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*Original Research*

# Fit-Model Sustainable Competencies of Palangka Raya Indonesia Peat Lands in the Environmental Literacy (P-PSEL) Questionnaire for Teacher-Candidates

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**Abstract**

Policies or actions on climate must be based on real community conditions. The sustainable competence of student teacher candidates in areas with peat lands characteristics can be measured by the P-PSEL. The P-PSEL questionnaire with three variables, namely knowledge, competence, and behavior, as well as 19 valid and reliable indicators, is the structure of the fit model as a measuring tool for environmental literacy in peat lands areas. The knowledge variable positively affects the competency variable, and the competency variable positively affects the behavior. The formation of peat lands environmental behavior can be started with the formation of knowledge and competence for the sustainable development of prospective teacher-candidates.

**Keywords**: sustainable competencies, peat land, Palangka Raya Indonesia, P-PSEL, Teacher-Candidates

## Introduction

Central Kalimantan has the largest remaining peatlands in Southeast Asia but experienced a very rapid decline in the percentage of peatlands still covered by forest from 1990 to 2015 [1]. The peatlands loss within the area of regrowing forest was reaching 44.2 cm deep on average, loss of peat will also cause loss of carbon [2]. The use of peatlands has changed the nature of the land and caused it to become more and more damaged [3, 4], causing $CO_2$ and $CH_4$ emissions [5]. The community has long felt climate change in Central Kalimantan but they do not have knowledge and awareness of sustainability [6, 7]. The problem of environmental damage can be reduced if the population develops environmental literacy. The philosophy of green chemistry plays an important role to reduce and prevent pollution of the environment [8]. In school students have a more favorable perception of environmental sustainability [9].

The Palangka Raya peatlands sustainable environmental literacy (P-PSEL) questionnaire is

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measuring instrument the sustainable competencies (systems-thinking, anticipatory, normative, strategic, and interpersonal) [12-14] student teacher-candidates in the dimensions of environmental literacy (knowledge, competencies, and behavior [10, 11]) peatlands. The P-PSEL questionnaire is an environmental literacy measurement tool that will be developed with sustainable peatland competencies. The most widely used environmental literacy dimensions are the dimensions of cognitive (knowledge and skills), affective, and behavioral [10, 11]. The cognitive element refers to the ability to identify, investigate, analyze and evaluate environmental problems and issues based on the knowledge of ecological and socio-political foundations. The affective element considers an individual's empathetic and caring attitude towards the environment who recognizes the values of environmental quality and is willing to take on appropriate actions to help prevent and resolve environmental problems and issues. The behavior element focuses on the belief of an individual or a group of individuals about their ability to influence outcomes of environmental problems and issues [11]. Environmental literacy in this study will be measured in sustainable competencies.

Sustainable competencies in higher education are most commonly mentioned transformative, normative, socio-emotional [12], systems thinking, anticipatory, strategic, interpersonal [13], integrated resolution, collaboration, critical thinking, and self-knowledge [14]. Sustainable competencies in higher education that are widely used in implementation are systems thinking, anticipatory, strategic, and interpersonal. Systems-thinking competence is the ability to analyze complex systems in different domains (environment, society, economy, etc.) and scales (local to global) while considering systemic characteristics and problem-solving frameworks. Anticipatory is the ability to analyze, assess, and articulate the long-term future of various sustainability issues, including unintended consequences and intergenerational equity. Normative competence is the ability to transmit, apply, and negotiate sustainable values, goals, and targets. Strategic competence is the ability to "make things happen" by designing and implementing transformative interventions and strategies to improve sustainability. Interpersonal competence is the ability to motivate, and facilitate collaborative and participative research on sustainability and problem-solving [13].

Central Kalimantan with some of its peatland areas, has an important role in mitigating global climate change. Student teacher candidates must have environmental literacy so that peatlands are sustainable. Environmental literacy of prospective teacher students must be measured correctly so that it becomes a guide in the development of learning at the university. That the Indonesian version of the peatland environmental literacy measurement tool for the public and students does not yet exist. It is necessary to develop a literacy measurement tool Palangka Raya Peatlands Sustainable Environmental Literacy (P-PSEL) for prospective teacher candidates. In P-PSEL the environmental literacy of prospective teacher students will be measured by looking at sustainable development competencies.

## Material and Methods

Development and validation P-PSEL questionnaire using eight steps [15]. The steps of development were to determine the construct to be measured, generate an item pool, determine format from measurement, have initial items reviewed by experts, consider validation items, administer items to a developmental sample, evaluate items, and optimize scale and length [15]. Content validity was assessed from an expert review. Criterion-related and construct validity was measured using an online P-PSEL of teacher candidates in Palangka Raya Indonesia.

### Scale and Item Development

We determined that our construct to be measured was peatlands environmental literacy in the sustainable competencies. Dimensions of peatlands' environmental literacy are knowledge, competencies, and behavior. Peatlands' environmental literacy dimension will be measured on student teacher candidates by looking at emerging sustainable development competencies. The P-PSEL construct consisting of peatlands' environmental literacy and sustainable competencies is shown in Table 2.

The questionnaire consisted of two main sections, demographic items, and P-PSEL assessment items. Although there were 6 items in the demographic section and 48 items used to assess the three main elements of knowledge, competencies, and behavior. Fifteen

Table 1. General Descriptive Information of the Sample (N = 143).

| Demographic Variable | Frequency | Percent (%) |
|---|---|---|
| Study program | | |
| Physics Education | 61 | 42.6 |
| Biology Education | 37 | 25.9 |
| Islamic Education | 27 | 18.9 |
| Madrasah Ibtidaiyah/ primary education | 18 | 12.6 |
| Semester | | |
| 4 | 87 | 60.8 |
| 6 | 26 | 18.2 |
| 8 | 17 | 11.8 |
| 10 | 13 | 9.1 |

question items were developed for the knowledge element were True-False questions. Next, 23 items were included in the competencies element which sought to assess peatland sustainable competence and was designed in the form of true and false. Lastly, the behavioral element was designed to investigate peatland sustainable competence in dimensions of strategic and interpersonal. It consisted of 9 question items using a four-point scale, a Likert-type scale ranging from 1 (strongly disagree) to 4 (strongly agree).

## Expert Review and Inclusion of Validation Items

P-PSEL questionnaire, the construct, and items in Table 2 were reviewed by seven experts in environmental and science education at Palangka Raya university. Three experts in environmental education either work with programs for peatlands conservation in National Sebangau Park Palangka Raya Indonesia. Experts in science education are a practitioner and researchers of environmental-based science education, especially peatlands conservation in Palangka Raya.

Experts commented on the relevance of items to each construct, clarity of wording and response options, acceptability for use in the field, and improvements to capture the meaning of the scale. Reviewed seven experts led the validation process and calculated content validity by Aiken´s V coefficient [16-18]. Average the results of the item's validity coefficient with dimension knowledge, competence, and behavior of 0.83 with probability 0,045 so that all the dimensions and items developed in this study as valid (Table 3).

Table 2. The Construct of the P-PSEL Questionnaire with Peatlands Environmental Literacy (P-EL) and Sustainable Competencies (SC), Items, and Loading Factor from SmartPLS 3.

| Knowledge (P-EL) [10, 11] | | |
|---|---|---|
| Indicators | Items Statement | Loading Factor |
| Knowing environmental issues. [10, 11] | Peatland degradation is linked to greenhouse gas emissions and global climate change (P4) | 0.787 |
| Knowing the solution to environmental issues. [10, 11] | The peatland conservation model must be oriented toward sustainable development (P9) | 0.641 |
| Understanding community participation and its strategies. [10, 11] | The pattern of community interaction with the environment affects the condition of peatlands (P10) | 0.741 |
| Competence (P-EL) : [10, 11] | | |
| Systems thinking (SC) [13, 14] | | |
| Analyze complex systems from multiple fields (environmental, economic, and social) and scale (local to global). [13, 14] | Utilization of peatlands that are not under their characteristics reduces the ability of peatlands to prosper the community (K8) | 0.602 |
| Understand the various possible solutions. [13, 14] | The sustainable use of shallow peatlands can maintain the environmental carrying capacity of human life (K5) | 0.600 |
| Understand the direct and indirect causes of unsustainable conditions that occur. [13, 14] | The clearing of peatland forests into plantations on a large scale changes the peatland ecosystem (K10) | 0.538 |
| Anticipatory (SC) [13, 14] | | |
| Indicators | Items Statement | Loading Factor |
| Analyzing the sustainable future of various issues. [13, 14] | The use of peatland that is not under its characteristics causes generational poverty (K15) | 0.653 |
| Analyzing the consequences of unsustainable development for generations. [13, 14] | Generational health decline due to current peatland degradation (K16) | 0.564 |
| Designing sustainable development prevents harm to generations. [13, 14] | Conservation of peatlands through the formal education system by forming environmental awareness of students and the community (K6) | 0.439 |
| Normative (SC) [13, 14] | | |
| Analyze sustainability issues by understanding the problems and solutions for sustainability. [13, 14] | Discussions on the ability of peatlands to support the life of the next generation that depends on current conditions must continue (K21) | 0.622 |
| Communicating, implementing, and negotiating sustainability values, goals, and targets. [13, 14] | Support and encourage the government to manage the sustainable use of peatlands (K23) | 0.701 |

Table 2. Continued.

| | | |
|---|---|---|
| Behavior (P-EL) : [10, 11] | | |
| Strategic (SC) [13, 14] | | |
| Designing sustainable solutions to problems that occur. [13, 14] | Learning tools for managing science classes for the establishment of peatland environmental literacy (PR1) | 0.800 |
| Communicating problem-solving plans to related parties. [13, 14] | Campaigning through social media about the importance of peatland conservation for the next generation (PR2) | 0.777 |
| | Campaigning for the advantages of traditional limited use of peatlands by local communities as a conservation activity (PR3) | 0.837 |
| | Submitting the design of environmental literacy-oriented science learning tools to the school (PR4) | 0.804 |
| | Provide input to related parties to manage peatlands in a sustainable manner (PR5) | 0.835 |
| Interpersonal (SC) [13, 14] | | |
| Evaluate and motivate sustainability actions in solving problems. [13, 14] | Participate in conservation programs held by the government or the private sector (PR7) | 0.908 |
| | Evaluating students' environmental literacy formed after learning that is oriented towards the peatland environment (PR8) | 0.829 |
| | Encourage and assist schools around peatlands to carry out learning oriented towards peatland environmental literacy (PR6) | 0.830 |
| | Support and encourage related parties to manage peatlands in a sustainable manner (PR9) | 0.834 |

### Survey Administration to Determine Criterion-Related and Construct Validity

A survey was constructed that variables needed for construct validity. This research was carried out in Palangka Raya state Islamic institute of religion (IAIN Palangka Raya) Central Kalimantan province Indonesia with part of the land peat land, even the IAIN Palangka Raya campus stands on peat land. Respondents are student teacher candidates in the Faculty of Tarbiyah and Educational Sciences in four study programs. A total of 143 student teacher candidates voluntarily filled out the questionnaire as participants piloted the survey between March-July 2022. Data collected from this pilot test were used to inform the scale development and scale validation. A general description of the respondents is shown in Table 1.

### The Palangka Raya Peatlands Sustainable Environmental Literacy (P-PSEL) Questionnaire

The Palangka Raya Peatlands Sustainable Environmental literacy (P-PSEL) questionnaire was developed based on aspects of environmental literacy and sustainable development competencies related to the Palangka Raya peatlands, Central Kalimantan, Indonesia. For this study, environmental literacy is regarded as an individual's knowledge, competencies, and behavior [10, 11] about the Palangka Raya peatland and uses five key sustainability competencies in that are systems-thinking, anticipatory, normative, strategic, and interpersonal [12-14]. The dimensions and indicators of P-PSEL are shown in Table 2.

### Data Collection and Analysis

The P-PSEL questionnaire response googles form analysis with smart pls 3 for outer dan inner model [19-22] in the condition of small sample size and research exploratory [23]. Analysis of the outer model to look for convergent variables from the value of loading factor, AVE, and community [19-22]. Discriminant validity from the value of cross-loading. Reliability from the value of Cronbach's alpha and composite reliability. Analysis of the inner model to look for structure model from the value of R-Square, Cross-validated redundancy, Effect Size, Path Coefficients, and fit model [19-22].

## Result and Discussion

### Validity and Reliability P-PSEL Questionnaire

The initial structural model of the P-PSEL questionnaire with three variables and 48 items. Some items are invalid with a loading factor value below 0.5 so some items are removed from the knowledge, competence, and behavior variables. After 8 steps of item reduction, a structural model with valid factor loading was obtained. There are 19 valid items with 3 knowledge items, 8 competencies, and 9 behaviors shown in Table 4.

Table 3. Content Validity and Aiken's Value of P-PSEL from Seven Rater.

| No | Dimensions | Aiken's Value | V table | Validity |
|---|---|---|---|---|
| 1. | Knowledge | 0,84 | 0.76 | valid |
| 2. | Competence | 0,85 | 0.76 | valid |
| 3. | Behavior | 0,81 | 0.76 | valid |
| | Average | 0,83 | | valid |
| | Probability (p) | | | 0.045 |

All outer loading values were found to be above 0.5 so it can be said that all 19 items were valid [24]. The AVE value of knowledge and behavior latent variables is above 0.5 (Table 4) in the valid category [24], and the competency variable is 0.353 accepted as a valid variable [25, 26]. The P-PSEL questionnaire with the variables of knowledge, competence, and behavior has internal consistency reliability with composite reliability of 0.7-0.9 [24]. So the P-PSEL measuring instrument can be used to measure the environmental literacy and sustainable competence of prospective teacher candidates in areas with peatlands, especially in Palangka Raya, Central Kalimantan, Indonesia.

## Structure Model of P-PSEL Questionnaire

The VIF value of the knowledge variable on the competency and behavior variables is less than 5 (Table 5) so this variable is collinear, has a low correlation, and can predict the model well [27]. The high collinearity between two or more indicators can bias the result [22]. Knowledge of sustainable development of the Palangka Raya peatland environment can be well modeled by the knowledge variable which is represented by the three items well. The pattern of community interaction with the environment, greenhouse gas emissions, peatland conservation, and sustainable development are issues that can represent P-PSEL knowledge variables.

The competency variable is collinear with other variables, so it can be a good model for the competency variable [27]. The P-PSEL competency variable is well modeled by 8 items related to the relationship between peatlands and the next generation. Behavioral variables are collinear with other variables, so the items in this variable can model behavior well [27]. The nine items related to actions that can be taken to conserve peatlands sustainably can be a good model for the P-PSEL behavior of prospective teacher candidates.

The coefficient of determination ($R^2$) competence and behavior variables can be described by items with weak models (Table 5) [27] because P-PSEL is an early development so it is not yet known by respondents, and the literature related directly does not yet exist so it is still quite foreign. However, the three variables have Q-square values as predictive relevance greater than zero so predictive relevance is accurate [27]. Knowledge and competence variables have a small effect size on behavioral variables ($f^2$ = 0.053 and 0.050), while the knowledge variable has a large effect size on competence ($f^2$ = 0.381) [27].

The P-PSEL variable structure developed has a size effect or relationship between variables with the largest relationship being on the knowledge and competence variables. Knowledge will affect competence directly because it is not related to behavior. Behavioral variables are weakly influenced by knowledge and competence variables because behavior is influenced by many other factors besides knowledge and competence. Sometimes the behavior formation of knowledge and

Table 4. Discriminant Validity with Fornell-Larcker Criterion SmartPLS 3 P-PSEL Questionnaire.

| Variable | Cronbach's Alpha (CA) | rho_A | Composite Reliability (CR) | Average Variance Extracted (AVE) | Reliability from CA | Reliability from CR |
|---|---|---|---|---|---|---|
| Competence | 0.748 | 0.757 | 0.811 | 0.353 | Reliable | Reliable |
| Knowledge | 0.546 | 0.551 | 0.768 | 0.527 | Reliable | Reliable |
| Behavior | 0.943 | 0.956 | 0.952 | 0.687 | Reliable | Reliable |

Table 5. The Results of the Inner Model P-PSEL Questionnaire with Smartpls 3.

| | Knowledge | Competence | Behavior | R square (R2) | Q square (Q2) |
|---|---|---|---|---|---|
| Knowledge | | • 1.000 (VIF)<br>• 0.381 (f2)<br>• 0.525 (Path Coefficiens) | • 1.381 (VIF)<br>• 0.053 (f2)<br>• - 0.262 (Path Coefficiens) | | |
| Competence | | | • 1.381 (VIF)<br>• 0.050 (f2)<br>• 0.254 (Path Coefficiens) | 0.271 | 0.059 |
| Behavior | | | | 0.050 | 0.031 |

competence variables requires a mediating variable [9]. It was determined if faculty and gender affected the environmental attitudes and behaviors of the students [28]. Most studies that explored the relationship between knowledge and behavior found either no significant relationship or a weak relationship between them [29, 30]. To develop sustainable development competencies, students must build knowledge about the environment and sustainable development of peatlands. However, the formation of behavior begins with the development of knowledge and competence of prospective teacher students about P-PSEL.

The knowledge variable has a strong and positive relationship or influence on the competence variable from the value of path coefficients (Table 5) [22], this relationship is the strongest compared to other variable relationships. Knowledge of P-PSEL will form strong student and teacher competencies. Teacher-candidate students with P-PSEL knowledge will have P-PSEL competence. The motivation in the environment and climate change knowledge showed greater motivation and willingness in environmental activities [31].

The competence variable has a strong relationship with positive behavior (Table 5) [22]. In this study, some of the P-PSEL questionnaire competency indicators are under the effect component of environmental literacy. Most studies evaluating relationships between environmental literacy components found the highest correlation between effect and behavior [10, 32, 33]. The effects of environmental awareness and environmental concern on environmental behavior were found significantly positive [34]. Teacher candidate students who have P-PSEL competence will behave constructively toward the protection and maintenance of the sustainable environment of Palangka Raya peatlands. Activities to protect the environment of the Palangka Raya peatlands are carried out through education as in the behavioral variable items. The relationship between knowledge and behavior is weak and negative [22], this is probably due to the lack of items on knowledge and does not describe activities in education. The lack of a high correlation between knowledge and behavior has been reported in other studies in different contexts [10, 32, 35].

The value of SRMR indicates the acceptable fit model with it produces a value smaller than 0.10 is 0.099 [36, 19], with the output path coefficients test as shown in Fig 1. The P-PSEL questionnaire for prospective teacher students has a fit model with three variables, namely knowledge, competence, and behavior. The knowledge variable has 3 indicators related to knowledge about peatlands, greenhouse emissions, and sustainable peatland conservation. The competency variable has 8 indicators related to the sustainable use of Palangka Raya peatlands, Central Kalimantan, Indonesia, and the effect of peatland damage on the lives of current and future generations. The behavioral variable has 9 indicators related to the behavior of protecting the environment of Palangka Raya's peatlands sustainably through education.

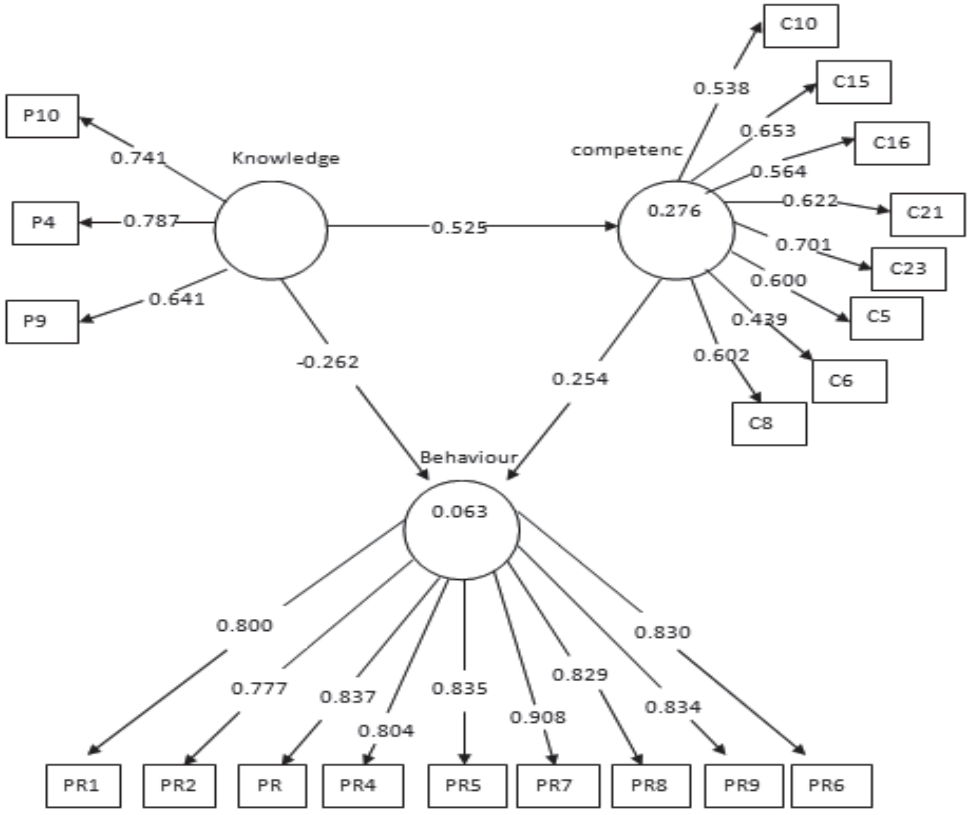


Fig. 1. Ouput SmartPLS 3 Path Coefficients Test with Fit Model P-PSEL Questionnaire.

## Conclusions

The sustainable competence of student teacher candidates in areas with peatland characteristics can be measured by the P-PSEL (Palangka Raya-Peatland Sustainable Environmental Literacy) questionnaire. The P-PSEL questionnaire with three variables, namely knowledge, competence, and behavior, as well as 19 valid and reliable indicators is the structure of the fit model as a measuring tool for environmental literacy in peatland areas. The knowledge variable positively affects the competency variable, and the competency variable positively affects the behavior. The formation of peatland environmental care behavior can be started with the formation of knowledge and competence for the sustainable development of prospective teacher students. Environmental care behavior must be owned by all sections of society, including student teacher candidates so that the peatland environment is sustainable as an action against climate change.

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## Conflict of Interest

The authors declare no conflict of interest.

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