December 21, 2022

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MODESTUM EURASIA Journal of Mathematics, Science and Technology Education, 2022, 18(12), em2206
ISSN:1305-8223 (online)
OPEN ACCESS Research Paper https://doi.org/10.29333/ejmste/12732

The development and validation of environmental literacy instrument based on spirituality for prospective science teachers

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Received 30 September 2022 ▪ Accepted 15 December 2022

Abstract

The spiritual (S) aspect needs to be integrated with the environmental literacy instrument (ELI) so that it becomes ELIS. This study was designed to develop and validate an instrument for prospective science teacher in the form of environmental literacy instrument based on literacy (ELIS). The instrument was developed based on previous research findings and focus group discussions involving eleven experts. The factors and internal consistency were examined by involving 634 students/prospective science teachers from various universities in Indonesia. Validity and reliability were tested using exploratory factor analysis and confirmatory factor analysis. This study proposes a 26-item ELIS with acceptable internal validity and consistency. It is composed of four dimensions: ecological knowledge (five items), environmental hope (seven items), cognitive skills (eight items), and behavior (six items). The ELIS is recommended as a measure of the development of environmental literacy based on spirituality for prospective science teachers.

Keywords: confirmatory factor analysis, exploratory factor analysis, prospective science teacher, environmental literacy, spirituality, teachers

INTRODUCTION

Environmental literacy is the main goal of environmental education (McBride et al., 2013; Szczytko et al., 2019). Environmental literacy for prospective science teachers to comprehend and respond to changes in the environment through environmentally friendly behaviors, environmental literacy also needs to be increased (Darling-Hammond et al., 2020; Goulgouti et al., 2019; Khoiri et al., 2021; Loubser & Swanepoel, 2001; Wilujeng et al., 2019). If these prospective science teachers become teachers in the future, they will play an important role in achieving environmental education goals, as well as developing environmental literacy in the students they educate (Kidman & Casinader, 2019). Environmental literacy is widely recognized as a solid foundation for responding to future environmental problems and assisting in the transition to a sustainable community (McBride et al., 2013; Shri & Tiwari, 2021). Sustainable community behavior will help maintain the environmental sustainability (D'Arco & Marino, 2022; Hermawan et al., 2022; Putra et al., 2021). The integration of sustainability issues in environmental awareness campaigns, including in educational institutions, is necessary to close the gaps between learning theory and practice (Biswas, 2020).

On the other hand, environmental education must be accommodating to spirituality values (Kurniawan & Syifauddin, 2021; Ramírez & Fernández, 2018; Robina-Ramírez et al., 2020). Existing learning environmental education materials should not only target cognitive aspects but also include spirituality and religiosity values that emerge in society (Karyadi, 2016; Parker, 2017). Aspects of environmental sustainability are intertwined with, and cannot be separated from, human spirituality (Bajuri et al., 2021; Hafeez et al., 2022; Krempl, 2014). There is also widespread consensus that spirituality, along with all other materials, should

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Contribution to the literature

- Identification of the environmental literacy aspect of prospective teachers is crucial so that they can be the main actors who have a role in "transmitting" their students.
- Instruments to measure spirituality-based environmental literacy have not yet been found, both globally and specifically in Indonesia, so the resulting instrument can be the main reference because of its pioneering nature.
- This study presents actual results related to exploratory factor analysis and confirmatory factor analysis of the draft spirituality-based environmental literacy instrument that can be used as a reference in developing similar instruments and proving the validity of the instruments that have been developed.

contribute to the educational for sustainable development goals (Altmeyer, 2021; Hanifah et al., 2020).

The results of searching on the Scopus database (as a manifestation of the world's most comprehensive database of reputable international journals) reveal that several previous researchers have tried to focus their investigation on this issue. Expert has long emphasized the significance of the relationship between environmental literacy and spirituality (Martin, 1994). This is then followed by several scientists (Chaichana et al., 2019; Robina-Ramírez et al., 2020; Singleton, 2015; Spínola, 2021). Specifically, other researcher review the relationship between spirituality and sustainability education (Matlock & Jurin, 2016). Spirituality will motivate humans to maintain ecological balance by shifting their focus from a mechanistic and materialistic view of the environment to an organic-transcendental view (McDaniel, 2002; Sayem, 2021). Beliefs, divine orientation, and spiritual experiences, as well as altruistic behavior, are related to sustainable behaviors in humans (Bella et al., 2021; Muñoz-García & Villena-Martínez, 2020). However, it is believed that human holistic evolution can occur with a balance of material and non-material aspects of spiritual, cultural, social, and environmental (Bożek et al., 2020; Huynh et al., 2022; Purvis et al., 2019; Summers et al., 2012). This exemplifies how close the relationship between sustainable development and spirituality is (Gupta & Agrawal, 2017).

Therefore, in the context of measuring environmental literacy, several instruments have been developed and utilized extensively. As a pioneer, Dunlap et al. (2000) introduce the new ecological paradigm scale for a new version in which it is a revision of the instrument they developed in 1978. Swanepoel et al. (2002) develop an instrument to measure the environmental literacy of teachers. Lloyd-Strovas et al. (2018) also develop the instrument for undergraduate college students; meanwhile, Rahman (2019) focuses his instrument on Aboriginal students. Meantime, Hunter and Jordan (2019) develop the "TELA" for environmental literacy educators. Currently, Szczytko et al. (2019) develop an instrument for adolescents. Yet, among the six previously developed instruments, no one has linked it with the spiritual aspect. It means that they ignore the aspects of environmental spirituality that are very likely to be owned by respondents in relation to environmental literacy (Mahat et al., 2022).

In line with the descriptions above, this study aims to develop an environmental literacy instrument based on spirituality (ELIS) to measure the prospective science teachers' environmental literacy. According to experts, spirituality in the environmental field is a manifestation of the spiritual relationship between humans and the environment (Heard et al., 2022). Spirituality in the environmental field includes intuitive awareness and manifests in life (Lincoln, 2000). Spirituality in the environmental field means having an attitude of respect for the environment in the form of preservation, feeling one with the universe, respecting the environment, understanding the risks involved in creating ecosystem imbalances, understanding the ethical dimension, protecting and preserving nature, and having curiosity in understanding ecosystems (Suganthi, 2019). Spirituality in the environmental field is crucial as a spirit carrier that can ignite spirituality for the life of human community on Earth (King, 2010). Ecology and spirituality are strongly linked, since deep ecological awareness is ultimately spiritual awareness (Shenoy, 2016). Through the implementation of ELIS, the environmental literacy of prospective science teachers can be assessed, and it can be linked to spirituality aspects.

This study is in line with the recommendation from previous studies that environmental literacy needs to be integrated with spirituality and religiosity, especially in countries that uphold spiritual values such as Indonesia (Husamah et al., 2022). This study is based on previous researchers' work with the environmental literacy instrument for adolescent or ELIA instrument (Szczytko et al., 2019). The researchers assume that strengthening spirituality is positively correlated with a person's real actions for environmental sustainability (Cobb, 2021). Personal optimism is also facilitated by healthy spiritual beliefs (Robertson, 2008). Religious beliefs have the strongest relationship with literacy, emphasizing the importance of continuous spiritual self-reinforcement, assessment, and reflection (Selby, 2018).

This research try to generate a valid instrument so that it can be used to measure the environmental literacy

based on spirituality for prospective science teachers in general, particularly in the country that considers spirituality important for society, and especially in countries where religion and spirituality come first (i.e., Indonesia). The instrument that we developed is expected to reflect the NAAEE definition of environmental literacy, which indicates that environmental literacy includes knowledge, skills, behavior, and motivation (hope) to solve current and future problems (North American Association for Environmental Education, 2011a, 2011b). Thus, this study directly discusses the content and framework of environmental literacy according to the NAAEE. However, the literacy referred to in this study is a development because it is based on the concept of spirituality. This study is expected to contribute to the development of spirituality-based environmental literacy studies, which can become a reference for researchers who have an interest in this topic.

METHODOLOGY

The explanatory mixed methods paradigm (combining two methods, namely qualitative and then followed by quantitative) was used to carry out this study, which was aimed at developing environmental literacy based on spirituality (ELIS) instruments. The instruments were used to measure the aspect of environmental literacy of prospective science teachers. ELIS was developed using the process of Suwono et al. (2022) who divided the patterns into three: namely, domain and items, expert validation, exploratory factor analysis (EFA), and test content validity and data reduction as well; and construct validity and internal consistency from instruments generated through confirmatory factor analysis (CFA).

Development of Domains and Items

In this stage, the researchers carried out an item preparation by searching for the literature using "environmental literacy", "environmental literacy instrument", "environmental literacy and spirituality", and "spirituality scale" keywords, particularly in the Scopus database and Google Scholar. A review of the literature was focused on the aspect of environmental literacy based on spirituality as the basis for instrument development. The researchers discovered several instruments during our investigation, including the environmental literacy instrument (ELI) for undergraduate college students (Lloyd-Strovas et al., 2018), the environmental literacy instrument in the context of Aboriginal students (Rahman, 2019), teacher environmental literacy assessment (Hunter & Jordan, 2019), and environmental literacy instrument for adolescents or ELIA (Szczytko et al., 2019). The researchers adopted four domains elucidated by Szczytko et al. (2019), namely ecological knowledge, environmental hope, cognitive skills, and behavior. However, to make the ELIA completer and more useful, the researchers incorporated some elements from the other three sources of environmental literacy instruments.

Related to spirituality, the researchers also discovered that Butler (2010) had developed spirituality in professional practice scale. Furthermore, Butler (2010) developed personal spirituality. Specifically, the researchers adopted the integrative framework proposed by Chaichana et al. (2019) in which it was in the form of five components of environmental literacy, namely competencies (knowledge and skills in scientific and socio-cultural aspects), spiritual growth (knowledge and skills in the humanities), participation (norms of life), attitudes (appropriate character traits), and awareness (value awareness). This was in line with the theory elucidated by Singleton (2015) that ecological integrity also included recognizing and preserving spiritual knowledge and wisdom in all cultures that contributed to environmental protection and human well-being.

Based on the input of some experts, those various sources were adopted by the researchers. The researchers also added some items based on the reviewed literature. Based on input from experts that we need to adopt items from various sources but must adapt to conditions in Indonesia. Therefore, all of our items were adopted, sentence and context items were adjusted because they were considered important for assessing environmental literacy in students. Meanwhile, the existing literature is also in line with this view. We are not only adopting but also making modifications to suit the Indonesian context. Finally, at the end of the stage, the researchers compiled the environmental literacy based on spirituality (ELIS), which consisted of 40 items including the four domains, namely ecological knowledge (10 items), environmental hope (10 items), cognitive skills (10 items), and behavior (10 items). The questionnaire was compiled using a Likert scale consisting of five items, namely 1=strongly disagree, 2=disagree, 3=neither agree nor disagree, 4=agree, and 5=strongly agree.

Expert Validation and Exploratory Factor Analysis, and Testing Content Validity and Data Reduction

This stage was performed under expert validation and EFA. In this study, this stage was carried out to obtain a complete instrument to measure the environmental literacy of prospective science teachers.

Participants

Participants in this study included a total of 634 students who were prospective science teachers. Participants were divided into three, 134 students for descriptive statistics, EFA of 250 students, and also CFA

of 250 students. Thus, the participants for each analysis were different. The characteristics of the respondents are that they represent all of the main/largest islands in Indonesia, have various accreditation backgrounds for study programs, and represent all semester levels. They represented the entire territory of Indonesia (mewakili pulau-pulau terbesar di Indonesia), with the highest percentage coming from Java island, which was 35.9% (the largest Indonesian population was in Java and the highest universities were also in Java).

Meanwhile, other participants came from Sumatra at 22.6%, Bali/Nusa Tenggara Island at 19.3%, Borneo Island at 14.5%, and Sulawesi Island at 4.8%. Meanwhile, only 2.9% of participants were from Papua/Maluku Island, which was in line with the fact that the number of universities on the island was indeed the least compared to other regions in Indonesia.

The accreditation status of the participant study programs was quite diverse, namely 53.3% accredited B/very good, 37.4% accredited A/excellent, and 9.4% accredited C/good. According to gender, most of the participants were female students; there were 83.6% of female students and the rest of 16.4% were male students.

Meanwhile, participants' level semesters were varied, 30.6% were in 7th or 8th semester (currently/had taken courses related to environmental science), 26.3% were in 5th or 6th semester, 25.2% were in 3rd or 4th semester, and 4.1% was in 9th semester or more. This study's strength came from the respondents' varied backgrounds, which highlights how distinctive the participants' academic circumstances were (Brown, 2002). The number of participants in this study was significantly greater than the minimal number needed to do factor analysis research, which was typically between 100 and 150 (Dörnyei, 2003; Tabachnick & Fidell, 2019).

Procedure

In an effort to adhere to the health procedure since this study was carried out during the COVID-19 outbreak, the researchers distributed a questionnaire in the form of a Google Form. Additionally, this method had various benefits for researchers, including a wide range of potential participants, environmental friendliness, economic effectiveness, and lack of pushiness–only those who were willing would participate (voluntarily).

The researchers collaborated with the head of the biology education department, who was a member of the official organization, the Indonesian Biology Education Consortium, to make the distribution of the questionnaire easier. In this way, we ensure that those who fill out the questionnaire are students with prospective science teacher status (they are members of the student WhatsApp group in their respective study programs/departments). As a result, the distribution could be said to be official, to have met the requirements/permits, and to be legal. They assisted in the distribution of the questionnaire link to the students who were prospective science teachers throughout Indonesia (generally using WhatsApp groups facility).

Expert Validation and Exploratory Factor Analysis

The ELIS draft generated from the first stage would be handed over to the panel experts for reviewing so that it could determine its validity. The panel of experts consisted of 11 environmental education and environmental science experts. The experts were the expert in the field of instrument development.

The experts already had experience in teaching "environment and sustainability" material, had the status of a certified lecturer (in Indonesia, this was proof that a lecturer deserved professional status), and had an "educational" background in at least one of their undergraduate education levels. These 11 experts were asked to conduct an assessment qualitatively on the content validity for each item elucidated in the instrument. Each statement included in the instrument item was evaluated by all experts. This intended to guarantee that the instrument would be simple for respondents to comprehend, clear, and represent spirituality and environmental literacy.

The experts were given a fair amount of time, or one month, and were instructed to carefully examine the available items to ensure that there were no repetitive statements. By accomplishing this, the researchers could make sure the instrument met the definition of "constructively appropriate". Aside from selecting alternatives linked to each item, such as suitable, correct, or does not match/delete, the experts also were required to remark or make notes on each one. The 11 experts' responses provided support for initiatives to expand the scope of the developed instruments.

The researcher calculated the content validity ratio for each item that had been assessed by the experts. From the assessment, all of the items were relevant (all content validity ratio values were above 0.80). Hence, the final results of this stage consisted of 40 items. However, some advice from experts needs to be taken into account, and the researchers would use it as feedback.

The most common comments are typing error, repetition of words twice or more so that it did not comply with the correct writing rules in Indonesian, and some terms were still in English so it was possible that it would make it difficult for respondents who had limitations in understanding English. We accept all inputs and immediately follow up on these inputs by revising the items in question.

Testing Content Validity and Data Reduction

Researchers looked at student responses to ELIS, this could support content validity and achieved data

reduction. We used descriptive statistics, such as the mean, standard deviation (SD), and item-total correlation (Pearson product-moment correlation coefficient) to analyze the received scores. EFA is widely used in education research in the early phases of questionnaire development for constructing new dimensions (Tavakol & Wetzel, 2020). EFA reduced items by identifying interrelated and eliminating items that had an identical meaning. The item reduction stage resulted in a comprehensive instrument in which the existing domains and items reflected the environmental literacy based on the spirituality of prospective science teachers. The researchers counted the number of common domains based on eigenvalue >1 (greater than one). A varimax-based rotation method with Kaiser normalization was also used. Referring to the theory, if the rotated factor load was <0.50 or cross-loading was indicated, it was necessary to reduce the items. If the existing public domain consisted of only one item, then that item must be deleted (Suwono et al., 2022). The researchers adopted this provision and used it as an effort to ensure that there were at least two items in each public domain.

Construct Validity and Internal Consistency with Confirmatory Factor Analysis

The researchers performed this construct validity stage to make sure that they had exactly and accurately located the public domain of the items retrieved from the reduction stage hence CFA was employed by the researchers. The covariance matrix fit model was evaluated using maximum likelihood estimation. The researchers followed the previous studies that used a data matching index, such as the Chi-square goodness test (χ^2/df), root mean-square error from approximation, goodness-of-fit index, adjusted goodness-of-fit index, comparative fit index, and Tucker–Lewis index. Generally, the criteria used in the determination of model fit were χ^2/df≤3.00, and root mean-square error from approximation of ≤0.08 (Schumacker & Lomax, 2016; Tabachnick & Fidell, 2019); and goodness-of-fit index, adjusted goodness-of-fit index, comparative fit index, and Tucker–Lewis index, which indicated the status was accepted if the value was ≥0.9 with an indication of "good fit" (McCoach et al., 2013).

Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE) were also utilized to ensure that the items in the instruments were internally consistent. Multivariate analysis scientists i.e., Hair et al. (2010) provided suggestions on the acceptable values, namely Cronbach's alpha (≥0.6), CR was ≥0.7, and AVE was ≥0.5. Several experts such as Ahmad et al. (2016) and Huang et al. (2017) provided the value of CR that was ≥0.6. This size could be an alternative. The researchers also tested concurrent validity by connecting the four domains to the overall score.

Table 1. Results of descriptive statistical analysis

Item	Mean	SD	r	Item	Mean	SD	r
1	4.12	1.15	0.829**	21	4.06	1.11	0.918**
2	4.40	1.03	0.776**	22	4.18	1.08	0.890**
3	4.26	1.01	0.897**	23	4.10	1.11	0.926**
4	3.96	1.01	0.851**	24	4.24	1.00	0.868**
5	4.32	1.15	0.865**	25	4.22	1.03	0.895**
6	3.96	1.12	0.848**	26	4.10	1.07	0.915**
7	4.22	1.06	0.911**	27	3.98	1.15	0.923**
8	4.22	1.13	0.920**	28	4.04	1.09	0.865**
9	4.24	0.98	0.900**	29	4.18	0.94	0.842**
10	4.26	1.05	0.884**	30	4.22	1.03	0.805**
11	4.18	1.06	0.929**	31	4.38	1.03	0.812**
12	3.98	1.12	0.843**	32	4.18	1.02	0.795**
13	4.10	1.05	0.855**	33	4.36	1.04	0.742**
14	4.12	1.10	0.881**	34	4.38	1.05	0.869**
15	4.14	1.14	0.875**	35	3.84	1.11	0.670**
16	4.22	1.15	0.929**	36	4.22	1.13	0.648**
17	4.20	1.05	0.812**	37	4.10	1.34	0.482**
18	4.38	1.03	0.888**	38	3.90	1.15	0.648**
19	4.20	1.11	0.913**	39	4.34	0.96	0.685**
20	4.08	1.10	0.933**	40	4.24	1.15	0.654**

RESULTS

Table 1 displays the findings of the descriptive statistical analysis. The descriptive statistics analysis results show that SD does not exceed 2.5 SD from the mean and that the Pearson correlation value has a significant and positive correlation (p-value <0.01).

According to **Table 1**, the mean value of the items ranges from 3.90 to 4.40, with an SD of 0.96 to 1.27. Pearson product-moment correlation coefficient ranges from 0.482 to 0.933, with a 0.0000<0.01 significance level. Pearson product-moment correlation is a type of correlation test that is used to determine the degree of relationship between individual item scores and total score. Referring to these values, it can be said that the coefficient values range from "the correlation is quite large or strong enough" to "the correlation is very large or very strong". As a result, all items in this instrument can be used in conjunction with the EFA test.

The item reduction stage uses the EFA test, the results are presented in **Table 2**.

Based on **Table 2**, it can be seen that the results of the EFA test show that the Kaiser–Meyer–Olkin measure of sampling adequacy is in the "very good/special" category with a value of 0.935, in accordance with the criteria presented by Kaiser (1970). The data meet the requirements for the EFA test, as indicated by the Bartlett test value of 0.000. The EFA test generates five dimensions with a total percentage of 65.078% (within the recommended range). There are 10 items with a loading factor of less than 0.5 (items 32, 39, 36, 2, 3, 4, 23, 14, 10, 37, 7, and 1) and one item in one dimension (item 12) among the 40 items, leaving 27 items.

The results of the next stage, CFA, are shown in **Figure 1**.

Table 2. Exploratory factor analysis test

Dimension	Item	LF	E	% of V	C %
1	25	0.784	11.992	44.415	44.415
	28	0.724			
	24	0.709			
	27	0.668			
	30	0.644			
	29	0.614			
	26	0.608			
	22	0.559			
2	8	0.727	1.639	6.072	50.487
	9	0.663			
	5	0.662			
	18	0.649			
	19	0.598			
	11	0.558			
	6	0.531			
	7	0.506			
3	31	0.763	1.477	5.469	55.956
	33	0.759			
	34	0.665			
	40	0.600			
4	21	0.625	1.417	5.247	61.203
	13	0.613			
	15	0.603			
	16	0.558			
	20	0.543			
5	35	0.794	1.046	3.874	65.078
	38	0.739			

Note. LF: Loading factor; V: Variance; E: Eigenvalues; C: Cumulative; KMO MSA=0.935; & Bartlett's test=0.000

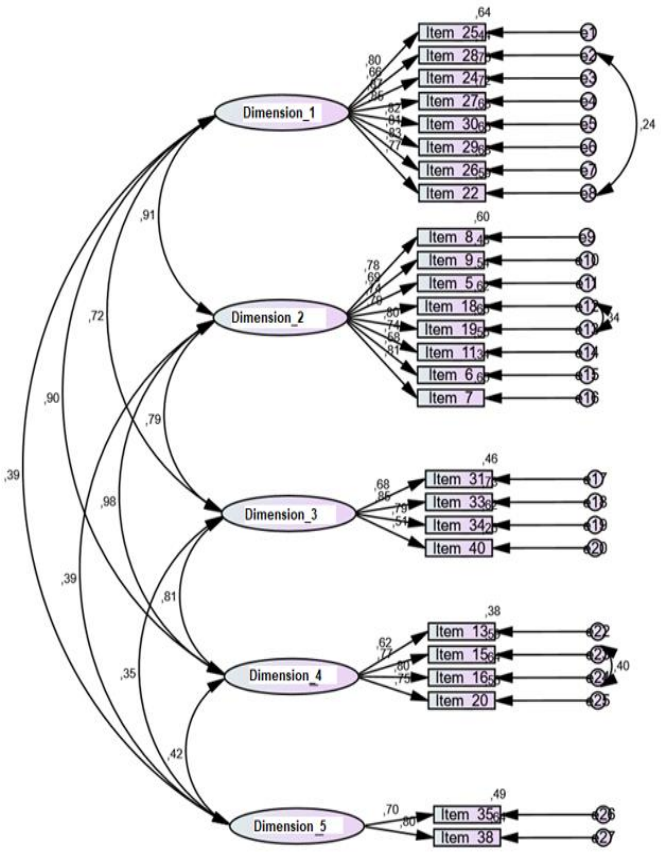

Figure 1. Results of confirmatory factor analysis (CFA Results)

The results of CFA with six dimensions (correlated model) show that good of statistics is not good, where the value of χ^2/df>3, and the value of GFI, AGFI, TLI, NFI, and CFI are far from 0.90, and even below 0.70 (poor). Considering the deletion of several items with value lambda (λ) less than 0.5 (item 7) and relate items with modification indices (MI) that are too high with other items in the same dimension (e.g. items 28 and 22 in dimension 1, items 8 and 19 in dimension 2, and items 15 and 16 in dimension 3), then the GOF value can be increased by χ^2/df=1.965 (good), GFI=0.861 and AGFI=0.829 (acceptable), NFI=0.883 (acceptable), TLI=0.930 and CFI=0.938 (good), RMR=0.034 (good), and RMSEA=0.062 (good). Thus, the remaining items are as many as 26 items (five dimensions).

The last stage is analyzing the internal consistency, which is shown in **Table 3**.

We measure internal consistency to answer whether the scale works even with different respondents. The measures used included Cronbach's alpha, CR, and AVE in each dimension. Departing from **Table 3**, the value of CR and Cronbach's alpha meets the criteria, namely ≥0.6. Meanwhile, the value of AVE meets the criteria of ≥0.5. Hence, all dimensions/items have internal consistency so that they can be utilized. Dimensions and items that can be utilized, as well as those that we delete will be presented in the discussion section.

DISCUSSION

This study is carried out to develop and validate the ELIS of which instrument can be used to diagnose the level of environmental literacy of prospective science teachers, particularly in Indonesia or even another country that has similar characteristics. The ELIS is developed by means of rigorous statistical and psychometric processes to ensure that the instrument is valid and reliable. The environmental literacy for the teachers and even prospective science teachers are crucial as a result or embodiment of environmental education and educational for sustainable development (McBride et al., 2013; Szczytko et al., 2019), as well as sustainable development (Boeve-de Pauw et al., 2022; Cebrián & Junyent, 2015; Ploum et al., 2018). Teachers and prospective teachers have a significant role in achieving sustainable development education targets and achieving sustainable development goals (Al-Kuwari et al., 2021; Chisingui & Costa, 2020; Fischer et al., 2022; Novidsa et al., 2020).

The researchers assure that the instruments can provide a significant contribution in measuring environmental literacy based on spirituality of prospective science teachers and even for science teachers in Indonesia and other countries that have similar characteristics. This is because many countries are beginning to recognize the importance of religion

Table 3. Internal consistency

Dimension	Item	LV (λ)	CR	AVE	CA (α)
1	25	0.802	0.94	0.65	0.94
	28	0.663			
	24	0.870			
	27	0.847			
	30	0.822			
	29	0.814			
	26	0.827			
	22	0.766			
2	8	0.777	0.91	0.56	0.91
	9	0.694			
	5	0.736			
	18	0.789			
	19	0.804			
	11	0.742			
	6	0.585			
	7	0.806			
3	31	0.679	0.81	0.52	0.78
	33	0.853			
	34	0.790			
	40	0.512			
4	13	0.617	0.82	0.54	0.84
	15	0.770			
	16	0.798			
	20	0.745			
5	35	0.702	0.73	0.56	0.72
	38	0.799			

Note. LV: Lambda value & CA: Cronbach's alpha

and spirituality in efforts to achieve educational targets for sustainable development in particular and sustainable development goals in general (Azman et al., 2021; Burford et al., 2013; Filho & McCrea, 2018; Koenig, 2012; Tkáˇcová & Slivka, 2021).

Domain and Questionnaire Item

This study has succeeded in identifying five domains, which are similar to Szczytko et al. (2019), namely ecological knowledge, environmental hope, cognitive skills, and behavior. The results of this study are in line with the first design, as the researchers have adopted into a single entity from various sources (which we call it by the term ELIS) namely environmental literacy instrument (ELI) for undergraduate college students (Lloyd-Strovas et al., 2018), environmental literacy instrument in the context of Aboriginal students (Rahman, 2019), teacher environmental literacy assessment (Hunter & Jordan, 2019), and environmental literacy instrument for adolescents (Szczytko et al., 2019).

The ELIS is also in line with the spirituality domain that has been adopted from Borg (2007) and Butler (2010), as well as specifically in accordance with the integrative framework of Chaichana et al. (2019). Yet, the items are different since the items are reduced, as presented in **Table 4**.

Table 4. Four remaining/selected dimensions

No	Domain	Item
1	Ecological knowledge	1. The sun is the original source of energy for all life on Earth's surface. 2. The biosphere refers to all living organisms and non-living parts of the environment. 3. Water falling from the atmosphere in the form of rain, ice, or snow occurs after surface water is heated and turns into a gas in the clouds, then the gas cools and turns back into a liquid in the atmosphere. 4. Worms, bacteria, and fungi play an important role in recycling the remains of dead organisms. 5. Shrimp have a desire for clinging to sea cucumbers. This interaction benefits the shrimp because it obtains the rest of the food from the sea cucumber. Meanwhile, the presence of shrimp around them has no effect on sea cucumbers. Commensalism refers to this type of symbiotic relationship.
2	Environmental hope	6. I believe that people (together) will be able to solve most environmental problems. 7. I believe that scientists will find a solution to environmental issues. 8. As a religious person, I am aware that environmental issues concern me. 9. Because everyone can learn from their mistakes (including the mistakes of others), our positive role will have a positive impact on the environment (religion teaches repentance). 10. We can solve environmental problems if everyone works together (because religion wants people to help each other in goodness). 11. Environmental issues are extremely complex, but we must always believe that we can overcome them (religion teaches humanity to be optimistic). 12. Because my religion teaches these principles, I am aware that there are numerous things I can do to assist with environmental issues.
3	Cognitive skills	13. Human populations are rapidly expanding geometrically, while agricultural lands are eroding, forests are dwindling, species are facing extinction, clean water supplies are dwindling, fisheries are declining, and pollution is endangering human health. 14. Air pollution is defined as the presence of contaminants (in the form of one or more physical, chemical, or biological substances) in an open space (atmosphere) at such a concentration and duration that it causes disturbance, harm, or has the potential to harm the health of humans, animals, plants, or objects–other objects that can interfere with comfort and aesthetics. 15. Global warming is the gradual increase in the temperature of the earth's surface caused, in part, by pollutant emissions. These pollutants accumulate in the atmosphere, forming a thick layer that blocks the sun and contributes to global warming and the greenhouse effect. Climate change caused by global warming will disrupt the lives of living things on a global scale.

Table 4 (Continued). Four remaining/selected dimensions

No	Domain	Item
3	Cognitive skills	16. Conservation of living natural resources and their ecosystems aims to preserve living natural resources and the balance of their ecosystems in order to better support efforts to improve community welfare and human life quality. This is the government's and the community's responsibility and obligation. The protection of life support systems, the preservation of the diversity of plant and animal species and their ecosystems, and the sustainable use of living natural resources and their ecosystems all contribute to the conservation of living natural resources and their ecosystems. 17. The environmental conditions of nature conservation areas are exploited while the functions of the area are preserved. Utilization of wild flora and fauna species is done while keeping in mind the potential, carrying capacity, and diversity of wild flora and fauna species. Under certain conditions, it is critical to maintain or restore the sustainability of living natural resources and their ecosystems. 18. The relatively rapid population growth has consequences for the availability of land, which is insufficient to meet the demands of living welfare. The amount of available land is fixed and cannot be increased in order to increase the environmental burden. Nature's carrying capacity appears to be becoming increasingly out of balance with the rate at which demands for meeting population needs are increasing. On this basis, systematic environmental exploitation is carried out in a variety of ways and under various pretexts. 19. The goal of quality sustainable development is to provide human beings with a decent standard of living in this world and the next, including adequate clothing, food, shelter, education for their children, good health (including environmental health), necessary employment opportunities, security and political freedom, freedom from fear and violence, and the freedom to exercise their rights as citizens. This level of well-being is sought by preserving the natural environment and ensuring the availability of necessary resources. 20. Technological solutions, political regulation, or financial development cannot achieve sustainable development. Quality education and learning are urgently required for sustainable development at all levels and in society. Education for sustainable development (ESD) is a community-wide effort to encourage constructive and creative responses to global challenges in order to build a resilient and sustainable society.
4	Behavior	21. When I leave the house, I turn off the lights. 22. When not in use, I turn off the water. 23. I close the fridge door after removing items or if I have not decided what to remove for a while. 24. At home, I recycle. 25. On campus and/or in the community, I am involved in natural resource conservation activities. 26. I learned skills that can help a lot of people and prefer eco-friendly skills.

Meanwhile, the deleted items are as presented in **Table 5**.

In the context of prospective science teachers in Indonesia, the change in the number of items that respondents prefer to accept reveals an intriguing phenomenon. Prospective science teachers in Indonesia are very interested in incorporating spiritual values into the implementation of environmental education, particularly in achieving environmental literacy.

Incorporating spirituality and religion into environmental education (including environmental literacy) is one way to connect students with systems that are important to them (Crowe, 2012). In the context of environmental literacy, religious people must have a purpose in our role of promoting concern for the natural environment and our interactions with it. Religious people must create environmental education that incorporates spiritual components. The community, especially students are called to set a good example for the people around us (Murdoch, 2012).

The ecological literacy emphasis is a clear emphasis on sustainability, as well as the introduction of a spiritual, holistic component, expressed in terms of "celebration of Creation", "spirit", "reverence for the Earth", and "soul expansion". Eco-literates are prepared to be effective members of a sustainable society because they have a comprehensive ability of head, heart, hands, and soul, which includes an organic understanding of the world and participatory action in and with the environment (McBride et al., 2013). Sustainability education is also linked to scripture. It is founded on the experience of Creation's natural beauty, which evokes feelings of awe and spiritual awe that are directly related to environmental protection (Robina-Ramírez et al., 2020).

The positive impact of eco-spirituality attitudes, perceived behavioral control, and subjective norms is observed on sustainable consumption intentions, whereas the total indirect impact of environmental awareness and environmental knowledge on sustainable consumption intentions is higher with partial mediation of attitudes from eco-spiritually (Jaciow et al., 2022; Pimdee, 2021; Rasanjalee & Lakshika, 2021; Yang et al., 2018). Spiritual belief possessed by individual has function as basic morality that culminating in moral behavior. Spiritual experiences enable one to go beyond a narrow self-concept and to practice genuine empathy with others and to take an all-encompassing perspective (Rasanjalee & Lakshika, 2021).

Respondents can accept five items with spiritual nuances, all of which are in the domain of environmental hope. First, "as a religious person, I am aware that environmental issues affect me." This is consistent with the view that individual religious awareness of

Table 5. Deleted items

No	Domain	Item
1	Ecological knowledge	1. Phosphate is considered dangerous for rivers, because it causes algae/algae to grow rapidly which can reduce oxygen in the water. 2. Ecology is the study of the relationship between organisms and their environment. 3. A series of predictable changes that occur in a community over time is called succession. 4. There are four ironwood trees (eusideroxylon zwageri) per hectare in a certain area of the National Park. The population characteristic that this information refers to is population density. 5. One of the efforts to prevent erosion on sloping land is to make swales by reforestation.
2	Environmental hope	1. The actions I take alone are too small to help solve most environmental problems. 2. When some people give up, I know there will be people who will continue to try to solve environmental problems because it is based on their religious beliefs and commands. 3. Every day, I believe that more and more religious people are concerned with environmental issues.
3	Cognitive skills	1. Snapper is a fish that is often caught in recreational and consumption activities. Commercial anglers and fishermen spend more time fishing for snapper than usual. In this regard, according to experts, we must ensure that fishing for snapper in a sustainable manner from time to time is very necessary. Thus, we have to think about many things to determine the best solution to the problem. The most important question to ask when you start solving this problem is "how many new snappers are introduced into the population each year, so that the population remains safe?" 2. Overall, society is pursuing economic growth by ignoring the declining quality of natural resources while human growth depends on it. 3. Conservation of living natural resources and their ecosystems aims to achieve the realization of the preservation of living natural resources and the balance of their ecosystems so that they can better support efforts to improve community welfare and the quality of human life. This is the responsibility and obligation of the Government and the community. The conservation of living natural resources and their ecosystems is carried out through the protection of life support systems, preservation of the diversity of plant and animal species and their ecosystems and the sustainable use of living natural resources and their ecosystems.
4	Behavior	1. I pick up trash found in the neighborhood. 2. I walk if I go to a nearby place or use a ride-hailing vehicle if I drive long distances. 3. I do not consume rare animals or plants. 4. I apply ethics based on religious teachings in my life related to the environment.

environmental problems is related to belief in life after death and divine intervention (Hope & Jones, 2014). Environmental awareness results in beliefs and willingness to sacrifice for the environment, individual behavior related to the personal environment, and even political environmental activism (Fang et al., 2020). As a result, developing effective strategies for communicating environmental issues and risks within religious traditions, as well as encouraging collaboration among religions and beliefs, will be essential in addressing future global environmental challenges (Skirbekk et al., 2020).

Second, because everyone can learn from previous mistakes (including those of others), our positive role will have a positive impact on the environment (religion teaches repentance). It might be referred to as the respondent's anticipation of "Repentance to the Earth" in this context. This way of thinking reflects repentance for the unnaturally bad behavior of humans. The primary motivation is just to help make things better for the environment, including the natural and social settings. There is nothing grandiose about this. According to Wong (2019), the occurrence of various disasters -such as climate change–is a signal that "God's call to repentance". In line with the above statement, Northcott (2007) has emphasized that the trend of modern society to worship science without realizing the importance of spirituality is a dangerous extension of the problem. These people will simply be unable to get to the bottom of the issue. From the standpoint of faith, these people are guilty of selfishness and self-reliance, and they should repent. However, Balzer (1992) postulates that God has called us to care for and love the environment. We must believe that our actions will have an impact in accordance with God's plan for us, even if we cannot always quantify the benefits or see a complete solution at this time.

Third, "if everyone works together, we can address environmental issues (since religion calls for people to assist one another in goodness)". Religion teaches that in order to address environmental issues, we must cooperate or work together (Rahman & Jalil, 2021). This collaboration can be done in the context of multi-faith dialogical initiatives and program (Sayem, 2020). Religious communities must work together to become more environmentally friendly and to use their resources to overcome environmental challenges. If necessary, the desire to address climate change and environmental challenges must become communal awareness (Koehrsen et al., 2022).

Fourth, "environmental problems are extremely complex, but we must always believe that we can overcome them (religion teaches humanity to be optimistic)." Scientists have investigated about the relation between religion and climate change, which includes social science research on how religious

identity emerges in an optimistic attitude toward climate change, confessional involvement, and religious constructive thinking about how climate change affects religious people's lives, and how religion interprets climate change (Jenkins et al., 2018). Religion and spirituality spiritual has been closely associated with efforts to eliminate negativity, such as greater psychological distress, decreased well-being, difficulty finding meaning in life, and poor environmental relationships (Hart et al., 2020).

Fifth, "Because my religion teaches these principles, I am aware that there are numerous things I can do to assist with environmental issues". Religion and spirituality require an active complicity of individual to overcome environmental issues and develop positive relation with environment. Strong spiritual belief affects natural resource management since they actually associate people and natural resources (Chunhabunyatip et al., 2018). Environmental sustainability is arguably determined by how people choose to relate to the natural environment, and these relationships are fundamentally shaped by faith (Martinez, 2019).

Factorial Validity and Questionnaire Reliability

This study aimed to develop and validate ELIS for prospective science teachers. The researchers use two kinds of analyses, namely EFA and CFA. The researchers have ensured that the sample size is adequate based on the view of Meyers et al. (2016) since this is crucial in data analysis process and it will affect the obtained results. There are 634 of prospective science teachers as the respondents of this study. This amount exceeds the required amount of 100 to 150 (Dörnyei, 2003; Tabachnick & Fidell, 2019). The measurement results with the Kaiser–Meyer–Olkin test also shows excellent results. Number of final items that can be produced in this study is 26 (65%, from the initial amount of 40 items).

This study's sample size is quite large, which may have implications for producing meaningful statistical power. Cronbach's alpha coefficients are more significant than 0.80 for all items and most domains (total 0.96); This shows the fulfillment of the reliability aspect on all items in the instrument (Meyers et al., 2016). There are two domains that have Cronbach's alpha coefficient value of 0.72 and 0.78, namely the 3rd dimension group and the 5th dimension group. However, those numbers are still categorized as significant since the numbers are greater than 0.60. According to Hair et al. (2010), this result still represents reliability. It can be said that if referring to each domain and as a whole, ELIS can be utilized in further studies in measuring the aspect of environmental literacy for prospective science teachers. The analysis results of internal consistency reveal that the value of CR is 0.73-0.94 and Cronbach's alpha is 0.72-0.94, it means that the values meet the criteria, namely ≥0.7. Meanwhile, the AVE value of 0.52-0.65 also meets the criteria since the number is ≥0.5. Accordingly, all dimensions/items have internal consistency, and it is feasible to be used. In a nutshell, the four domains generated together can be used to illustrate the aspect of environmental literacy of prospective science teachers, particularly in Indonesia.

CONCLUSION

The ELIS developed has four dimensions, totaling 26 items: ecological knowledge (five items), environmental hope (seven items), cognitive skills (eight items), and behavior (six items). EFA and CFA are employed to assess validity and reliability. The dimensions and items are all internally consistent, making it possible to utilize them to illustrate the environmental literacy of prospective science teachers. This instrument is useful and significant in measuring aspects of environmental literacy of prospective science teachers, especially in the context of Indonesia.

Implications

The study on development and validation ELIS has theoretical and practical implications to assess environmental literacy for prospective science teachers in Indonesia. This study is the first study on ELIS, particularly in Indonesia; thus, further researchers can utilize this study as a reference and baseline. Further researchers can implement the ELIS in various colleges around Indonesia or countries that have the same demographic and cultural characteristics as Indonesia. Another researcher can also use learning model or implement environmental education learning at the college level, especially in the department of science education, the results of which can be assessed using ELIS. Further researchers may be able to improve this instrument in accordance with the times, theories, learning needs, higher education developments, and the flexibility of environmental education, particularly during a pandemic.

Author contributions: All authors have sufficiently contributed to the study and agreed with the results and conclusions.

Funding: No funding source is reported for this study.

Ethical statement: The authors stated that the study was approved by the Indonesian Biology Education Consortium in 2022. Informed consent was obtained from the participants.

Declaration of interest: No conflict of interest is declared by authors.

Data sharing statement: Data supporting the findings and conclusions are available upon request from the corresponding author.

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