing and identifying solutions for plant tissue culture in biotechnology can prevent the extinction of plant species.
SDGs target 3 (Good health and well-being)	Discussing and identifying solutions about health issues, including the circulatory system, digestive system, excretory system, respiratory system, immunological system, and the existence of viruses in life, are inextricably linked to efforts to live a healthy lifestyle. It is feasible to live a healthy life if we can keep our different bodily systems in good working order and prevent potential complications.
SDGs target 13 (Climate action)	Observing and make solutions in environmental conditions contaminated by CO ₂ caused by the presence of industry and efforts to address this.
SDGs target 2 (Zero hunger)	Discussing to determine utilizing biotechnology for food security, such as genetic engineering, to generate pest-resistant rice with high yields in a single harvest.

The prospective biology teachers have listed the implementation of biology learning with innovative learning models, including Project Based Learning (PjBL) (25%), Problem-Based Learning (PBL) (50%), Contextual Teaching Learning (CTL) and Case-Based Learning (CBL) and role-playing. The learning models were chosen because they raised contextual topics, enabled students to solve problems and create projects. This is in line with the learning characteristics that integrate the SDGs. 21st-century education optimizes the process of globalization and internationalization as well as character development in pupils both inside and outside the school environment. At present, some of the learning models that have been applied in 21st-century learning are differential learning based on PjBL, PBL, and so on. This learning process can motivate and increase the motivation of the student to further develop a productive personality [20]. PBL and PjBL are widely used because they have several advantages, as stated in several related studies. Students' scientific literacy abilities in the medium category are enhanced when the PBL-integrated ESD learning tool is used [21]. The PBL-SDG scenarios creatively, cooperatively, and transversally addressed a number of SDGs and sustainability competencies [22]. Project-based learning (PjBL) is one of the learning strategies that can develop students' scientific skills in the 21st century. The most widely measured skills as learning outcomes are critical and creative thinking [23]. In addition, the PjBL model has an impact and works well at all educational levels and in the field of biology education to enhance learning outcomes, critical and creative thinking, and, in bigger groups, 21st-century knowledge and skills, or cognitive learners [24].

The development of 21st-century skills (critical thinking, collaboration, communication, creativity – 4C) in the pupils while performing the biology exploration has been brought about by all the students of the future teachers who develop learning modules. 4C has almost become a must in the implementation of learning in schools to provide the learners as younger generations with the values important in worship in society. All the components of 4C have been explained in each step of learning clearly. 4C's expertise as a solution to global difficulties through critical thinking includes providing new ideas as creative individuals, solving real-world problems, and working together and collaboratively in groups [25]. The learning approaches used, incorporating the 4C aspects, considerably enhance students' motivation [26]. It also encourages the students to participate in the community on the Society 5.0 agenda by applying the 4C skills they have [27].

The modules developed have been equipped with learning media and technologies that match the chosen biology material. All candidate teachers develop learning media in the form of Students Activity Sheets equipped with technology such as link YouTube or link web articles related to learning materials, barcodes that can be scanned to obtain materials, PPT, and other supporting learning videos. With the presence of Information and Communication Technology (ICT) media variation accompanied by the use of technology will increase the enthusiasm of students to learn. The successful integration of ICT resources into teaching and learning depends on the ability of lecturers to structure their learning environment to merge technology traditionally [28]. Lecturers play a crucial role in incorporating ICT into

their teaching methods. The use of instructional technology in the classroom has led to a shift away from lecturer-centred teaching. This approach emphasizes student-centred learning and an engaging classroom environment [29].

Almost all modules developed (91.7%) have included sustainability-based evaluation and reflection in biology learning, which is gotong royong and critical. With these evaluations and reflections, it is expected that teachers and learners who use this module can improve the good things that have been done and improve the things that are still not going well. This is the core of sustainability; good things are done continuously to quality education [30].

Only one group (8.3%) has collaborated with stakeholders in learning material components of the ecosystem. They invited posyandu officers to share information about natural larvicide production, and pupils could discuss with the source before they engaged in larvicide production activities. Information related to larvicide in the findings reveals research into mosquito populations has gradually increased, peaking in 2020 and then declining. More mosquito population studies can help to understand disease transmission and the effects of climate change [31]. This suggests that prospective teachers need to design a learning that involves communities and stakeholders that match the integrated biological material of the SDGs so that more visible sustainable value is contextualized in learning. Learning like this will be meaningful learning for students who will shape their competence in knowledge, values and skills [32].

From the discussion of the results of the teaching modules developed by the prospective biology teachers can be made a profile that they have been able to learn modules that integrate sustainable values; implement biology learning that integrates the SDGs contextually; implement innovative learning; develop 21st-century skills (4C); use learning media supported by appropriate technology; and include evaluation and reflection activities. What needs to be enhanced is collaboration with the community and related stakeholders. In order to improve the profile of the quality of education in Learning Planning courses, one of the solutions offered is the need for a learning module on learning planning based on the Sustainable Development Goals (SDGs) by providing sustainability values. We hope it can be used as a guide by future teachers in developing appropriate teaching modules. The professional practice dimension was found to be the ability to design effective evaluation tools and interpret learning outcomes [33]. Teachers' instructional views and interests in Education for Sustainable Development (ESD) are associated with holistic, pluralistic, and action-oriented instructional approaches in ESD teaching [34].

According to research on the preparedness to incorporating sustainable development into the biology teacher education program, readiness is highest in behaviours, followed by comprehension and attitude. The recommended readiness analysis is required for curriculum design that incorporates sustainable development [35]. The university systems have roles and responsibilities to address intensively sustainable development issues, promote the development of sustainability competencies, and develop specialized learning outcomes [36]. Higher education institutions contribute significantly to accomplishing those goals through teaching, research, and community engagement [37, 38]. Indonesia's policy aims to improve educational accessibility and quality, improve educator quality and support mechanisms, improve educational services, and promote and develop character education [39]. Higher education institutions play an important role in sustainability. They play a crucial role in the education of future leaders, which will aid in the successful implementation of the United Nations Sustainable Development Goals [40]. Therefore, prospective biology teachers who fulfil the requirements of SDG-based teaching modules and demonstrate their ability to create teaching materials that uphold sustainability values can become invaluable human resource capital for the realization of high-quality education with the assistance of higher education institutions. They should be centred and numbered with the number on the right-hand side.

4 Conclusion

The profile of potential prospective biology teachers in developing learning modules that integrate sustainability values into Learning planning courses is that they have acquired learning modules that integrate sustainable values; implemented biology learning that contextually integrates SDGs; implemented innovative learning; developed 21st-century skills (4C); used learning media supported by appropriate technology; and included evaluation and reflection activities. Collaboration with the community and other stakeholders must be strengthened. This profile contributes to the attainment of quality education by SDG goal 4.

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