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Development of an Environmental Awareness Instrument Based on the New Environmental Paradigm (NEP) Using Exploratory Factor Analysis (EFA) in The Education Department

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Abstract. Various environmental damages are often found in various regions. This research aims to develop an environmental awareness questionnaire instrument based on the new environmental paradigm for prospective teachers in the education department. The research method used in this research is the non-test instrument development model proposed by Mardapi. The instrument consists of 60 statements developed from the new environmental design theory and then analyzed using EFA (Explanatory Factor Analysis). The instrument was content validated by 6 experts, consisting of 4 science education lecturers and 2 educational research and evaluation lecturers. Then the instrument was tested on 100 prospective teachers who were studying in the education department. The analysis used is exploratory factor analysis (EFA) and is followed by a reliability test. The research results showed that 12 of the 60 instruments were declared to need revision by experts, while the others met the criteria. After testing, the environmental awareness instrument has a KMO value above 0.5, namely 0.648, and the Bartlett test result is <.001, which indicates that the statement can be analyzed further. Based on the variance data, there are 16 components formed with a total percentage of 78.999%. For identical statement numbers, 43 statement items are identical in the components formed, whereas the rest can be considered not to be used or revised. Furthermore, the reliability test is 0.962, which means that all statement items are reliable. The findings of this research indicate that environmental awareness instruments are suitable for use. It is still possible to test this environmental awareness instrument on a larger scale so that its feasibility level can be better.

Keywords: Instruments, Environmental awareness, NEP, EFA

INTRODUCTION

Environmental damage is one of the most pressing and complex global problems facing humanity today. The natural environment, consisting of air, water, land, and biodiversity, plays a vital role in supporting life on Earth. However, increasingly intensive human activities have had a significant negative impact on ecosystems, causing potentially irreversible damage. When human life begins, there begins an undeniable reciprocal relationship between the environment and the individual. This human relationship with the environment carries the task of passing on a clean and sustainable environment to the next generation. Growing an environmentally friendly society seems to be a debt for future generations [1]. This makes the Earth sacred and vital for creating a balance between human activities and ensuring the protection of the Earth's resources and conditions that support life [2]. Individuals need to have certain basic skills to get to know nature, obtain existing information, solve problems faced in everyday life, and understand the relationship between humans and the environment[3].

Human life today involves many things, both living and non-living. Involvement can occur both directly and indirectly, sometimes causing various organisms to change direction, causing evolution and extinction. Humans are the most intelligent creatures because they can perfectly improve and adapt natural resources and the environment to support life, which results in environmental pollution problems [4]. Throughout human history, individuals and nature have interacted. However, along with industrialization, when people began to use natural resources as if they were unlimited to improve their quality of life, the balance of nature began to be disturbed[5]. A society that has high environmental awareness can only be realized through the presence of teachers who have high environmental awareness[6]. Respecting life, biodiversity, and protecting nature and our world are important elements for sustainable

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environmental awareness. Thanks to these elements and the policies implemented, a more sustainable life can be achieved by minimizing consumption and protecting the environment [7].

Environmental problems are an important issue that cannot be addressed effectively, and are growing in quantity and variety[8]. Environmental damage is a multidimensional problem that requires a holistic approach to handling. Mitigation and adaptation efforts to environmental damage must involve various stakeholders, including the government, the private sector, and civil society. Environmental education and awareness, implementation of environmentally friendly technologies, and policies that support sustainability are some of the important steps that must be taken to reduce the negative impact of human activities on the environment. Only with global cooperation and collective commitment can we maintain and restore the health of our planet for future generations. Solving environmental problems is only possible by increasing awareness of these issues and the environment. This is an educational process. This success will be possible if the educational process through formal and informal channels is maintained. Environmental education to increase environmental awareness can be provided informally by families, through mass communication, the Internet, social networks, and similar methods of influence. However, apart from all of the above, what is important is providing formal education about the environment. Educational activities whose content is to increase environmental awareness in students of all ages must be carried out [9]. The journey of forming environmental awareness that takes place cumulatively and gradually within the individual requires a complete "consciousness" [10].

For educators, environmental awareness has a very important role, because they function as agents of change and models that can influence the younger generation. Educators are role models for students. By having high environmental awareness, educators can demonstrate environmentally responsible behavior in everyday life. This includes simple actions such as saving energy, reducing plastic use, and recycling. This example can inspire students to adopt similar practices.

Teachers have a huge influence on increasing students' environmental awareness and helping them develop sensitivity to environmental issues. Protecting the world is the common duty of all teachers on earth [11]. Environmentally conscious educators can integrate sustainability concepts into the curriculum, teach the importance of conserving natural resources, and promote ways to reduce environmental impacts. This helps students understand the connection between their actions and the health of the planet. With increasing environmental threats such as climate change, pollution, and biodiversity loss, it is important to prepare future generations with the knowledge and skills necessary to face these challenges. Environmentally conscious educators can equip students with an understanding of environmental issues and potential solutions, preparing them to become responsible leaders in the future.

Environmental awareness encourages students to think critically about environmental problems and seek creative solutions. Educators who understand the importance of the environment can create learning environments that promote critical thinking, problem-solving, and innovation. This is important for developing the skills needed to find new and effective solutions to environmental challenges. Environmental awareness instilled by educators not only affects students but also their communities. When students take home what they learn about the importance of protecting the environment, they can influence their families and communities to also take more environmentally friendly actions. This creates a positive chain effect on the environment.

Environmental awareness for educators is not only important but essential for a sustainable future. Educators have the power to shape students' thoughts and attitudes, making them more caring and responsible individuals towards the environment. Thus, investment in environmental education and environmental awareness among educators is an investment in a cleaner, healthier, and more sustainable future.

The new environmental paradigm, sometimes referred to as the NEP, was designed by American environmental sociologist Riley Dunlap and colleagues. It is designed to measure the environmental awareness of a group of people using a survey instrument in which respondents are asked to indicate the strength of their agreement or disagreement with each statement [12] . This revised new environmental paradigm maximizes content validity, as one measure [13]. NEP is a useful tool to measure and then track how worldviews towards the environment and sustainability-related attitudes change during university education. To administer the NEP, undergraduate students were given a paper instrument and asked to rate their level of agreement with each NEP statement on a Likert scale [14]. The New Ecological Paradigm (NEP) is a popular measure of adult environmental concern and pro-environmental orientation [15]. The NEP scale is considered a measure of the environmental worldview or paradigm (frame of thinking). The 5 broad categories of NEP according to Dunhamp consist of Limits to growth, Anti-anthropocentrism, Balance of nature, Anti-exemptionalism, and Eco-crisis.

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This research asks the question of how to develop an environmental awareness instrument based on the New Ecological Paradigm (NEP) for prospective teachers in the education department using EFA analysis. The instrument is used to take photos environmental awareness of students, especially prospective teachers. Therefore, the material discussed in this instrument is adapted for higher education levels. Thus, the environmental problems discussed are at an advanced level. It is hoped that this instrument can be an alternative to measuring students' environmental awareness. After the instrument was developed, analysis was carried out using exploratory factor analysis (EFA). Explanatory factor analysis (EFA) helps researchers who do not know how many factors explain the relationships between a set of items. EFA is useful for exploring the underlying dimensions of a construct of interest [16]. EFA is also a statistical technique used to combine several interrelated variables to form more general and basic variables, namely "factors" [17].

METHOD

The research method used is a development research method through steps such as planning instrument specifications, instrument feasibility testing, and instrument testing. The research design for developing non-test instruments proposed by Mardapi consists of: (1) Determining instrument specifications, (2) Writing the instrument, (3) Determining the scale of the instrument, (4) Determining the scoring system, (5) Examining the instrument, (6) Carrying out trials, (7) Analyzing instruments, (8) Assembling instruments [18]. Through these steps, the final research product can be produced in the form of a good instrument. In the development steps, there are steps to test the validity and reliability of the instrument, so it is deemed necessary in this research to test the validity of the content, construction, and reliability of the instrument for assessing students' environmental awareness attitudes, so that the instrument can be accounted for. Content validity was carried out by 6 experts, consisting of 4 science education lecturers and 2 educational research and evaluation lecturers. The instrument was tested on 100 prospective teachers or students in the education department. For sample size, Hair et al. suggest that the sample size should be at least 100 or larger[19]. The analysis used is explanatory factor analysis (EFA), which is then followed by a reliability test. Explanatory factor analysis and reliability were carried out with the help of SPSS 25.

DISCUSSION

This research aims to develop an instrument for assessing environmental awareness attitudes among prospective teachers in the education department. The instrument was developed based on a new Environmental Paradigm (NEP) with 5 dimensions in the form of Limits to Growth, Anti-anthropocentrism, Balance of Nature, Anti-exemptionalism, and Eco-crisis. The 5 dimensions are described in 10 indicators and consist of 60 statement items. Each indicator is developed into 5 to 7 statement items containing negative and positive statements. Each statement item has a score weight of 1 to 4. The following is the rubric development of an Environmental Awareness Instrument based on the New Environmental Paradigm (NEP).

TABLE 1. Instrument development rubric

No	Dimensions	Indicator	Statement Number
1	*Limits to growth*	Students master the limitations of the earth in providing natural resources	12, 25, 26, 29, 49, 57
		Students explore how population growth, industry, pollution, food production, and resource consumption can impact the planet's capacity	19, 22, 23, 37, 39, 40
2	*Anti anthropocentrism*	Students do not show a high ego towards the environment	13, 34, 35, 36, 45, 53, 54
		Students respect and preserve nature for the benefit of all living creatures and the planet.	14, 38, 41, 42, 43, 44
3	*Balance of nature*	Students do not have the potential to damage nature in the future	8, 17, 24, 31, 32, 59, 60
		Students respect and protect all forms of life, both flora and fauna, by preserving their natural habitat.	7, 33, 46, 47, 48, 51
4	*Anti-exemptionalism*	Students can be responsible for the environment	1, 2, 3, 4, 52, 58

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		Students have fair and equal access to environmental benefits and are involved in decision-making regarding environmental policy.	11, 15, 16, 30, 56
5	*Eco-crisis*	Students can understand that environmental damage is mostly caused by humans.	5, 6, 20, 21, 50
		Students make efforts to prevent various environmental damage.	9, 10, 18, 27, 28, 55

After the instrument was created and reviewed, the content validation process was carried out with 6 experts, consisting of four science education lecturers, two of whom had biology expertise. This selection of lecturers is based on the consideration that in the education department, those who have a strong connection with the environment are lecturers from the natural sciences education department. Apart from that, the content validation process is also carried out by lecturers who have expertise in educational research and evaluation to look at the content and linguistic appropriateness of the instruments being developed.

Based on the results of content validation, it was found that 100% of the items were in the context of environmental awareness. This statement is proven by the decisions of all validators who give a check mark (√) in the Yes column for this criterion. Thus, the questionnaire created was sufficient to proceed to construct validation. However, there are several notes from validators as input and suggestions for improvement. The conclusion from the content validation process is that the instrument can be used with revisions. Revisions were made to 12 of the 60 statements given suggestions and input by the validator. The revised statements include statement numbers 4, 5, 6, 7, 8, 9, 17, 22, 25, 26, 27, and 59.

The statements that have been revised and declared good by the validators are continued with the construct validation process, the instrument is tested on 100 prospective teacher in the education department who are currently taking their sixth semester of undergraduate level. After the data is collected, scoring is carried out on a scale of 1-4, which is then analyzed by explanatory factor analysis using SPSS 25. The following is a basic component analysis chart in SPSS [20]

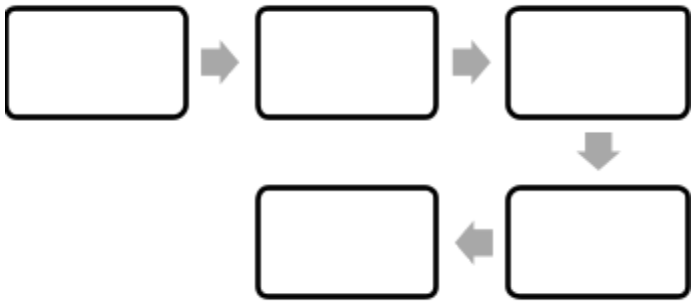

FIGURE 1. Instrument analysis flow

The statistical EFA test is necessary because it provides various benefits in understanding, simplifying, and analyzing complex data. By identifying underlying structures, reducing the dimensionality of data, and ensuring the validity and reliability of measurement instruments, EFA has become an essential tool in many research fields, especially in the social sciences, psychology, education, and marketing. The following is the output of the analysis using EFA on the NEP-based environmental awareness questionnaire instrument:

TABLE 2. The Kaiser-Meyer-Olkin (KMO) and Bartlett's Test

EFA Model Index		Mark
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.648
Bartlett's Test of Sphericity	Approx. Chi-Square	5792.152
	df	1770
	Sig.	<.001

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Based on the exploratory factor analysis test in Table 2 above, the instrument has a KMO value of above 0.5, namely 0.648. This figure indicates that the 60 items of the environmental awareness attitude scale can be analyzed further. In the same statistical test, the attitude scale items can be analyzed by grouping them into one component. In other words, the items in one component are items that are categorized into the same indicator statistically. To see whether the items are correlated, you can look at the Sig value. In Bartlett's Test of Sphericity, in Table 2, it can be seen that the Sig value is below 0.05, namely 0.001, which indicates that the items are correlated with each other. Next, we obtain variance data from the components formed as in the table below:

TABLE 3. Total Variance Explained (N=100)

Components	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	20,309	33,848	33,848	20,309	33,848	33,848
2	4,483	7,472	41,319	4,483	7,472	41,319
3	2,494	4,156	45,475	2,494	4,156	45,475
4	2,389	3,982	49,458	2,389	3,982	49,458
5	2,124	3,539	52,997	2,124	3,539	52,997
6	1,962	3,270	56,267	1,962	3,270	56,267
7	1,767	2,945	59.212	1,767	2,945	59.212
8	1,639	2,732	61,944	1,639	2,732	61,944
9	1,567	2,612	64,556	1,567	2,612	64,556
10	1,476	2,460	67,016	1,476	2,460	67,016
11	1,374	2,289	69,305	1,374	2,289	69,305
12	1,293	2,155	71,461	1,293	2,155	71,461
13	1,261	2,101	73,562	1,261	2,101	73,562
14	1,145	1,908	75,470	1,145	1,908	75,470
15	1,105	1,842	77,312	1,105	1,842	77,312
16	1,012	1,687	78,999	1,012	1,687	78,999

EFA then performs principal component analysis extraction and varimax rotation. Total explained variance is also the process of extracting items to reduce them to a manageable amount before further analysis. As seen in Table 3, the output shows that EFA has extracted sixteen constructs or components of the AQ construct, with the total variance explained being 78.999%. 16 components have Eigenvalues more than 1, which means there are 16 new factors formed from the 60 statement items analyzed. This data can also be visualized in the scree plot graph below, where the inflection point occurs at point 17. The first to the sixteenth factors are the factors before the inflection point occurs. At point 17, the line looks like it is starting to slope.

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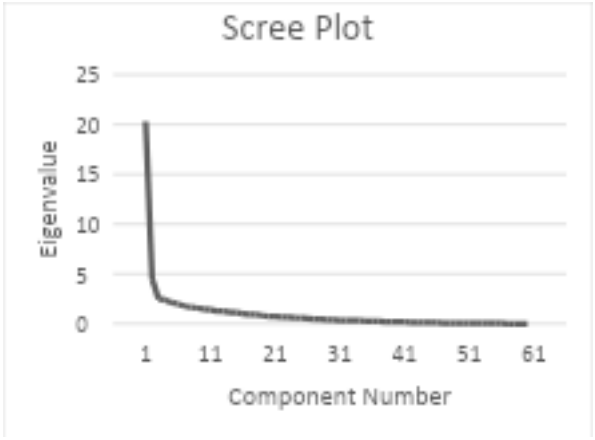

FIGURE 2. Scree Plot graph of variance

The next data is a matrix component where if the factor loading value is > 0.5 and is grouped into one factor, it can be concluded that the variable being analyzed will become a new factor. The guideline for the loading factor value according to Hair (2010) is a minimum of 0.5. These grouped items can also be concluded that the statements are identical to each other with certain factors or components. Further component matrix data can be seen in the following table:

TABLE 4. Component Matrix

Statement Number	Component 1	Statement Number	Component 3	Statement Number	Component 11
5	.505	13	.507	1	.505
7	.597				
9	.607				
11	.571				
16	.650				
17	.643				
18	.714				
19	.673				
22	.540				
23	.736				
24	.584				
25	.759				
26	.624				
27	.729				
28	.663				
29	.720				
30	.770				
31	.664				
32	.686				
33	.628				
34	.764				
35	.693				

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36	.581
37	.531
38	.569
39	.727
40	.681
41	.668
42	.629
43	.562
44	.569
46	.670
47	.715
48	.675
49	.696
51	.544
53	.541
54	.516
55	.603
56	.580
60	.627

In the table above, there are 43 statements that are identical to certain components. Meanwhile, 17 other statements can be considered for non-use or use through a revision process. The results of this trial are also the basis for selecting statement items that are reliable for use as environmental awareness questionnaire instruments. Based on the exploratory factor analysis test, there were 60 statement items developed that could evaluate ten indicators of the environmental awareness attitude component. Sixty items of this attitude scale were declared reliable with an α of 0.962, as shown in Table 5. For each statement item, a Cronbach's alpha value was also obtained above 0.7, which indicates that the statement items are reliable.

TABLE 5. Reliability Test Results

Reliability Statistics	
Cronbach's Alpha	N of Items
.962	60

Awareness of environmental problems is an important first step to creating positive and sustainable change. By understanding, educating, and encouraging action, we can together overcome the environmental challenges facing the world today. The NEP itself is very good as a reference in developing instruments for assessing human environmental awareness. Dimensions such as Limit to growth and statements developed in this dimension project the consequences of unlimited population growth in a world with limited resources. This report emphasizes the importance of environmental awareness and sustainable management of resources to avoid ecological and economic collapse. In the anti-anthropocentrism dimension, the statement developed is directed by a philosophical view that rejects the belief that humans are the center or most important in the universe. In the context of environmental awareness, anti-anthropocentrism advocates respect and protection of all forms of life and ecosystems, regardless of direct benefit to humans. In the balance of nature dimension, the statement of environmental awareness focuses on the balance of nature, emphasizing the importance of understanding and respecting the complex relationships between various ecosystem components.

Anti-exemptionalism is the fourth dimension where an important concept in environmental awareness emphasizes that humans must live within ecological limits and not consider themselves free from ecological consequences. Adopting an anti-exemptionalism perspective helps ensure that we respect and protect the ecosystems we depend on for our lives and well-being. The last dimension is eco-crisis, where this dimension detects students' awareness of environmental damage. Environmental awareness must become part of culture and daily practices to achieve a healthier and more sustainable environment. By increasing environmental awareness,

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we can take collective steps to mitigate the impact of the ecocrisis and preserve the earth for future generations. Moreover, students in the education department are prospective teachers who will later educate and play a role in building the character of the next generation of young people.

Increasing environmental awareness is a very important effort in maintaining the sustainability of our planet. Many things can be done to encourage environmental awareness, such as environmental activities. Environmental activities increase students' awareness of the environment [21]. Environmental awareness assessment is an important step to evaluate the extent to which individuals or groups understand and care about environmental issues. By using these various methods, environmental awareness assessments can provide a comprehensive picture of an individual's or group's level of awareness and involvement in environmental issues. The results of this assessment can be used as a basis for designing more effective educational and intervention programs to increase environmental awareness.

CONCLUSION

The development of environmental awareness instruments was made concerning the *New Environmental Paradigm* (NEP). The feasibility test of this instrument was carried out by validating the content with experts, and the constructs were tested on prospective teachers in the education department. The trial results were analyzed using explanatory factor analysis. The KMO results show a value above 0.5, namely 0.648, and the Bartlett test results with a significance value below 0.05, namely <.001, which indicates that the statement questionnaire can be used. In the EFA analysis, 16 new factors were also obtained. Next, the data was analyzed for reliability. The reliability test produced a Cronbach's Alpha value above 0.7, namely 0.962, so it can be concluded that the NEP-based environmental awareness questionnaire instrument is reliable. It is important to continue to develop instruments containing environmental awareness as evaluation material to develop characters who care about the environment and live wisely with nature.

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