Indexing environmental sustainability literacy knowledge among Malaysian youth: confirmatory factor analysis approach (CFA)

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Abstract. An index is one of the approaches to measuring behaviour and is commonly used in economics and social sciences. Therefore, this study aimed to investigate the key factors for indexing environmental sustainability literacy knowledge among Malaysian youth using exploratory and confirmatory analyses. Respondents consisted of 100 Malaysian youth who were selected using a simple random sampling technique. A questionnaire using a Likert scale was used to get the responses. The results show that study items achieved acceptable reliability with Cronbach Alpha values for each variable greater than .70 and meet the test of normality. Then, the data obtained were processed through an exploratory factor analysis (EFA) to observe the factor structure of environmental sustainability literacy knowledge. Next, a confirmatory factor analysis (CFA) was also conducted to validate the accumulated variables. In conclusion, the findings from both analyses have identified and validated the four key factors in Malaysian youth environmental sustainability literacy knowledge, namely lithosphere, hydrosphere, atmosphere, and biosphere. The findings also indicate that a fit indices value is in compliance with the terms set forth. Therefore, the four factors set out should be emphasized in the construction of instruments for indexing environmental sustainability literacy knowledge among Malaysian youth.

1. Introduction
Sustainability is the basis of any nation’s goals regarding economic, social, and political transformation [1] and the balance of ecosystems and human beings. As explained in the Sustainable Development Goals of 2030, there are 17 goals, which a nation needs to achieve in order to foster a more sustainable future and to address global challenges, such as poverty, inequality, climate change, environmental destruction, prosperity, peace, and justice. Hence, the agenda for improvement in terms of sustainability is a matter of concern. Moreover, as stated by [2], the establishment of a society that is environmentally conscious should be based on sustainable development.

Sustainable development comprises three key components (environmetal, economic, and social), as per the initial idea of sustainability written in the Bruntland Report [3]. Sustainability is referred to as resource used in any way that does not affect the environment or the well-being of people living on earth and does not destroy future generations' capacity to meet their needs adequately [4]. In Malaysia, the concept of sustainable development has been taken seriously since the instigation of the Second Malaysia Plan. The achievement of sustainability is still ongoing, now in accordance with the Eleventh Malaysia Plan. Malaysia is committed to its sustainable development goals (SDGs), which were put
forth to improve living standards, dignity, and the potential of people to participate in the economy and enjoy the wealth of the country.

In addition, the adoption of green growth will stimulate an important shift in the socio-economic development of the country while protecting development outcomes and biodiversity. In this case, the design of socio-economic development strategies that can improve sustainability under the conditions of climate change and natural disasters is critical. An environment that supports green growth is strengthened primarily in terms of policies, regulatory frameworks, human capital development, green technology investment, and financial instruments [5].

In the context of sustainable development, science plays a key role in supporting the growth of open-minded, critical, and literate people who will ensure that the quality of the environment remains preserved. Exposure to sustainability through education is the most influential agent of change in society. Such exposure enhances environmental literacy and improves humans’ capacity to address environmental issues [6].

Today, literacy is a necessity for building nations without ignoring the boundaries of humanity. Literacy is regarded as the basic knowledge and skills that must be acquired for societies across the modern world [7]. Literacy even helps children make decisions and master multiple languages to face the educational challenges of the 21st century [8]. In the field of education, literacy and access to educational opportunities can help people meet the demands of the job market, thus ensuring their economic prosperity and their community’s well-being [6]. In this way, literacy is the key to enhancing an individual’s capabilities and opportunities while benefitting their families, communities, and the nation.

Literacy is globally assessed through the 2030 Sustainable Development Goals (SDGs) aimed at achieving the goal of quality education (Target 4.6) by 2030, which are all youth and most adults, men and women, attaining literacy. This is because literacy can produce individuals who can solve the problem well by using a combination of intuition and logic (literacy) to produce solutions. Intuition in this context is the ability to understand something instinctively, without the need for conscious consideration, while logic is used according to principles and considerations. Along with the formation of individuals who can make decisions and solve problems, the role of literacy in creating awareness in individuals, in the context of sustainability, is undeniable.

Consequently, environmental sustainability literacy is a catalyst to change the model of economic development of the industrial community to meet the standards of the ecological era economic development model to build a higher civilization of society which is more concerned with environmental care while having good, sustainable, dynamic economic resources and working towards a more sustainable society [9] and [2]. This clearly demonstrates that the continuity of environmental studies should be implemented continuously at the planning, implementation, and evaluation levels in line with the changing technological and environmental conditions of the nation to maintain a sustainable community life in line with the green growth trajectory introduced by the government [5].

2. Methods

2.1. Population and Sampling
The sample of the study is 100 Malaysian youths, who are the initial sample for the verification of instrumentation measurement using the Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). The selection of samples was based on [9] and [10] who state that to conduct the analysis of Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA), the minimum sample size is 100 persons.

2.2. Instrument
This study used a questionnaire as a research instrument, which consisted of five parts, namely A, B, C, D, and E (Table 1). Part A contains respondents’ profile information, while Parts B, C, D, and E cover the constructs of the study, namely environmental sustainability (atmosphere), environmental
sustainability (hydrosphere), environmental sustainability (lithosphere), and environmental sustainability (biosphere).

Table 1. Respondent Questionnaire Information

| Part                          | Constructs                          | Number of Items | Source of Item                      |
|-------------------------------|--------------------------------------|-----------------|-------------------------------------|
| A                             | Background of Respondents Location  | 3               | Built according to study needs      |
|                               | Ages                                 |                 |                                     |
|                               | Gender                               |                 |                                     |
| B                             | Environmental Literacy Knowledge     | 15              | Built and modified from [9] and [11]|
|                               | (Atmosphere)                         |                 |                                     |
| C                             | Environmental Literacy Knowledge     | 15              | Built and modified from [9] and [12]|
|                               | (Hydrosphere)                        |                 |                                     |
| D                             | Environmental Literacy Knowledge     | 15              | Built and modified from [9]         |
|                               | (Lithosphere)                        |                 |                                     |
| E                             | Environmental Literacy Knowledge     | 15              | Built and modified from [13] and [14]|
|                              | (Biosphere)                          |                 |                                     |

2.3 Instrument Reliability

Table 3 shows the reliability of environmental sustainability literacy knowledge with Cronbach alpha values, which measure constructional internal consistency. According to [15], Cronbach alpha values are classified based on reliability index classification. A value of 0.90-1.00 is very high, a value of 0.70-0.89 is high, a value of 0.30-0.69 is simple, and a value of 0.00-0.30 is low. The results of the analyses show that the Cronbach alpha values were in the high and very high classifications, ranging from 0.70-0.95. The instrument of this study has high reliability according to [15] classifications.

2.4 Data Analysis Method

The questionnaire that has been through the data collection will be analyses using Exploratory Factor Analysis (EFA) for the grouping of items that actually represent the study’s variables. Reliability tests were performed for each variable, and it was discovered that the reliability values exceeded 0.7, while Confirmatory Factor Analysis (CFA) was carried out to determine construct validity. Confirmatory Factor Analysis (CFA) was conducted on the measuring model based on the hypothesised factors, using Analysis Moment of Structure - AMOS 18.

2.5 Background of Respondents

The backgrounds of respondents, consisting of 100 youths selected based on age, gender, and location categories. The findings show that 50 youths live in urban and rural areas. In addition, 50 youths are male, and 50 are female. Of the respondents, 50 are aged between 20 and 29 years old, and 50 respondents are aged between 30 and 39 years old.

2.5.1 Exploratory Factor Analysis (EFA) of Environmental Literacy Knowledge (Atmosphere) Construct

The results of the EFA on the measuring environmental literacy knowledge (atmosphere) construct indicated that the anti-image correlation analysis procedure had a correlation coefficient value greater than 0.5, which gave the impression that the factor analysis could be carried out. The sampling adequacy measurement of Kaiser–Meyer–Olkin (KMO) and Bartlett's Test of Sphericity showed that the KMO value was 0.794, and the Bartlett's Test of Sphericity was significant with a chi-square value of 755.316 at the degree of freedom of 171.

The researchers determining the number of factors to be extracted into three, as categorised in the questionnaire carried out factor analysis. Table 2 shows the component matrix with varimax rotation. The varimax rotation method was performed, as it is able to reduce the amount of complex constructs and increase the expected outcome. The results showed that the p10, p13 and p16 items were dropped for having an 'anti-image correlation matrix' of less than 0.5. The values of p1, p2, p3, p4, p5 and p6 belonged to component 1, which was knowledge of atmosphere sustainable factor (PF1), p7, p8, p9, p11
and p12 belonged to component 2, which was knowledge of atmosphere sustainable effect (PK1) and p14, p15, p17, p18 and p19 were accumulated in component 3, which was knowledge of atmosphere sustainable how to overcome (PCM1). The values shown in Table 5 are the coefficient or the loading factor for each item that tends to each factor accumulated. This value shows the correlation relationship between the item and the factor formed, which is the key to understanding the nature of these factors. Next, the CFA was conducted to confirm the results obtained from the EFA.

### Table 2. Component Matrix with Varimax Rotation of Environmental Literacy Knowledge (Atmosphere) Construct

| Item | PF1 | PK1 | PCM1 |
|------|-----|-----|------|
| p1   | .579|     |      |
| p2   | .644|     |      |
| p3   | .848|     |      |
| p4   | .656| .552|      |
| p5   | .645|     |      |
| p6   | .539|     |      |
| p7   |     | .596|      |
| p8   |     | .639|      |
| p9   |     | .733|      |
| p10  |     | .731|      |
| p14  |     | .644|      |
| p15  |     | .769|      |
| p17  |     | .795|      |
| p18  |     | .701|      |
| p19  |     | .726|      |

Legend:
PFI = Knowledge of Atmosphere Sustainable Factor
PK1 = Knowledge of Atmosphere Sustainable Effect
PCM1 = Knowledge of Atmosphere Sustainable How to Overcome

### 2.5.2. Confirmatory Factor Analysis (CFA) of Environmental Literacy Knowledge (Atmosphere) Construct

After EFA, CFA was performed using the AMOS 20 software to determine the model of CFA for the first levels of environmental literacy knowledge (atmosphere) construct. Figure 1 shows the first-level CFA model of environmental literacy knowledge (atmosphere) construct that achieved good compatibility accuracy. The model analysis reached a good level of compatibility based on the determined indicator (CMIN = 50.962, DF = 32, CMIN / DF = 1.593, p = .018, GFI = .907, CFI = .948, TLI = .927, and RMSEA = .077).

### 2.5.3. Exploratory Factor Analysis (EFA) of Environmental Literacy Knowledge (Hydrosphere) Construct

The results of the EFA on the measuring environmental literacy knowledge (hydrosphere) construct indicated that the anti-image correlation analysis procedure had a correlation coefficient value greater than 0.5, which gave the impression that the factor analysis could be carried out. The sampling adequacy measurement of Kaiser–Meyer–Olkin (KMO) and Bartlett's Test of Sphericity showed that the KMO value was 0.882, and the Bartlett's Test of Sphericity was significant with a chi-square value of 967.827 at the degree of freedom of 105.

The researchers determining the number of factors to be extracted into three, as categorised in the questionnaire carried out factor analysis. Table 3 shows the component matrix with varimax rotation. The varimax rotation method was performed, as it is able to reduce the amount of complex constructs and increase the expected outcome. The results showed that the values of p20, p21, p22, p23 and p24 belonged to component 1, which was knowledge of hydrosphere sustainable factor (PF2), p25, p26, p27, p28 and p29 belonged to component 2, which was knowledge of hydrosphere sustainable effect (PK2) and p30, p31, p32, p33 and p34 were accumulated in component 3, which was knowledge of
hydrosphere sustainable how to overcome (PCM2). The values shown in Table 8 are the coefficient or the loading factor for each item that tends to each factor accumulated. This value shows the correlation relationship between the item and the factor formed, which is the key to understanding the nature of these factors. Next, the CFA was conducted to confirm the results obtained from the EFA.

Table 3. Component matrix with Varimax Round Constructs of Environmental Literacy Knowledge (Hydrosphere) Construct

| Item | Component |
|------|-----------|
|      | PF2       | PK2       | PCM2      |
| p20  | .721      |           |           |
| p21  | .597      |           |           |
| p22  | .644      |           |           |
| p23  | .817      |           |           |
| p24  | .824      |           |           |
| p25  |           | .844      |           |
| p26  |           | .653      |           |
| p27  |           | .730      |           |
| p28  |           | .601      |           |
| p29  |           | .615      |           |
| p30  |           |           | .661      |
| p31  |           |           | .724      |
| p32  |           |           | .753      |
| p33  |           |           | .625      |
| p34  |           |           | .703      |

Legend:
PF2 = Knowledge of Hydrosphere Sustainable Factor
PK2 = Knowledge of Hydrosphere Sustainable Effect
PCM2 = Knowledge of Hydrosphere Sustainable How to Overcome

2.5.4. Confirmatory Factor Analysis (EFA) of Environmental Literacy Knowledge (Hydrosphere) Construct. After EFA, CFA was performed using the AMOS 20 software to determine the model of CFA for the first levels of environmental literacy knowledge (hydrosphere) construct. Figure 2 shows the first-level CFA model of environmental literacy knowledge (hydrosphere) construct that achieved good compatibility accuracy. The model analysis in Figure 2 shows that the model reached a good level of compatibility based on the determined indicator (CMIN = 45.787, DF = 24, CMIN/DF = 1.908, p = .005, GFI = .912, CFI = .956, TLI = .935, and RMSEA = .096).

2.5.5. Exploratory Factor Analysis (EFA) of Environmental Literacy Knowledge (Lithosphere) Construct. The results of the EFA on the measuring environmental literacy knowledge (lithosphere) construct indicated that the anti-image correlation analysis procedure had a correlation coefficient value greater than 0.5, which gave the impression that the factor analysis could be carried out. The sampling adequacy measurement of Kaiser–Meyer–Olkin (KMO) and Bartlett's Test of Sphericity showed that the KMO value was 0.801, and the Bartlett's Test of Sphericity was significant with a chi-square value of 948.536 at the degree of freedom of 120.

The researchers determining the number of factors to be extracted into three, as categorised in the questionnaire carried out factor analysis. Table 4 shows the component matrix with varimax rotation. The varimax rotation method was performed, as it is able to reduce the amount of complex constructs and increase the expected outcome. The results showed that the values of p35, p36, p37, p38 and p39 belonged to component 1, which was knowledge of lithosphere sustainable factor (PF3), p40, p41, p42, p43, p44 and p45 belonged to component 2, which was knowledge of lithosphere sustainable effect (PK3) and p46, p47, p48, p49 and p50 were accumulated in component 3, which was knowledge of lithosphere sustainable how to overcome (PCM3). The values shown in Table 4 are the coefficient or
the loading factor for each item that tends to each factor accumulated. This value shows the correlation relationship between the item and the factor formed, which is the key to understanding the nature of these factors. Next, the CFA was conducted to confirm the results obtained from the EFA.

Table 4. Component matrix with Varimax Round Constructs of Environmental Literacy Knowledge (Lithosphere) Construct

| Item | PF3 | PK3 | PCM3 |
|------|-----|-----|------|
| p35  | .786 |     |      |
| p36  | .769 |     |      |
| p37  | .839 |     |      |
| p38  | .737 |     |      |
| p39  | .578 |     |      |
| p40  |     | .716 |      |
| p41  |     | .844 |      |
| p42  |     | .726 |      |
| p43  |     | .592 |      |
| p44  |     | .849 |      |
| p45  |     | .727 |      |
| p46  |     | .810 |      |
| p47  |     | .751 |      |
| p48  |     | .842 |      |
| p49  |     | .737 |      |
| p50  |     | .677 |      |

Legend:
PF3 = Knowledge of Lithosphere Sustainable Factor
PK3 = Knowledge of Lithosphere Sustainable Effect
PCM3 = Knowledge of Lithosphere Sustainable How to Overcome

2.5.6. Confirmatory Factor Analysis (EFA) of Environmental Literacy Knowledge (Lithosphere) Construct. After EFA, CFA was performed using the AMOS 20 software to determine the model of CFA for the first levels of environmental literacy knowledge (lithosphere) construct. Figure 3 shows the first-level CFA model of environmental literacy knowledge (lithosphere) construct that achieved good compatibility accuracy. The model analysis shows that the model reached a good level of compatibility based on the determined indicator (CMIN = 8.772, DF = 6, CMIN / DF = 1.462, p = .187, GFI = .971, CFI = .992, TLI = .981, and RMSEA = .068).

2.5.7. Exploratory Factor Analysis (EFA) of Environmental Literacy Knowledge (Biosphere) Construct. The results of the EFA on the measuring environmental literacy knowledge (biosphere) construct indicated that the anti-image correlation analysis procedure had a correlation coefficient value greater than 0.5, which gave the impression that the factor analysis could be carried out. The sampling adequacy measurement of Kaiser–Meyer–Olkin (KMO) and Bartlett's Test of Sphericity showed that the KMO value was 0.839, and the Bartlett's Test of Sphericity was significant with a chi-square value of 1767.928 at the degree of freedom of 171.

The researchers determining the number of factors to be extracted into three, as categorised in the questionnaire carried out factor analysis. The component matrix with varimax rotation. The varimax rotation method was performed, as it is able to reduce the amount of complex constructs and increase the expected outcome. The results showed that the values of p51, p52, p53, p54, p55, p56, p57 and p58 belonged to component 1, which was knowledge of biosphere sustainable factor (PF4), p59, p60, p61, p62 and p64 belonged to component 2, which was knowledge of biosphere sustainable effect (PK4) and p65, p66, p67, p68 and p69 were accumulated in component 3, which was knowledge of biosphere sustainable how to overcome (PCM4). The values shown the coefficient or the loading factor for each item that tends to each factor accumulated. This value shows the correlation relationship between the
item and the factor formed, which is the key to understanding the nature of these factors. Next, the CFA was conducted to confirm the results obtained from the EFA.

2.5.8. Confirmatory Factor Analysis (EFA) of Environmental Literacy Knowledge (Biosphere) Construct. After EFA, CFA was performed using the AMOS 20 software to determine the model of CFA for the first levels of environmental literacy knowledge (biosphere) construct. Figure 1 shows the first-level CFA model of environmental literacy knowledge (biosphere) construct that achieved good compatibility accuracy. The model analysis in Figure 1 shows that the model reached a good level of compatibility based on the determined indicator (CMIN = 32.212, DF = 17, CMIN / DF = 1.895, p = .014, GFI = .932, CFI = .970, TLI = .950, and RMSEA = .095).

![Figure 1. First-Level CFA Model of Environmental Literacy Knowledge (Biosphere) Construct](image)

3 Result and Discussion
Based on the analysis of the study, the findings clearly show that each factor exploration factor (EFA) can produce a grouping of each item according to the set conditions as described in the research method. Atmosphere constructs, hydrosphere, lithosphere, and biosphere show three components, which are the factors, effects and solutions that address the requirements of the EFA procedure proposed by [14]. Once CFA that demonstrated the construction of environmental sustainability literacy model (i.e., atmosphere, hydrosphere, lithosphere, and biosphere) also meets, the conditions set by [14], [15] and [16], which state that a model corresponds to when the compatibility index shows the values as stated in the study method. Thus, it is concluded that the construct of environmental sustainability literacy knowledge can be broken down into four components, namely atmosphere, hydrosphere, lithosphere, and biosphere.

4. Conclusion
The main purpose of this article is to identify the components of environmental sustainability literacy knowledge among Malaysian youth using EFA and CFA, which is one of the steps in the initial study of the production of research instruments. The EFA and CFA results show that the validity of centralized and legitimate discrimination can be achieved. EFA findings show that four components of environmental sustainability literacy knowledge have been developed, namely atmosphere, hydrosphere, lithosphere, and biosphere. Each component has its own sub-components, factors, effects, and ways to overcome. Additionally, through this analysis, items were excluded. Out of the 69 initial items that have been constructed by researchers, there was 33 items have been selected to obtain a good compatibility index. Overall, the environmental sustainability literacy knowledge model generated from the CFA process can be used to measure the level of knowledge of environmental sustainability of environmental youth in Malaysia. The production of environmental sustainability literacy knowledge
instruments through a model that has been created via the CFA process is expected to be a guideline in construction of environmental sustainability index instrument.

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