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# Development and Validity of an Environmental Knowledge Instrument

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This research aims to develop an environmental knowledge instrument. This research employs qualitative and quantitative methods. Five experts check the developed instrument based on evaluation, content and language aspects. The respondents consist of 120 pre-service biology teachers. The test results are analysed from the difficulty level and distinguishing power index. Test items that meet both aspects are analysed using the confirmatory factor analysis, to measure construct validity, and estimated for its coefficient of reliability. The result shows that all items have a medium difficulty level and a good distinguishing power index. The confirmatory factor analysis shows that the items met the construct validity from factor loading of higher than 0.07 and t-value of higher than t-table. The coefficient of reliability, according to Cronbach alpha, is higher than 0.70. Based on the analysis results, the developed instrument to measure environmental knowledge has met the criteria for a valid and reliable instrument.

**Key words:** *Confirmatory factor analysis, Construct validity, Environmental knowledge, Instrument, Reliability.*

## Introduction

Every individual now needs to participate in solving the environmental crisis through their knowledge, attitude and behaviour (Pothitou et al. 2016). Individuals of any age, socio-economic background and education level should contribute significantly and respond positively to current environmental changes (Atabek-yiğit et al., 2014). Environmental knowledge influences the environment in a complex way (Vicente-Molina et al., 2013). Sustainable behaviours as a transformation of environmental knowledge contribute to

preserving natural resources (Raeisi et al., 2018). However, the influence varies based on social-demographic and cultural contexts (Paço & Lavrador, 2017). Environmental knowledge does not only refer to declarative knowledge but also is closely related to procedural knowledge, like environmentally friendly acts (Martinez-Martinez et al., 2015).

In the 21st century, environmental issues increase the challenges to education to contribute to empowering students' environmental literacy at all levels (Ehrlich, 2011). Empowerment means building an individual's capacity in deciding on a response to certain conditions (Alsop & Heinsohn, 2005; Simmons et al., 2011). Empowerment has four dimensions, namely self-control, change in knowledge, ability to decide and recognition of specific conditions. Empowerment is not only a result but also covers the building process of self-confidence, care, thinking abilities and decision making through social learning (Eger et al., 2018). Such changes give individuals the freedom to express themselves in an action (Lara et al., 2017).

Real environmental literacy takes a long time to develop to the top level where the individual realizes the ecological concern and knowledge within real action. Environmental concern shows that an individual recognizes his/her surrounding environment but this is limited to the understanding of cause and effect. The next level is the individual's attention to environmental issues that triggers the individual to act. The top-level is that where environmental values bring individuals to investigate facts related to environmental issues and plan for problem-solving (Coyle, 2005).

Environmental education as formal learning has to contribute to the growth and improvement of the students' behaviour toward the environment because this is a product of the curriculum which is implemented by the institution (Wurjaningrum, Auliandri & Kartika, 2020). Nature-based learning as meaningful learning is fundamental to improve students' understanding of human interaction with the environment and to stimulate their environmental behaviour (Tang et al., 2017). The transformation from environmental knowledge to environmental behaviour leads to sustainable development (Bissinger & Bogner, 2017). Introducing students to environmental issues through video or real conditions may gradually encourage the growth of sustainable behaviour to solve social problems cooperatively. Besides studying the environmental crisis, the investigation of local environmental potential which supports local economic improvement may become the intermediary or media to grow environmental balance protection behaviour (Fisman, 2005).

Environmental knowledge is a crucial element for building people's environmental practice. Since knowledge is not limited to ecological knowledge but also includes taking a position towards environmental problems, it promotes people to analyse the relationship between human-nature interaction and its impact on the environment (Zareie & Navimipour, 2016).

The changing of behaviour as a result of knowledge transformation into the actual action contributes to reducing the person's environmental impact (Lu & Wang, 2018).

According to the essential role of environmental knowledge, this research aims to develop an instrument to measure the environmental knowledge of pre-service biology teachers in the environmental science course, and to identify the component of environmental knowledge, which consists of analysis, evaluation and creation.

## Literature Review

### *Environmental Literacy*

Environmental literacy has a few components. Simmons in Hollweg et al. (2011) identify seven components, namely: 1) affect, 2) ecological knowledge, 3) socio-political knowledge, 4) knowledge of environmental issues, 5) skills and action strategies about environmental problems, 6) determinants of environmentally responsible behaviour, and 7) behaviour. McBeth and Volk (2010) specify four dimensions of environmental literacy, namely, knowledge of the ecological system, physics and environmental issue; competence to identify, analyse and plan environmental problem solving; disposition, sensitivity, attitude, environmental concern, motivation and the objective to perform an act; and responsible behaviour for the environment, such as ecology management (Hollweg et al. 2011). The North American Association for Environmental Education explains that environmental literacy consists of four major aspects. First, develop the new invention, investigation skills and analysis. Second, acquire knowledge of the relationship between social systems and process existing in ecology. Third, deepen the skill to face environmental issues. Fourth, participate individually or in a group to decide on environmental policy (Evers, 2011). Also, environmental literacy focuses on problem-solving for environmental issues (McBride et al., 2013).

### *Environmental Knowledge*

Environmental knowledge is the main component of environmental literacy, followed by skill, attitude and behaviour (Erdoğan et al., 2009). Research states that environmental knowledge influences two aspects, namely the social system (change in demography and urbanisation) and the ecological system (the practice of land use and its management) (McDaniel & Alley, 2005). Environmental education, which integrates environmental knowledge and nature-based learning, facilitates changing behaviour towards the environment (Otto & Pensini, 2017). Besides this, other research also shows that in an environment-based school, the students show their concern about environmental issues after they have sufficient knowledge and assessment of their surrounding environment (Spinola,

2015). Therefore, environmental knowledge should become part of education at all levels since environmental knowledge is a prerequisite for environmentally-friendly behaviour building (Raeisi et al., 2018).

Environmental knowledge refers to some definitions. NAAEE (North American Association for Environmental Education) states that such knowledge includes a knowledge of physics, ecological systems, environmental issues, social-political systems and strategies to solve environmental issues (Hollweg et al. 2011). An individual's understanding of the concept of ecology and environmental issues, the ability to evaluate environmental impacts as the result of human interaction with nature, is a component of environmental knowledge (Kokkinen, 2013). Fundamental knowledge of the environment develops into new knowledge through socialisation, externalisation, combination and internalisation (Martinez-Martinez et al. 2015). Environmental knowledge consists of declarative knowledge relating to knowledge application, while procedural knowledge is related to acts of efficiency such as greening programs (Chou et al., 2005).

Based on the analysis of several pieces of research, the construct of environmental literacy refers to a series of knowledges of the environment and its issues and the cognitive skill to solve environmental issues. The environmental knowledge focused on in this research is an individual's understanding of the concept of environment and its issues in the social and ecological context. The concept of environment includes the interaction of biotic, abiotic and cultural components, and the interaction may result in a positive and negative impact on the environment. The social context consists of human components and social processes, particularly livelihood activities and technology, while the ecological context includes ecological components and processes. Social and ecological contexts cannot be separated because there are interdependencies, and the interaction of each other is dynamic (Virapongse et al., 2016).

According to the dimension of the cognitive process explained by Bloom's Taxonomy, the researcher develops variables in the construct of environmental knowledge (EK) to three levels of cognitive process, namely; analysis, evaluation and creation (Anderson & Krathwohl, 2001). Analysis refers to the outlining or division of material into composing parts or components. Evaluation refers to an individual's ability to evaluate and or assess the correlation between the problem and the impact caused by it. Creation refers to the planning of a strategy or procedure to solve certain problems. Each of the cognitive process levels is outlined in learning objectives and test items formulation. Furthermore, this research tests the construct validity and coefficient of reliability of the environmental knowledge instrument. It shows the goodness of fit of indicators (analysis, evaluation and creation) as a latent variable of environmental knowledge.

Table 1 below is an arranged construct of environmental knowledge. The measured latent variable is operationally defined. The researcher then determines the measurement indicator, designs question items based on the indicator and assesses or validates the content with the experts. Table 2 is the description of the latent variable's indicator to design the question items.

**Table 1:** Construct of Environmental Knowledge (EK)

| Environmental Knowledge | Component/Factor | Operational definition |
|---|---|---|
| Understanding of environmental concepts and issues in ecological and social contexts | Analyse | Outline material into composing parts or components. |
| | Evaluate | Evaluate and or assess the correlation between problems and impacts caused |
| | Create | Plan a strategy or procedure to solve specific issues |

**Table 2:** Developed Indicators to Arrange the Test Items

| Factor | Outline of indicator | Item |
|---|---|---|
| Analysis | Analyse the scope of environmental science | ANA1, ANA2 |
| | Analyse the components and role of Ethno-socioecology as an example of environmental protection and management | ANA3, ANA4, ANA5 |
| Evaluation | Assess the correlation between issues in biotic, abiotic and socio-cultural environments. | EVA1, EVA2, EVA3, EVA4 |
| Create | Design the strategy to solve the environmental problem. | CRE1, CRE2 |

## Method

### *Development of Instrument*

This research employs qualitative and quantitative methods. The instrument development consists of three phases, namely; arranging the construct of environmental knowledge through theoretical review and defining variable existing therein, determining measurement indicator, and arranging test items based on the indicator into a descriptive test (Pallant, 2010). Each item has an equal score with a four rating scale (1-4). There are eleven (11) items of question developed in the descriptive form.

The two crucial points which have to be fulfilled within the instrument development are validity and reliability. Validity refers to the quality of the inferences, claims or decisions

drawn from the score of an instrument. Validation means a series of processes to collect and evaluate the evidence to determine that the instrument is appropriate, useful and meaningful (Zumbo, 2007; 2009). The determination of content validity is the first prerequisite before other measurements. The construct validity is a central work of validation because it is the empirical evidence that includes test content, response processes, internal structure, relation to other variables, and consequences to use or not use the instrument. Construct validity also presents the relation among items, domains and concepts that support the prior hypothesis (Messick, 1989). An instrument is reliable if the test item presents a consistent response when tested on the same respondent at different times (Nunnaly & Bernstein, 1994).

The part of the qualitative method is an expert's assessment based on the appropriation of the instrument with the developed outline, and the content of the developed instrument is representative. The expert gives suggestions for improvement from the substance, construction and language aspects. This phase informs whether the outline arranged represents the content or construct to be measured. The researcher revises the outline or test items according to the expert's assessment and re-consults for the final outline (Pallant, 2010). The quantitative method includes the expert's measurement of content validity and testing of the test items on 120 pre-service biology teachers, which is followed with an analysis of test items for difficulty level and distinguishing power index, an analysis of construct validity and an estimation of the instrument's coefficient of reliability.

***Sample/Participants***

There are five biology education lecturers involved in expert judgment and 120 preservice biology teachers who are required to answer the test.

***Analysis***

***Content Validity***

Content validity of five experts' judgment on test items referring to the substance, construction and language aspects. The substance aspect includes three assessment criteria, namely; goodness of fit of test item with the indicator to be achieved, material in test items and an answer key. The construction aspect includes three assessment criteria, namely; questions formulation, questions free from multiple interpretations and answer of a question not related to other questions. The language aspect includes three assessment criteria, namely; using correct communicative language and restriction of the sentence of the questions from ethnic, religious, racial and intergroup relations elements. The experts suggest correction and assessment of the questions under the scale of assessment (1-4), and the three aspects' scores are summed and averaged. The scores show the items' feasibility. The items' coefficient of

validity is calculated using Aiken's validity coefficient formula (V). Aiken determines the minimum acceptable limit of validity coefficient, for example, there are five experts (raters) with a maximum score (c) = 4, the minimum threshold will be 0.87 (Aiken, 1985).

### *Test Item Analysis*

The obtained data from testing is analysed for difficulty level and distinguishing power index to determine good items. Dividing the item's mean score with the item's maximum score to obtain the difficulty level index (P). The question is good if the difficulty level index $0.30 \leq P \leq 0.70$. The coefficient of correlation between an item's score and the total score shows the different power index of the descriptive question. A question will have a good distinguishing power index if the smart group gives more correct answers than the less smart group. A question will have a good distinguishing power index if $D \geq 0.3$. Items that meet the criteria of difficulty level and different power index are analysed for construct validity.

### *Construct Validity and Reliability*

Construct validity is determined using confirmatory factor analysis and LISREL 8.50 software for calculation. This research uses a reference to factor loading value to determine the construct validity. If the standardised factor loading is higher than 0.70, the indicator has good validity. The t-value shows how significant the correlation between indicator and the latent variable is. If the t-value is higher than the t-table (1.96) at level 5%, the indicator is significant. The p-value is higher than 0.07, and the Root Mean Square Error of Approximation is less than 0.08 (RMSEA < 0.08), being the two criteria to determine the model goodness of fit of developed test items to the arranged construct (Hair et al., 2006). To estimate the coefficient of reliability, the researcher employs Cronbach's Alpha formula. A good item has a coefficient of reliability higher than or equal to 0.7 ($r_{11} \geq 0.7$) (Pallant, 2010).

## Findings

### *Developed Instrument*

Table 3 is a description of the developed instrument to measure environmental knowledge. The instrument of environmental knowledge consists of three indicators, which are validated by an evaluation of the expert.

**Table 3:** The instrument of Environmental Knowledge

| Indicator | Item |
|---|---|
| Analyse the scope of environmental science | Environmental science is multidiscipline. For example, the decrease in fishery productivity engages the collaborative work of various experts to address the problems. How can it be? (ANA1) |
| | The waste which contaminates mangrove ecosystems has an impact on the increasing of coast abrasion. Also, the decrease of crabs and shrimp productivities has an impact on the decreasing of local people's income. What is the contribution of environmental science to improve public welfare at the coastal ecosystem? (ANA2) |
| Analyse the components and role of Ethno-socioecology as an example of environmental protection and management | Local people that live on Lawu mountain refuse the planning of the uses of geothermal energy as a power generation. What are the factors that affect people's actions concerning the component of ethno-socioecology? (ANA3) |
| | At the Lawu mountain there is specific land which includes the forest ban. Analyse the land division at the Lawu mountain ecosystem like a forest ban from the theory of ethno-socioecology. (ANA4) |
| | The terrestrial area inhabited by local people has the highest biodiversity. What is the way local people interact with nature so that high biodiversity is created? (ANA5) |
| Assess the correlation between issues in biotic, abiotic and socio-cultural environments. | According to data from the Central Statistics Agency collated at the end of 2018, economic growth in Indonesia increases in 2018. Gross Domestic Product (GDP) reaches 5.17%, up from 5.07%from the previous year. Java island still contributed to the growth of gross domestic product by 57.8% (the largest), followed by Sumatera by 23.4%. On the other hand, the environmental conditions in Java, especially in densely populated areas, are already alarming. Likewise, the problem of land-use change is increasing in Java and Sumatera. What is the impact of increasing economic welfare on the environment in Indonesia? (EVA1) |
| | Air and water quality in most regions of big cities are very poor. Based on the result of the Ministry of Environment Research, the air quality index in the Jakarta is the lowest (53.5) compared to other regions in Indonesia and far below the air quality index national level (87.03). Also, the Jakarta water quality index was 21.33, and Yogyakarta was 20.19. Both are far below the national water quality index, which is equal to 58.68. Why is the problem of natural resources always related to population density? (EVA2) |

| Indicator | Item |
|---|---|
| | Economic progress has a significant impact on technological development. Sophisticated technology has changed the lifestyles of most people. What do you think about human activities that cause the climate on earth to heat up? (EVA3) |
| | In 2004, WHO found that around 1.7 billion people lived in developing countries that were experiencing water pressure. Why can a decrease in water resources have an impact on poverty? (EVA4) |
| Design the strategy to solve the environmental problem. | How to use water more efficiently in the middle to upper-income groups in daily life? (CRE1) |
| | What steps are needed for the water supply to keep continuing to meet daily needs for each person in all social strata? (CRE2) |

***Content Validity of Environmental Knowledge Instrument***

Based on the results of experts' judgment on the developed test items, the suggestions are that those test items must have a stimulus part before the core of the question. Such a stimulus is in the form of the latest research related to the context. Also, the structure of the sentence should avoid multiple interpretations. Experts assess the revised instrument according to the scale of assessment (1-4). Table 4 below is the content validity obtained from calculating the five experts' estimates based on Aiken's validity formula (V). Based on the calculation result, each item has good content validity (higher than 0.87).

**Table 4:** Content Validity of Test Items Based on Aiken's Validity

| Item | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| V | 0.90 | 0.93 | 0.87 | 0.89 | 1.00 | 0.93 | 0.93 | 0.88 | 0.90 | 0.90 | 0.96 |

***Test Item Analysis***

The revised test items which meet the minimum standard of content validity could be tested on the respondents for field data related to good test items from the difficulty level and a question's distinguishing characteristic aspects. Table 5 below presents the results of the test item analysis. Based on Table 5, all items have a medium difficulty level ($0.30 \leq P \leq 0.70$) and a good different power index ($D \geq 0.3$).

**Table 5:** Test Item Analysis

| Item | Difficulty level index | Distinguishing power index |
|---|---|---|
| 1 | 0.65 | 0.79 |
| 2 | 0.64 | 0.77 |
| 3 | 0.58 | 0.82 |
| 4 | 0.59 | 0.78 |
| 5 | 0.63 | 0.83 |
| 6 | 0.66 | 0.78 |
| 7 | 0.65 | 0.82 |
| 8 | 0.62 | 0.79 |
| 9 | 0.55 | 0.82 |
| 10 | 0.56 | 0.80 |
| 11 | 0.53 | 0.74 |

***Construct Validity***

The objective of the construct validity test is to test whether field data support the construct established to arrange the instrument. Based on the results of the test item analysis, all of the items may be used to measure the construct validity. Based on Figure 1, all items have met the construct validity with a standardised factor loading higher than 0.7. Also, the indicators have a significant correlation with the latent variable referring to higher t-value than t-table (t-value > 1.96), as shown in Figure 2 (Hair et al. 2006).

**Figure 1.** Path diagram based on a standardised solution.

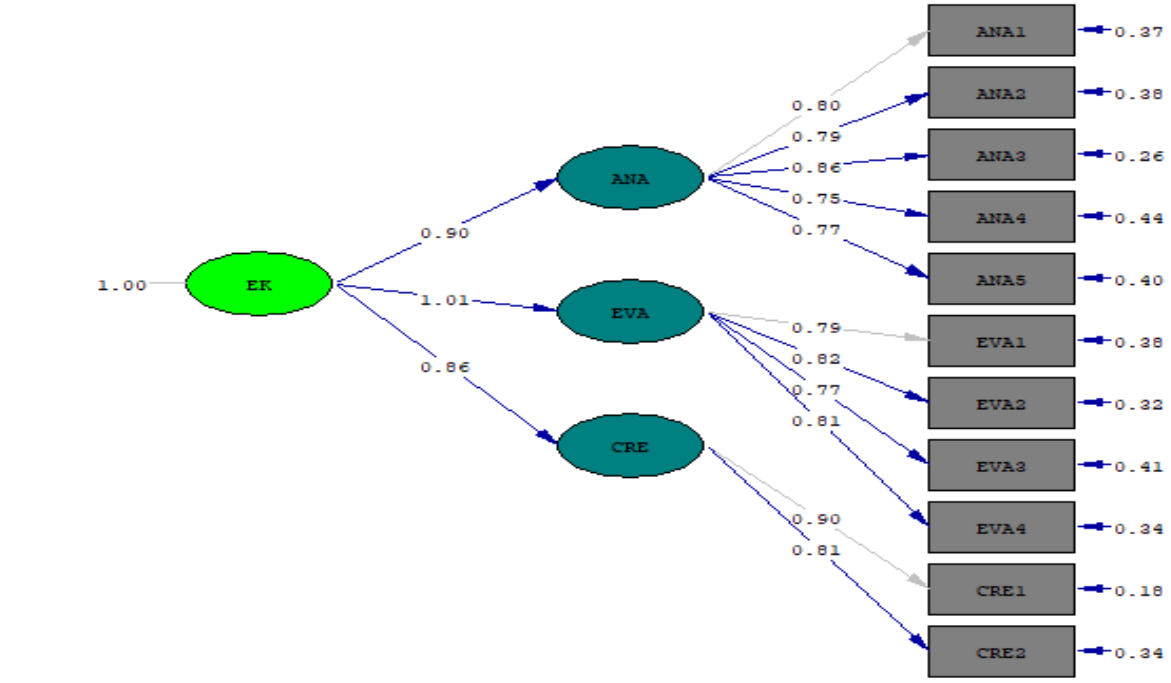
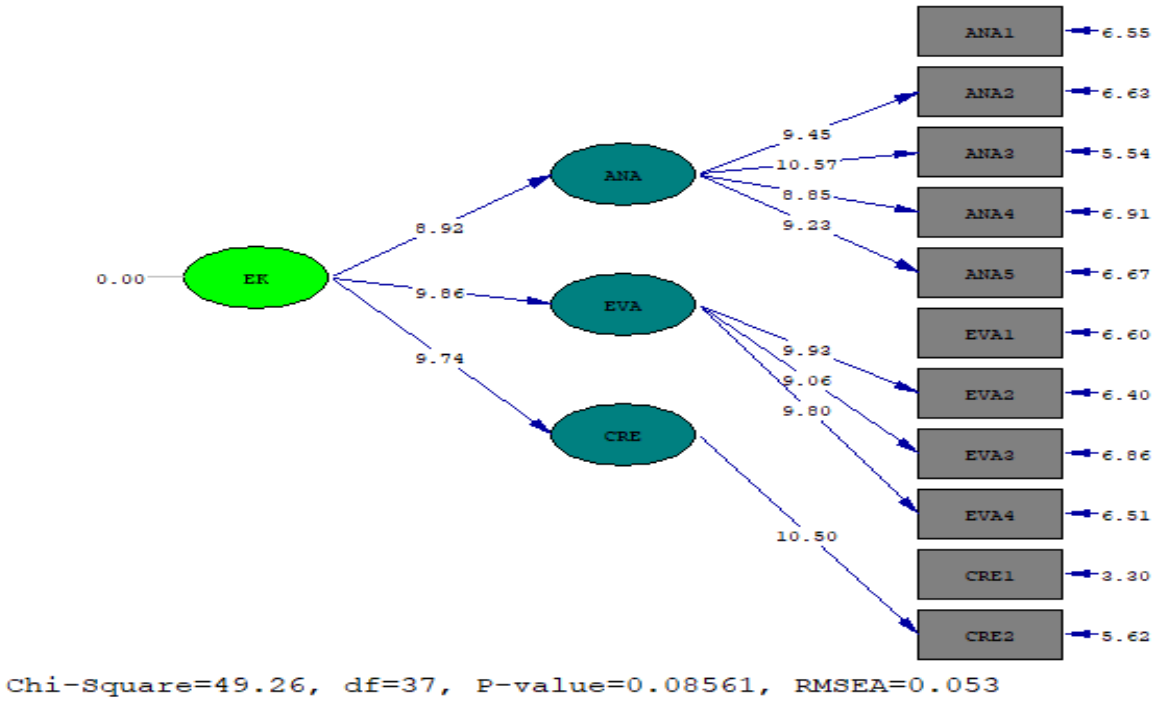



**Figure 2.** Path diagram based on t-values.




Based on the remarks below Figure 1 and 2, we may observe that $p = 0.08561 > 0.05$ and RMSEA is $0.053 < 0.08$. Besides the two criteria, the output shows that the Goodness of Fit

Indices (GFI) value is 0.93 ≥ 0.90, showing that the model fits the empirical data (Hair et al. 2006). Table 6 below presents a summary showing that the test to measure the environmental knowledge has met the construct validity based on the factor loading and t-values.

**Table 6:** Indicator, Standardised Factor Loading, and t-value

| Indicator | Item | Standardised Factor Loading | T-value |
|---|---|---|---|
| Analysis (ANA) | ANA1 | 0.80 | ** |
| | ANA2 | 0.79 | 9.45 |
| | ANA3 | 0.86 | 10.57 |
| | ANA4 | 0.75 | 8.85 |
| | ANA5 | 0.77 | 9.23 |
| Evaluation (EVA) | EVA1 | 0.79 | ** |
| | EVA2 | 0.82 | 9.93 |
| | EVA3 | 0.77 | 9.06 |
| | EVA4 | 0.81 | 9.80 |
| Create (CRE) | CRE1 | 0.90 | ** |
| | CRE2 | 0.81 | 10.50 |

***Coefficient of Reliability***

The researcher further estimates the coefficient of reliability using Cronbach's Alpha. Based on the estimation using the formula, all of the items have a coefficient of reliability 0.94 > 0.7. Thus the items are reliable (Nunnaly & Bernstein, 1994).

**Discussion**

Environmental concern is the priority in facing environmental changes in the 21st century. Formal learning plays a role in growing students' concerns about social-ecological issues through effective curriculum application (Aksan & Çelikler, 2013). Environmental issues developing in the community stimulate potentials teachers to take measures through collaborative activities (Grima et al., 2010). Potential teachers should be able to analyse any impacts of environmental issues both in social and ecological aspects. In this era of technological development, potential teachers have the opportunity to evaluate any negative impacts of technology development on the environment. Research explains that potential teachers are an innovator and adapter of the latest technology. Any problems in their environment need such ability. Real experience helps transfer knowledge to become a real act (Artun, 2016).

The social-ecological system theory explains that the integration of the two systems generates an effective practice of environmental management (Virapongse et al. 2016). Environmental

education, as part of a social system, serves to respond to environmental change. Environmental education addresses the challenges by designing an effective curriculum and learning to build students' interest and commitment towards being concerned about environmental issues and sustainable development (Zsóka, Szerényi, Széchy & Kocsis, 2013).

Environmental knowledge is a prerequisite for growing environmentally-friendly attitudes and behaviours (Fang, Yu, Yu & Chang, 2016). According to the Theory of Reasoned Action, knowledge is part of the background factor, which can influence beliefs, attitudes, objectives and behaviour (Fishbein & Ajzen, 2011). An individual's understanding of the ecological concept, environmental crisis, social-political system, human activity's impacts on the environment, and strategies to prevent or solve problems constitutes some components of environmental knowledge (Hollweg et al. 2011; Kokkinen 2013). Therefore, environmental knowledge mastery is somewhat important for pre-service teachers in order for them to take effective action in response to surrounding environmental changes (Guven & Sulun, 2017).

To develop an environmental knowledge instrument, the researcher first builds the construct. The environmental literacy constructs based on the result of the literature review are defined as a group of environmental knowledge and problems and cognitive skills for environmental problem-solving. Environmental knowledge is an individual's understanding of the ecological concept and its issues in social and ecological contexts. Cognitive skill refers to a series of skills used to identify and analyse environmental issues, and plan and evaluate strategies for environmental problem-solving.

The focus of this research is on environmental knowledge instrument development. The researcher divides environmental knowledge into three factors of cognitive processing skill, namely; analysis, evaluation and creation. Analysis refers to the ability to outline material into its composing parts. Evaluation encourages individuals to evaluate or assess the correlation between problems and impacts caused. Creation refers to the planning of strategy or procedure for problem-solving.

The first indicator analyses the scope of environmental science. Pre-service teachers are required to give details about the contribution of science related to environmental science within the problem, such as fishery and coastal ecosystem problems. Environmental problems certainly involve various scientific disciplines in the process of resolution. Students should be able to show the relationship between these disciplines.

The second indicator analyses the components and role of Ethno-socioecology as an example of environmental protection and management. Ethno-socioecology content provides insight into prospective teacher students about examples of nature conservation in the lives of local

communities. Ethno-socioecology, as local knowledge, certainly has values associated with the current changing environment that must be understood by prospective teachers.

The third indicator assesses the correlation between issues in biotic, abiotic and socio-cultural environments. The environment consists of biotic, abiotic and socio-cultural components. According to the social-ecological system, humans are an integral part of nature. Human interaction with nature has resulted in a habit, tradition and culture. During interacting with nature, humans influence components and processes that occur both in the biotic and abiotic environments. Changes that occur in the biotic and abiotic environment again, affect the human social environment. Students need to be able to provide an assessment related to the environmental issues that develop in society from the aspects of the biotic, abiotic and socio-cultural.

The fourth indicator is to design the strategy to solve environmental issues. Students have to become sensitive to environmental problems. Sensitivity to environmental problems shows that students can think critically and creatively in generating ideas to solve environmental problems that occur around it. Creating solutions can be in the form of designing tools or procedures that can be applied and that effectively overcome the problem.

The instrument assessed by the experts has good content validity, as proven with Aiken's validity value of higher than 0.87. Biology pre-service teachers complete the instrument developed. Based on the result of item analysis, the questions' difficulty level is medium ($0.3 \leq P \leq 0.7$). The different power index shows that the items can distinguish between potential teachers with upper and lower academic ability ($D \geq 0.3$). Therefore, all of the items have met a good quality of test items.

Based on the results of confirmatory factor analysis with LISREL 8.50 software, the analysis, evaluation and creation factors are dimensions of environmental knowledge, as shown with t-value, which is higher than t-table (t- value > 1.96). All of the analysis, evaluation and creation indicators have met a good convergent validity, as shown with standardised factor loading, which is higher than 0.7 and significant at a level of 5%. There is a significant correlation between the indicator and the latent variable, as shown with the t-value, which is higher than the t-table value (Hair et al. 2006).

An instrument is reliable if the test item presents a consistent response when tested on the same respondent at different times. Based on the result of estimation using Cronbach's Alpha formula, the instrument has met the reliability aspect with a coefficient of reliability of higher than 0.7 (Nunnaly & Bernstein, 1994).

## Conclusions and Implications

The developed instrument to measure environmental knowledge covers a few phases. These are: arranging the construct, defining the variable, developing indicators and test items, validating the content with experts, testing the instrument, analysis on test items for difficulty level and different power index, constructing a validity test, and estimating the coefficient of reliability. A question's stimulus is significant so as to provide information that may strengthen the core of the problem. The sentence should be communicative and unambiguous. The item analysis shows that all items are of medium difficulty level and have good and reliable distinguishing characteristics. The confirmatory factor analysis shows that analysis, evaluation and creation are dimensions of environmental knowledge and have good convergent validity. All of the indicators have good validity, and there is a significant correlation between indicator and latent variables. Based on the model goodness of fit test, the empirical data support the construct.

The research implies instruction development in environmental science courses, especially for pre-service teachers. Environmental issues and problems need to be a focus of the instruction. Therefore, pre-service teachers acquire the relevant topics to respond to the environmental changes and can think critically to identify the problems, analyse the cause and effect, and design the solution. Moreover, environmental problems promote pre-service teacher awareness toward the environment.

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