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Autonomy-Based Creative Learning: Equip Creativity and Concern for Prospective Physics Teachers in Wetland Environments

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Autonomy-Based Creative Learning: Equip Creativity and Concern for Prospective Physics Teachers in Wetland Environments

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Abstract. Creativity and environmental care in wetlands have received wide attention from the government and researchers in various countries, especially in the industrial era of 4.0. However, both competencies are less familiar in physics learning. Therefore, this study aims to analyze the effectiveness of Autonomy-Based Creative Learning (ABCL) in improving prospective physics teachers' creativity and caring attitude in wetland environments. This research includes development research using the ADDIE model. The implementation test was conducted on 59 physics education students in South Kalimantan (Indonesia), which were divided into three groups. Before and after learning, prospective physics teachers take a creativity test in designing ABCL, then fill out environmental care questionnaires to determine their attitude on preserving the environment's energy-saving behaviour, managing waste, loving the environment program, and health protocols. The results show increased students' creativity and caring attitude in the wetland environment. N-gain creativity in the medium criteria, while n-gain care for the environment in the standard serial. This creativity is because students initially have a good understanding of environmental care. Thus, this learning is effectively used to equip the creativity and concern of prospective physics teachers in the wetland environment.

1. Introduction

Currently, the issue of the wetland environment has received significant attention from governments and researchers in various parts of the world [1-4]. This study has covered 93 countries, of which China, the United States, the United Kingdom, Germany, and Australia are the five highest countries in research volume [5]. Wetlands are one of the largest areas on the earth's surface that harbour an extraordinary wealth of flora and fauna [6,7]. However, advances in science and technology have changed human thinking and behaviour towards the wetland environment [8,9]. On the one hand, humans are increasingly creative and innovative in overcoming the challenges and opportunities of life and careers in wetlands; on the other hand, the development of industry, settlements, agriculture, plantations, mining, and forest exploitation has caused damage to the wetland [3]. In addition, negative human behaviour has become the main trigger for the destruction of the wetland [10,11]. The exploitation of environmental resources is getting out of control, the modern arms race between countries, testing of weapons of mass destruction, and even the occurrence of modern wars between countries, such as Russia-Ukraine, Israel-Palestine, and others. As a result, various creative human products have caused tremendous environmental damage. Environmental destruction will essentially damage the order of human life itself [10,12].

Wetland environmental management cannot be separated from the role of physical science [9]. Physics as a science is based on experimentation, observation, and mathematical analysis to explain various natural phenomena. Studying physics increases an individual's insight into the development of science and technology and its application in today's most sophisticated equipment, such as the physics contribution to the development of mining industry equipment, transportation, communication tools, and others [3]. Applying physics to technology makes human work easier in managing the wetland environment [8]. If they lack a caring attitude towards the environment, it can lead to uncontrolled exploitation of natural resources and exacerbate damage to the wetland environment [10,11]. In line with the results of the researcher's initial study through interviews with prospective physics teachers and obtained information that learning physics can increase their insight and knowledge related to the development of physics and its application in the latest technology. However, they find it challenging to apply physics in their environment, namely the wetland environment. In addition, they do not take care of the environment, do not participate in environmental programs, and do not save energy, let alone manage waste not according to procedures. This activity leads to environmental pollution and the destruction of power. Therefore, developing creativity and environmental care is a fascinating current physics education phenomenon to be researched [4,13-15].

For creative individuals who care about the environment, every potential and problem in the wetland environment becomes a source of inspiration and imagination. Work hard and never gives up on finding the best solution to the problem [16]. The wetland environment can accommodate various development interests, such as tourism, agriculture, industry, housing, and the carrying capacity of the climate [3,17,18]. Thus, a creative culture and care for the wetland environment are critical factors in making learning more meaningful [19,20]. Prospective physics teachers connect their initial knowledge with the knowledge they are learning and apply it in their surrounding environment [21,22].

For creative lecturers, prospective physics teachers are a source of inspiration to work [23]. Each individual has a different provision of prior knowledge influenced by previous learning experiences and interactions with other people and their environment [24,25]. The learning process will become more meaningful when appropriate to the individual's level of ability or autonomy. Thus, lecturers applying creative learning methods or models must consider autonomy levels [4,13,14,26-28]; or Autonomy-Based Creative Learning (ABCL).

ABCL is a structured pedagogical approach that facilitates the development of creativity, caring, and independence of students by considering their autonomy level [29]. In this regard, learning physics plays a vital role in developing student autonomy through meaningful learning experiences [30,31]. In ABCL [29], creative learning is divided into three levels. **Autonomy I** is the lowest level in the classification. Lecturers use direct teaching and structured inquiry to teach basic information or procedures step by step. Educators can apply guided inquiry, guided discovery, and cooperative learning when basic information and procedures have been mastered in **Autonomy II**. In this case, students learn based on direct experience and internalise their standards of behaviour. **Autonomy III** is the realisation of the constructivist view. Educators can apply problem-based learning, project-based learning, and creative responsibility-based learning. Prospective physics teachers act as autonomous learners to produce innovative products that are useful for society and the environment.

The ABCL is believed to be able to equip students' 21st-century competencies to become creative, innovative, and independent individuals in supporting the industrial era 4.0. Meanwhile, the results of previous studies [29] recommend opportunities for ABCL to equip creativity and care for the wetland. Students are prepared as caliphs on earth [29,32-34], creative individuals responsible for protecting, maintaining, and managing the wetland for the good of humanity and the environment [29,35]. Therefore, this study aimed to analyse the effectiveness of ABCL in equipping prospective physics teachers with creativity and a caring attitude in the wetland environment.

2. Methods

This study uses the research design and development of the ADDIE model. The independent variable in this study is the ABCL book, while the dependent variable is creativity and care for the wetland environment. In previous studies [29], through the Analysis, Design, & Develop stage, researchers have produced a valid and reliable ACBL book in terms of format, material, language, and presentation. Implementation stage: Researchers tested the ACBL book's implementation on 59 prospective physics teachers in South Kalimantan, Indonesia. They are divided into three groups: group 1 is 19 students of class A, and group 2 is 20 students of class B who program introductory physical education courses. In contrast, group 3 is 20 students who program learning innovation courses.

The implementation test used a one-group pre-test and post-test (O1 X O2) design. Pre-test (O1) prospective physics teachers took a creativity test to discover their creativity in designing ABCL. They were also asked about caring about the wetland environment to explore their attitudes on preserving the environment, saving energy, managing waste, loving the environment program, and health protocols. ABCL book implementation (X); researchers guide prospective physics teachers to master the basics of physics education and learning innovation for four meetings, as presented in Table 1.

Table 1. Practicality of ABCL

Components of ABCL's book		Score of groups		
		1	**2**	**3**
Chapter 1 Introduction: Why Autonomy-Based Creative Learning?	Why do we learn science?	95.65	87.50	95.00
	Why do we learn scientific creativity?	95.65	87.50	95.00
	Why do we care about the environment?	95.65	87.50	95.00
	What is the role of science education?	86.96	68.75	80.00
	Why autonomy-based creative learning?	95.65	81.25	90.00
Chapter 2 Wetland Pearls: Creative and Environmentally Careful Generation	Science and wetlands	95.65	81.25	90.00
	Process skills	95.65	81.25	90.00
	Scientific creativity	95.65	87.50	75.00
	Environmental awareness	95.65	87.50	90.00
Chapter 3 Creative Learning Level 1: Practicing Creative Responsibility in Steps	Direct teaching concept	93.04	85.00	
	Example of direct teaching with an experimental method	89.13	78.13	
	Example of direct teaching with a problem-solving method	89.13	75.00	
	Example of direct teaching with an observational method	86.96	75.00	
Chapter 4 Creative Learning Level 2: Student Creative Responsibility Participation	Guided inquiry concept	91.30	81.25	
	Example of a guided inquiry lesson plan	86.96	50.00	
	Guided discovery concept	86.96	68.75	
	Guided discovery lesson plan example	69.57	68.75	
	Cooperative learning concept	90.43	85.00	
	Example of a cooperative learning plan	71.74	81.25	
Chapter 5 Creative Learning Level 3: Realization of Student's Creative Responsibility	The concept of problem-based learning	78.26	86.25	87.00
	Example of a problem-based learning plan	69.57	56.25	60.00
	The concept of creative responsibility-based learning			85.00
	Example of a creative responsibility-based learning plan			60.00
	The concept of project-based learning			79.00
	Example of a project-based learning plan			85.00

In groups 1 and 2, lecturers can guide prospective physics teachers to work and share the task of writing papers on the basics of physics education. The material focuses on the concepts of direct teaching, guided inquiry, structured inquiry, and problem-based learning, as well as examining examples of lesson plans, then presentation, discussion, evaluation, and reflection. Likewise, in group 3, the learning innovation course is a continuation of the basics of physics education, so the material is emphasized autonomy 3, namely problem-based learning, project-based learning, and creative responsibility-based learning. Post-test (O_2); prospective physics teachers rework creativity tests and environmental care questionnaires. Finally, during **the evaluation stage**, the weaknesses during the study became a consideration for researchers to revise the ABCL book to be of higher quality.

The data from the creativity and environmental care test results were analyzed by qualitative and quantitative descriptive. The mean scores obtained were adjusted according to the following criteria: 0 < not good ≤ 40; 40 < less ≤ 55; 55 < enough ≤ 65; 65 < good ≤ 80; and 80 < very good ≤ 100. Furthermore, the level of improvement will be analyzed through the N-Gain equation; then, the value is adjusted to the criteria of high, medium, or low.

3. Results and Discussion

Learning is said to be effective if it can achieve set goals [36]. In this study, the effectiveness of ABCL showed by the achievement of creativity and caring for the wetland environment.

3.1 Students' Creativity

Creativity in physics learning contributes to human life [20]. Through the development of creativity, prospective physics teachers can apply physics knowledge to produce innovative products to overcome problems in their lives [4,14,16,18]. In this study, innovative products are in the form of ABCL plans which can be seen in Table 2.

Table 2. Analysis of creativity

Group	Creative product		Pre-test		Post-test	
			Score	Criteria	Score	Criteria
1	Direct learning	Lesson plan	56	Enough	70	Enough
		Activities worksheet	55	Less	67	Good
	Guided inquiry	Lesson plan	51	Less	58	Enough
		Activities worksheet	40	Not good	54	Less
	Guided discovery	Lesson plan	54	Less	69	Good
		Activities worksheet	52	Less	70	Good
	Problem-based learning	Lesson plan	53	Less	71	Good
		Activities worksheet	53	Less	71	Good
2	Direct learning	Lesson plan	41	Less	70	Good
		Activities worksheet	33	Not good	65	Enough
	Guided inquiry	Lesson plan	36	Not good	64	Enough
		Activities worksheet	31	Not good	54	Less
	Guided discovery	Lesson plan	32	Not good	66	Good
		Activities worksheet	31	Not good	70	Good
	Problem-based learning	Lesson plan	31	Not good	69	Good
		Activities worksheet	32	Not good	68	Good
3	Problem-based learning	Lesson plan	61	Enough	76	Good
		Activities worksheet	61	Enough	75	Good
	Creative responsibility-based learning	Lesson plan	54	Less	76	Good
		Activities worksheet	52	Less	75	Good
	Project-based learning	Lesson plan	52	Less	76	Good
		Activities worksheet	53	Less	76	Good

Based on Table 2, students' creativity in all groups in making lesson plans and student activities was initially still low. Students should master the lesson plan components in the standard process [37]. In addition, they also do not understand the actions of teachers and students in learning syntax. After applying ABCL for four meetings, students could develop creative learning plans and student activities with good criteria. However, group 1 still had difficulties preparing lesson plans and student activities based on guided inquiry; group 2 had difficulty organising guided inquiry-based student activities. Meanwhile, group 3 is a good criterion because they already have previously acquired knowledge of the basics of physics education. This finding is reinforced by the results of the n-gain analysis, as presented in Table 3.

Table 3. N-gain creativity

Group	Pre-test		Post-test		N-gain	
	Score	Criteria	Score	Criteria	<g>	Criteria
1	51.94	Less	66.17	Good	0.30	Medium
2	33.20	Not good	65.79	Good	0.49	Medium
3	55.26	Enough	75.88	Good	0.46	Medium

Based on Table 3, the pre-test scores showed that the prospective physics teachers' creativity was still low at first. After applying ABCL, their creativity has increased to good criteria. Students still need more time to understand the content and pedagogical ABCL, let alone create creative lesson plans. Group 3 got the highest score because they had studied innovative learning models in the basics of physics education in the previous semester.

The results of the n-gain test show that prospective physics teachers' creativity can be increased by implementing ABCL. Creativity is not innate but can be learned and developed [4,28]. Through ABCL [29], they can study the content and pedagogical of ABCL; such as the reasons for studying science, creativity, caring for the environment, the role of education; science and wetland concepts, process skills, creativity, and environmental care; the idea of direct teaching along with examples of teaching plans using the methods of observation, experimentation, and problem-solving; the concept of guided inquiry, guided discovery, and cooperative learning along with examples of lesson plans; the idea of problem-based learning, creative responsibility based learning, and project-based learning along with their learning plans. In addition, prospective physics teachers can design ABCL in groups. They try to identify various potentials and problems in the wetland environment, then work hard and never give up on finding a solution to the problem [13,14,16]. This work becomes a source of inspiration and imagination for prospective physics teachers to design lesson plans and activities based on a wetland environment [38-40].

3.2 Care for the wetland environment

The quality of the wetland environment is mutually correlated with the thoughts and behaviours of the community [8,16]. Therefore, the development of creativity in physics learning needs to be complemented by its concern for the wetland environment [19,21,22]. The results of the analysis of prospective physics teachers' caring attitudes are presented in Table 4. The pretest data showed that the students' concern in preserving the environment and maintaining health was good initially, but saving energy, managing waste, and loving the environment programs were still low.

Table 4. Analysis of wetland environmental awareness

Group	Indicator	Pre-test		Post-test	
		Score	Criteria	Score	Criteria
1	Preserving the environment	76	Good	82	Very good
	Energy saving	66	Good	68	Good
	Managing trash	49	Less	51	Less
	Environmental love program	69	Good	74	Good
	Maintain health	86	Very good	88	Very good
2	Preserving the environment	67	Good	71	Good
	Energy saving	61	Enough	76	Good
	Managing trash	42	Less	52	Less
	Environmental love program	60	Enough	61	Enough
	Maintain health	77	Good	78	Good
3	Preserving the environment	72	Good	81	Very good
	Energy saving	60	Enough	82	Very good
	Managing trash	43	Less	62	Enough
	Environmental love program	64	Enough	77	Good
	Maintain health	85	Very good	90	Very good

After implementing ABCL (Table 4), students' concern for the wetland environment has improved, although managing waste (the three groups) and the environmental love program (Group 2) have not been good. However, all environmental care indicators have increased, as presented in Table 5.

Table 5. N-gain environmental care

Group	Pre-test		Post-test		N-gain	
	Score	Criteria	Score	Criteria	<g>	Criteria
1	69.20	Good	72.60	Good	0.13	Low
2	61.40	Enough	67.60	Good	0.15	Low
3	64.80	Enough	78.40	Good	0.38	Medium

Before ABCL was applied (Table 5), prospective physics teachers knew about caring for the wetland environment. In line with constructivism theory [24,25], they have prior knowledge from previous learning. Since wetlands are the hallmark of ULM, wetlands are often integrated into lecture materials and become the theme of scientific meetings [13,41,42]. In addition, the wetland environment has become a part of everyday life [7,11]. When interacting with other people and the surrounding environment, prospective physics teachers consciously or unconsciously have learned to care about the environment [43-45]. Unfortunately, they understand that environmental care is limited to knowledge but has not been actualized in their attitudes and behaviours [46].

After applying ABCL (Table 5), prospective physics teachers can improve their attitude toward caring for the environment in good criteria. They no longer only understand environmental care material; they also apply it in designing lesson plans and activities in daily life. They are introduced to various creative learning models and community learning experiences that support environmental conservation [38,39]. This culture is influenced by knowledge, value, behaviour, and understanding of the environment and its implementation in everyday life [40,47].

Based on Tables 3 and 5, the application of ABCL in physics learning is proven to increase students' creativity and caring attitude towards the wetland environment. ABCL can change students' mindsets as future professional physics teachers [29,31]. Prospective physics teachers learn physics not only to master the scientific field of physics and apply it to the latest technology products [30]. However, they also realize the importance of learning physics to maintain and manage wetland environmental resources for the good of humankind and ecological sustainability [32,34]. For example, prospective physics teachers learning electricity and magnetism inspire them to be able to design power plants that utilize resources in wetland environments. However, they must also consider the impact of these resources' utilization on environmental sustainability. The most important thing is that this learning experience of creativity and ecological care can be a source of inspiration to be taught and familiarized to students in the future.

The limitation of this research is that the allocation of learning time is only four meetings. The ABCL book is designed for learning for one semester. Although prospective physics teachers can understand the content and pedagogical ABCL and present it in front of the class, they are not optimal in the evaluation and reflection process. However, implementing ABCL is believed to be an alternative approach to equipping students with creativity and a caring attitude in the wetland environment.

4. Conclusion
Creativity and environmental care are not innate but can be learned and developed. In this case, implementing ABCL equips prospective physics teachers with creativity and concern for the wetland environment. They need to master physics content, ABCL content and pedagogy, be creative in designing lesson plans and apply them in everyday life. Further research is to test the implementation of ABCL on a broad scale and with a time allocation during the semester.

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