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We will inform you about the developments of your paper in a month. Thank you for your interest to our journal.

Best regards.

Ahmet Savas, Ph.D.

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Preliminary Review of the Manuscript EU-JER ID#21111715274746

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Dear Dr. Akhmad Sukri, (akhmadsukri@undikma.ac.id)

Thank you for your interest to our journal.

We have received your manuscript entitled “Validating Student’s Green Character Instrument Using Factor And Rasch Model" (Manuscript EU-JER ID#21111715274746) .

We are analyzing your paper whether it was suitable to the standarts of our journal. And also we will check it for plagiarism. The status of your paper is "under preliminary review".

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Completed the preliminary review the manuscript EU-JER ID#21111715274746

European Journal of Educational Research <editor@eu-jer.com> 1 Desember 2021 pukul 03.39
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We will inform you about the result, when we get the reports from referees.

PS: As you can see in our web site, we kindly remind that the authors were not allowed to withdraw submitted manuscripts after preliminarily review because the withdrawal is a waste of valuable resources that editors and referees spent a great deal of time processing submitted manuscript, money, and works invested by the publisher.

Best regards,

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akhmad sukri <akhmadsukri@undikma.ac.id> 3 Desember 2021 pukul 16.41
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Thank you for the information.

Best regards
Akhmad Sukri
[Kutipan teks disembunyikan]

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Corrections request for the manuscript ID# 21111715274746

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Dear Dr. Akhmad Sukri,

Congratulations! After a thorough double-blind review, I am pleased to inform you that your manuscript entitled "Validating Student's Green Character Instrument Using Factor And Rasch Model" (Manuscript EU-JER ID#21111715274746) can be published on condition that corrections are made.

Please consider the reviewers' reports and emendations about your paper, please edit your manuscript and resend it as author names **blinded** paper by email attachment to us as soon as possible. In addition, we request to fill out the attached correction report what you have done as a word file. Please also highlight the edited parts in different (yellow and green) colors for each reviewer.

After we check your manuscript, we will send you the acceptance letter. The deadline for sending your finalized paper is **January 17, 2022** in order to publish in our next issue. If you need more time, please don't hesitate to contact me.

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On 03-Dec-21 11:41 AM, akhmad sukri wrote:

> Thank you for the information.
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> Best regards
> Akhmad Sukri

On Wed, Dec 1, 2021, 03:39 European Journal of Educational Research <editor@eu-jer.com> wrote:

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> PS: As you can see in our web site, we kindly remind that the authors were not allowed to withdraw submitted manuscripts after preliminarily review because the withdrawal is a waste of valuable resources that editors and referees spent a great deal of time processing submitted manuscript, money, and works invested by the publisher.
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Review Form

Manuscript ID:	EU-JER_ID# 21111715274746	**Date:**	29/12/2021
Manuscript Title:	Validating Student's Green Character Instrument Using Factor And Rasch Model		

ABOUT MANUSCRIPT (Mark with "X" one of the options)	Accept	Weak	Refuse	Not Available
Language is clear and correct		X		
Literature is well written	X			
References are cited as directed by APA		X		
The research topic is significant to the field	X			
The article is complete, well organized and clearly written	X			
Research design and method is appropriate		X		
Analyses are appropriate to the research question	X			
Results are clearly presented	X			
A reasonable discussion of the results is presented		X		
Conclusions are clearly stated	X			
Recommendations are clearly stated		X		

GENERAL REMARKS AND RECOMMENDATIONS TO THE AUTHOR

Revise the language of the article.

In-text citations are incorrect. Author surnames are duplicated. Please refer APA 7 manual for in-text citation style.

Please show final form of the instrument showing factors and loading items in conclusion section. I wonder if you conducted CFA, EFA and RASCH analysis again after eliminating those items (4 + 2). The factor, Environmental Habits, had two items before RASCH analysis. What happened to this factor after eliminating one of the items? If only one item is left (even a factor with two items is arguable) then measuring "Environmental Habits" with only one item is not very valid and reliable.

Please rewrite discussion part separately.

THE DECISION (Mark with "X" one of the options)

Accepted: Correction not required	
Accepted: Minor correction required	
Conditionally Accepted: Major Correction Required **(Need second review after corrections)**	X
Refused	

Reviewer Code: R2613 (The name of referee is hidden because of blind review)

Validating Student's Green Character Instrument Using Factor And Rasch Model

Abstract. Many researches have developed Instruments to measure one of the environmental characteristics such as attitudes, values and knowledge. However, there has not been any instrument that can be used to measure all these aspects in one comprehensive instrument. This study is meant to develop and validate a green character instrument which reveals student behavior and awareness of the environment. The instrument consists of 40 statement items consisting of 5 aspects, namely private pro-environmental behavior, public pro-environmental behavior, environmental knowledge, environmental values, and environmental attitudes. It was implemented on 1,398 students from 15 universities in Indonesia. The instrument content validation was conducted by 3 experts who were then analyzed using the content validity index (CVI). The construct validity was analyzed using exploratory factor analysis, confirmatory factor analysis, and RASCH. The content validity results obtained CVI scores ranging between 0.8 and 0.9 with a good category, while item reliability was in a fairly good category with a high level of separation index. Construct validation resulted in 34 items (4 items were eliminated from EFA and CFA, and 2 items were eliminated from RASCH) spread over five constructs, namely environmental behavior, environmental knowledge, environmental values, environmental attitudes, and environmental habits. The resulting instrument has a good level of item difficulty, with a well understood response set which can be understood easily by respondents, and without bias. Therefore, it can be used to measure the students' green character on both male and female.

Keywords: green character, instrument, factor and RASCH.

Comment [A1]: lowercase

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Comment [A3]: check grammar and meaning

Comment [A4]: check grammar

Comment [A5]: Rasch Analysis

Comment [A6]: after EFA and CFA anlysis

Comment [A7]: Avoid using abbreviation in abstract. Use full term.

Comment [A8]: after RASCH analysis.

Comment [A9]: Rasch Analysis

Introduction

Character is part of humanity (Pradhan, 2009). Character can be in the form of values, beliefs, behavior, and morality (Hidayati et al., 2021). Even doing something right can also be called character (Pradhan, 2009). Character is related to habits, ways to act and is a picture of actual behavior (Ryan, 2013). Character is defined as a personality which is formed from virtue and is used to think and act (Maisardi, 2017)(Rahman et al., 2020). Character consists of good and bad habits (Ryan, 2013), mental and behavior (Rahman et al., 2020). Character need to be formed as it cannot spontaneously arise (Muharlisiani et al., 2019). Therefore, character needs to be familiarized to the younger generation through continuous learning, examples, and practices (Rahmawati et al., 2020). People with character will have good morals (Asrial et al., 2021), who consciously controls every action and behavior (Maisardi, 2017).

Good character is needed in all aspects, such as in environment. Example of good character to the environment is implemented in an attitude of caring for the environment (Sanjaya, 2021)(Pane & Patriana, 2016). The character of caring for the environment must also be made accustomed (Arent et al., 2020)(Ridlo, 2020), and it is important to be developed as the environment will have an impact on human existence (Yunesa, 2019). Environmental care character will create positive behavior towards the environment (Sukri, Rizka, et al., 2020)(Asrial et al., 2021), and reduce the negative impact of human behavior on the environment (Sukri, Efendi, et al., 2020)(Palupi & Sawitri, 2018). In addition, concerning for the environment is very important as most of the environmental damage is caused by human behavior (Sukri et al., 2018)(Faisal et al., 2014).

The term green character in this study refers to a person's behavior and awareness of the environment. Behavior refers to human activities to protect the environment or what is called pro-environmental behavior (Stern, 2000), while awareness refers to knowledge (Raymond et al., 2010), values (Barton, 1994) and attitudes to the environment (Dunlap et al.,

Comment [A10]: Too many "Character ..." sentences. This may disturb readers. Would you consider reorganizing this paragraph and sentences?

Comment [A11]: Merge parentheses.

Comment [A12]: Put multiple citation in the same parentheses. Check other multiple citations and fix this error, if any.

Comment [A13]: This reference has two authors

2000). Therefore, caring for the environment attitude is part of a green character. The term green character was chosen to describe all positive behaviors and awareness of the environment. Frasz (Frasz, 2016) mentions environmental character as feelings, sentiments and virtues towards the environment. The term green is also used by Chankrajang (Chankrajang & Muttarak, 2017) to describe one aspect of attitude towards the environment which is pro-environmental behavior. By using the term green character, all behaviors, attitudes, knowledge, values, and all things with a positive impact on the environment can be covered which makes this term more universal.

Currently, it is difficult to find an instrument that can fully accommodate all aspects of behavior and environmental awareness. The research conducted by Stern (Stern, 2000) only developed an instrument to measure pro-environmental behavior, while Raymond et al (Raymond et al., 2010) focused on the knowledge aspect. In addition, Thompson & Borton (Barton, 1994) and Dunlap et al (Dunlap et al., 2000) only focused on values and attitudes aspects. The only similar research has been conducted by Fu et al (Fu et al., 2018), which unfortunately has some weaknesses, namely (1) limited to the behavior and awareness of the campus academic community and not generally applicable to the wider community, and (2) statement items developed in the instruments are mostly not in accordance with the conditions, context, and socio-cultural prevailing in many countries, such as in Indonesia. Whereas according to Chwialkowska et al (Chwialkowska et al., 2020) and He & Filimonau (He & Filimonau, 2020), a person's socio-cultural background influences his behavior towards the environment. For example, the statement item "I believe I know environmental issues well' presented by Fu et al (Fu et al., 2018) cannot be reduced to a concrete statement because it is not in accordance with the conditions of society in several countries with the same culture and conditions, especially Indonesia. The statement will become understandable if it is transformed into real environmental issues occuring in the community, for example

Comment [A14]: Incorrect format. Use Author (Year) format

Comment [A15]: Incorrect format. Correct format is: "... used by Chankrajang and Muttarak (2017) ..." Check other citation and fix "repeated surname" errors

Comment [A16]: Delete the author in the parentheses

“Illegal logging can result in the loss of clean water sources and natural disasters” and “Throwing garbage in rivers can cause damage to marine ecosystems”.

Therefore, this research is very important to be conducted to produce an instrument that can accommodate all aspects of environmental behavior and awareness. The resulting instrument can used to measure not only the knowledge, values and attitudes towards the environment, but also to measure behavior reflected in pro-environmental attitudes. The results of this study can be used as a reference for other researchers in different countries which have similar or even the same cultural and socioeconomic conditions to Indonesia, which will make this instrument will be more contextual and precise to measure the "green character" of students.

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Contribution to the literature

Comment [A18]: All subtitles should be left aligned, italic and not bold according to the journal’s paper template. Edit all.

- Some of the instruments developed by previous researchers were limited to certain aspects and did not cover all aspects of environmental behavior and awareness
- Instruments to measure green character have not been disclosed and have not been validated, especially in Indonesia
- Instruments validated of this study can be used to measure students' green character precisely because it is contextual and in accordance with the conditions experienced by students.

Methodology

This research is meant to develop and validate the green character instrument. The development is conducted through three steps; 1) analyzing the supporting literature and arranging the items, 2) content validation, 3) construct validation through Exploratory Factor Analyis (EFA), Confirmatory Factor Analysis (CFA), and RASCH (Saefi et al., 2020).

Literatur review and item arrangement

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Literature review is done to determine the representative variables for green character instrument. Literature analysis is based on studies or research results that have been published in reputable international journals such as research by Stern (Stern, 2000), Raymond et al (Raymond et al., 2010), Thompson & Borton (Barton, 1994), and Dunlap et al (Dunlap et al., 2000). Based on the results of the review, a draft of a green character instrument was prepared which includes 40 items. The green character instrument draft consists of private pro-environmental behavior aspects (Stern, 2000) covering 11 items; public pro-environmental behavior aspects (Stern, 2000) which consists of 8 items; environmental knowledge aspects (Raymond et al., 2010) with 6 items; environmental value aspects (Barton, 1994) with 8 items; and environmental attitudes aspects (Dunlap et al., 2000) which consists of 7 items. The student's response consisted of five answer choices; 1 = strongly disagree, 2 = disagree, 3 = indifferent, 4 = agree, and 5 = strongly agree.

Content validation

Content validity is evidence of the extent to which the elements of an assessment instrument are relevant and represent a construct targeted for a particular assessment objective (Almanasreh et al., 2019). Content validity includes four criteria; relevance, clarity, simplicity, and ambiguity (Yaghmaei, 2003). The validity of the green character questionnaire content is done by lecturers, practitioners and researchers in the environmental field as experts in their respective fields to obtain acceptable assessment. In conducting the assessment, the validator was asked to fill in four criteria which are, 1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = very relevant which was adjusted to 4 aspects of content validation. Furthermore, from the four criteria, dichotomous data was made to measure content validation using the content validity index method (Polit & Beck, 2006) with the provisions that CVI values > 0.79 were accepted, CVI values 0.70-0.79 were revised, and CVI < 0.70 were rejected (Devon et al., 2007). The results of CVI analysis on 40 green

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character instrument items show that the CVI values range from 0.8-0.9 for all aspects. Based on these results, all items in the instrument have met the valid criteria which were reviewed based on relevance, clarity, simplicity, and ambiguity.

EFA, CFA, and RASCH Analysis

Research sample

This study involved 1,398 students as respondents from 15 universities in Indonesia through random sampling (Endo et al., 2016). Respondents consisted of 972 women (69.53%) and 426 men (30.47%) with the age ranging from 19 to 22 years old. Respondents came from various regions in Indonesia including western, central and eastern Indonesia from various different majors such as social science, science, science education, engineering, humanities and business. The number of samples, 1,398 people, met the ideal limits for factor analysis (Tabachnick & Fidell, 2014) and RASCH analysis (Hagell & Westergren, 2016).

Data Analysis

The initial stage of the analysis was performed through an exploratory factor analysis (Williams et al., 2010). Prerequisite analyzes such as Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity were performed prior to EFA (Chan, L. L., & Idris, 2017). Furthermore, EFA uses the varimax rotation method (Osborne, 2015) and maximum likelihood estimation (Kassim et al., 2013) with the criteria of Eigenvalue > 1 (Yong, A. G., & Pearce, 2013), and a minimum loading factor of 0.3 (Prasetyo, K., Masrukan, M., & Sunawan, 2019). CFA was conducted to confirm the EFA results with model fit criteria based on the Root mean square error of approximation (RMSEA 0.06), Goodness of fit index (GFI 0.95), Comparative Fit Index (CFI 0.95), Tucker-Lewis Index (TLI 0.95), and X2/df < 3.00 (Sun, 2005). The RASCH analysis measures the validity of the instrument's construct in terms of content and consequential aspects (Susongko, 2016). Since the sample used is > 500 (Sumintono & Widhiarso, 2015), the item fit criteria are seen based on the mean-square infit

Comment [A25]: Use “et al.”

and outfit values (MNSQs, between 0.6 to 1.5), and the point-measure correlation coefficient (PTMEA Corr, between 0.3 up to 0.7)(Linacre, 2018). Items that meet one of these criteria are designated as valid items, while items that do not meet the criteria will be deleted from the instrument. Furthermore, the reliability value of the items received is between 0.65 and 0.83 (Sumintono & Widhiarso, 2015) with a separation index value of 1 and > 2 (Ismail et al., 2020). In addition to reliability, Wright map analysis was also performed to determine the items' level of difficulty (Scoulas et al., 2021) followed by rating scale analysis to evaluate the clarity and ease of interpretation of the response set in the instrument (Kim & Kyllonen, 2006). Finally, to avoid bias in the instrument, a Differential Item Functioning (DIF) analysis was conducted to determine the responses of male and female students (Iseppi et al., 2021).

Result and Discussion

Comment [A26]: Results and discussion section should be separated. Reorganize them as separate titles.

Exploratory Factor Analyis (EFA)

This study will test the green character instrument consisting of 40 items which are coded from A1 to A40. The first step to test the relationship between variables in the instrument is performing factor analysis. Factor analysis serves to reduce variables that are replaced by several factors which summarize the relationship between variables (Goldberg & Velicer, 2006). The initial assumption in factor analysis is the adequacy of the sample in the analysis (Hadia et al., 2016). Sample adequacy is measured by the Kaiser-Meyer-Olkin (KMO) value which must be greater than 0.5 (Hair et al., 2010). In addition to the adequacy of the sample, the assumption that must be met in the EFA is that there should be relationship between variables in the factors (Mohd Matore et al., 2019) which is indicated by the value of Bartlett's Test of Sphericity (BTS) which must be less than 0.05 (Chan, L. L., & Idris, 2017). The results of the KMO and BTS analysis are shown in Table 1 which shows that the KMO value is 0.917 and is in the very good category (Hadia et al., 2016), while the BTS value is <.001

which indicates that both EFA assumptions are met and acceptable for further analysis (Field, 2000).

Table 1. KMO and BTS Analysis Result

Kaiser-Meyer-Olkin	Bartlett's Test of Sphericity		
Overall MSA	X^2	df	p
0.917	18800.609	780.000	<.001

After the EFA assumption test is met, the next step is to perform a factor analysis of 40 instrument items using the varimax rotation method (Osborne, 2015) and maximum likelihood estimation (Kassim et al., 2013). To determine the number of factors being formed, the parallel analysis method was used (Çokluk & Koçak, 2016). The results can be seen in Figure 1 which shows that the implementation point is formed after five factors resulted in 5 constructs which were formed from the results of factor analysis. Each item in the formed factor has a loading factor of more than 0.3. The minimum factor loading value used in this study is 0.3 to indicate that the formed factor has met the fit criteria (Prasetyo, K., Masrukan, M., & Sunawan, 2019). The loading factor and the variance that were formed are shown in Table 2.

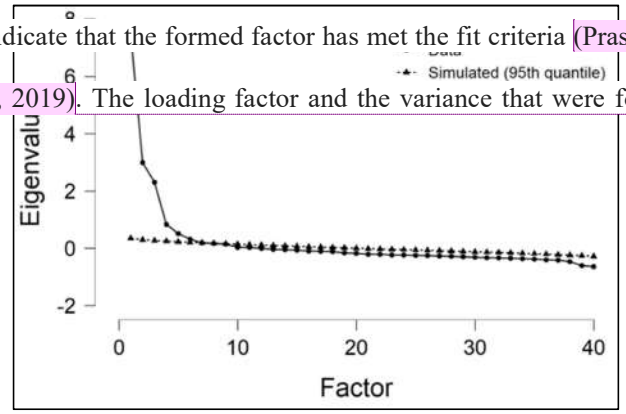

Figure 1. Scree plot Result of factor Analysis

Table 2. Loading factor and variants formed from factor analysis

Items	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
A1	0.362				
A2	0.344				

Comment [A27]: Use "et al."

Comment [A28]: Edit the scattered figures please

Comment [A29]: Figure title should be written in title case. Check other figure titles and fix errors, if any.

Comment [A30]: Table title should be written in title case and italic. Check other table titles and fix errors, if any.

A3	0.344				
A4	0.314				
A5	0.509				
A6	0.654				
A12	0.645				
A13	0.730				
A14	0.555				
A15	0.637				
A16	0.593				
A17	0.651				
A18	0.614				
A19	0.507				
A20		0.649			
A21		0.649			
A22		0.755			
A23		0.758			
A24		0.758			
A25		0.655			
A26			0.422		
A27			0.772		
A28			0.755		
A30			0.762		
A32			0.508		
A37			0.464		
A38			0.523		
A29				0.499	
A31				0.390	
A33				0.502	
A35				0.453	
A36				0.464	
A39				0.571	
A40				0.514	
A9					0.537
A10					0.721

Based on Table 2, several items such as items A7, A8, A11 and A34 were eliminated from the analysis because they had a loading factor of less than 0.3. Based on these results, 40 items were analyzed resulting in 5 factors. The five formed factors were then grouped and named according to the similarity of characteristics possessed by each item as follow factor 1, environmental behavior; factor 2, environmental knowledge; factor 3, environmental value; factor 4, environmental attitude; and factor 5, environmental habits. The results are strengthened by the Eigenvalue, variance, interitem correlation and Cronbach's alpha value which are presented in Table 3.

Table 3. Characteristics of the formed factors

Construct	Initial Eigen values	% of var.	Cumula -tive %	Average interitem correlation	Average interfactor correlation	Alpha Cronbach	N
Environmental Behavior (EnB)	4.77	11.90	11.90	0.31	0.03	0.85	14
Environmental Knowledge (EnK)	3.63	9.10	21.00	0.57	0.05	0.89	6
Environmental Value (EnV)	3.04	7.60	28.60	0.36	0.02	0.79	7
Environmental Attitude (EnA)	2.27	5.70	34.30	0.30	0.07	0.75	7
Environmental Habits (EnH)	1.54	3.80	38.10	0.60	0.06	0.74	2

Table 3 shows that the Eigenvalue is more than 1 (range from 1.54 to 4.77). Eigenvalue is a measure used to determine the number of factors being formed (Larsen & Warne, 2010). Based on the Eigenvalue, the 5 formed constructs are fit. This is in accordance with Yong & Pearce (Yong, A. G., & Pearce, 2013) opinion which say that the Eigenvalue value of more than 1 indicates that the factor has met the assumption of the fit criteria. Table 3 also shows the value of the variance formed on each factor (ranging from 3.80 to 11.90) with a cumulative variance of 38.10%. The cumulative variance value is relatively small as usually the cumulative variance for humanities research ranges from 50-60% (Pett et al., 2011). However, the resulting variance value is still acceptable as the other criteria have been met in the EFA analysis. The low value of this variance is thought to be caused by the maximum likelihood extraction method used. According to Costello & Osborne (Costello & Osborne, 2005), the principle component analysis (PCA) method in extraction produces a greater variance than the maximum likelihood (ML) method. This happens because PCA does not divide the unique variance from communalities so it sets all item communalities at 1.0, whereas ML estimates the level of shared variance for the items, which ranged from 0.39 to 0.70.

The range of the average interitem correlation values in the factors is 0.31 to 0.6 (Table 3). This indicates that there is a strong relationship between each item in the same factor.

According to Tabachnick et al (Tabachnick & Fidell, 2014), the interitem correlation value that exceeds 0.3 meets good factorability in the EFA. Table 3 also shows that the average value of interfactor correlation is smaller than the average value of interitem correlation in factors that range from 0.02 to 0.07. This proves that the instrument has good specificity. The intended specificity is the instrument's ability to distinguish the specificity of each factor based on its correlation value (Trumpower et al., 2010). The results of Cronbach's alpha analysis in Table 3 reveal that the reliability value ranges from 0.74 to 0.85. This shows that the instrument has good reliability. The reliability value above 0.7 proves that the instrument is reliable and acceptable (Yu & Richardson, 2015).

Confirmatory Factor Analysis (CFA)

To test the consistency of the formed factors, a confirmatory factor analysis was performed (Tomé-Fernández et al., 2020). CFA was conducted on 5 factors and 36 items. They are Environmental Behavior (EnB), Environmental Knowledge (EnK), Environmental Value (EnV), Environmental Attitude (EnA), and Environmental Habits (EnH) factors. The fit model criteria are based on the Root mean square error of approximation (RMSEA), Goodness of fit index (GFI), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and X2/df (Sun, 2005). The interpretation of the CFA fit model uses Diagonally Weighted Least Squares (DWLS), which is considered as the most suitable for not normally distributed data compared to the maximum likelihood model (Nye & Drasgow, 2011). The results of the CFA fit model analysis are shown in Table 4.

Table 4. Goodness of fit index confirmatory factor analysis

Index	Value	Cut off value	criteria
X^2/df	2.802	<3.00	Good
Root mean square error of approximation (RMSEA)	0.036	≤0.06	Good
Goodness of fit index (GFI)	0.957	≥0.95	Good
Comparative Fit Index (CFI)	0.952	≥0.95	Good
Tucker-Lewis Index (TLI)	0.948	≥0.95	Good

The results of the CFA analysis in Table 3 show that all fit criteria have been met by the model. The obtained RMSEA value is 0.036, CFI = 0.952, TLI = 0.948, GFI = 0.957, and x2/df = 2.802. All of these values have met the model fit criteria (Nye & Drasgow, 2011)(Prudon, 2014)(Hidayat et al., 2018). Therefore, the final measurement model which shows the structure of the green character instrument is shown in Figure 2. The results of this final measurement are then used for the validity and reliability of items using the RASCH model (Susongko, 2016).

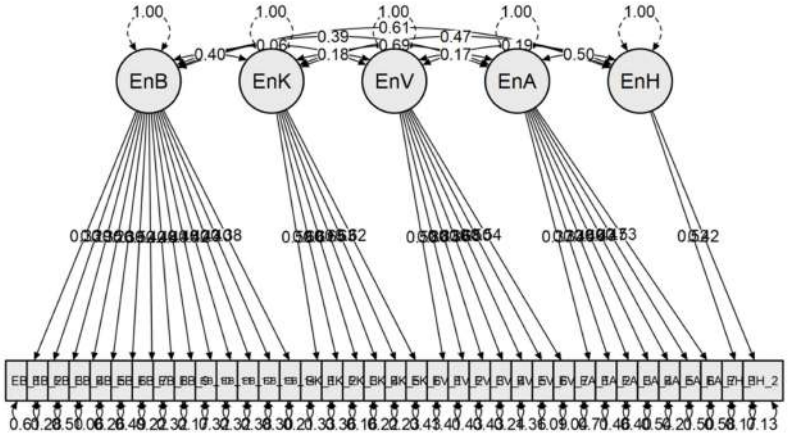

Figure 2. CFA final measurement model

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To strengthen the results of the EFA and CFA, a RASCH analysis was performed to determine the validity and reliability of the instrument following the Messick validity which includes several aspects namely content, substance, structure, external and consequential (Susongko, 2016). This research is only limited to the content and consequential aspects. The following describes the results of the RASCH analysis on the green character instrument.

Green Character Instruments Reliability

Reliability analysis was performed on five constructs, namely environmental behavior, knowledge, values, attitudes, and habits. The reliability analysis results showed that the item reliability values for each domain ranged from 0.99-1.00 with the item separation values

ranging from 9.63 to 24.44. A reliability value above 0.9 indicates that the instrument's reliability is in the good category (Saefi et al., 2020), while the separation index value of > 2.0 indicates that the measurement using RASCH can distinguish the instrument into several different groups or domains (Ismail et al., 2020). In addition, the results of the person reliability analysis ranged from 0.65 to 0.83 which include in the pretty good category (Sumintono & Widhiarso, 2015) with a separation index value ranging from 1 and above 2. These results indicate that the instrument has the capability to distinguish respondents' abilities, respondents with high and low performance (Ismail et al., 2020). The results of the measurement of reliability and separation of the item and person indices of the instrument are shown in Table 5.

Table 5. Reliability and Separation Index of Green Character Instrument

Construct	ID item	Item Measure		Person Measure	
		Reliability	Separation	Reliability	Separation
Environmental Behavior	EnB1-EnB14	1.00	16.88	0.83	2.18
Environmental Knowledge	EnK1-EnK6	0.99	9.63	0.78	1.89
Environmental Value	EnV1-EnV7	1.00	16.56	0.72	1.62
Environmental Attitude	EnA1-EnA7	1.00	23.52	0.65	1.35
Environmental Habits	EnH1-EnH2	1.00	24.44	0.66	1.40

Fit Analysis of Green Character Statistic Instrument

The fit index value indicates the quality of the items in the instrument which reveals how accurately the data fits the model (Scoulas et al., 2021). The fit model reference used in this study is the MNSQ infit/outfit value, and PTMEA, while the ZSTD infit/outfit value is ignored because the sample used in this research is > 500 (Sumintono & Widhiarso, 2015). The MNSQ value is used as an indicator of item discrepancy in the RASCH model (Ismail et al., 2020), while the PTMEA is performed to determine whether the instrument can distinguish respondents according to their response level (Saefi et al., 2020). The following describes the results of the item fit analysis for each construct shown in the Table 6.

Table 6. Item Fit Analysis Resultd of Green Character Instruments.

FACTOR	Item	Infit MNSQ	Outfit MNSQ	PTMEA
Environmental Behaviors	I bring my water bottle from home when traveling	1.0255	1.1764	0.3397
	I throw rubbish in the right place.	1.4535	1.2149	0.3775
	I ride bicycle or walk for short distance traveling.	0.8825	0.9661	0.3903
	I use public transportation for long distance traveling.	1.3165	1.6078	0.1784
	I keep my waste in my pocket or my bag when there is no trash can nearby and carry them until I find trash can.	0.8848	0.8299	0.4753
	I bring my own bag from home to reduce plastic waste when I go shopping.	0.8234	0.8759	0.4323
	I encourage my family and my colleagues to save resources	1.1317	1.0298	0.47
	I encourage my family and my colleagues to plan trees.	1.0375	0.9918	0.4587
	I support family members or colleagues activities in protecting the environment.	1.275	1.4922	0.2375
	I discuss environmental issues with family members and colleagues.	0.5566	0.6486	0.463
	I often involve in environmental cleaning activities.	0.7253	0.8411	0.4334
	I often pick up trash which scatter around public areas.	0.7584	0.7024	0.5311
	I remind family or colleagues who litter everywhere.	0.5751	0.6478	0.4271
	I throw waste from food and drinks in the right place when gathering with friends and families.	0.6102	0.6693	0.4198
Environmental Knowledge	Littering in the river can damage the sea ecosystem	0.6313	0.701	0.4039
	Using air conditioner can cause damage to the Ozon layers	0.7125	0.7815	0.4107
	Waste from motor vehicles can cause air pollution and climate change.	0.7462	0.7672	0.4929
	The extensive use of detergent can cause death for water creatures.	1.4783	1.2842	0.4844
	Illegal logging cam cause the disappearance of clean water sources and natural disaster.	0.8591	0.9089	0.4809

	Too many inhabitants can cause damage many places for housing	0.8618	0.8013	0.5501
Environmental Value	I prefer to see animal in the zoo to seeing them in the wild.	0.8494	0.7944	0.5503
	I do not need to worry about the environment damage as technology can solve that problem.	0.856	0.8029	0.5449
	Human does not always need nature to survive.	1.0492	1.0805	0.4782
	Let the environmental problem happen as it will be solved by itself.	1.0668	1.1274	0.4061
	Natural disaster such as flood, land slide, and drought do not have anything to do with environmental damage.	1.1545	1.3173	0.3169
	The environmental damage issues nowadays have been exaggerated.	0.8599	0.9589	0.404
	Human are here to rule the whole world.	1.2401	1.4703	0.1956
Environmental Attitude	I feel happy and pleased to be with nature	1.3965	1.5706	0.292
	The most important reason to protect the environment if to preserve the human sustainability.	1.554	1.5556	0.4062
	Human are part of the ecosystem just like animal.	1.4713	1.3966	0.4581
	Disturbing the nature will resulted in the damaging consequences.	1.3273	1.6123	0.316
	Plants and animals have the same right to live as how human does.	**1.9292**	**2.2336**	**0.3304**
	The balance of the nature is very sensitive and easily disturbed.	1.0766	1.2402	0.3712
	We will experience huge ecological disaster if everything continues as it is.	0.7641	0.8031	0.4858
Environmental Habits	I turn of the electricity when it is not in use.	1.1692	1.2962	0.3878
	I always turn off the tab when it is not in use.	**1.6487**	**1.9841**	**0.0954**

The results of the item fit analysis in Table 6 show that there are two items which do not meet the fit index criteria. One item on the environmental attitude construct is EnA5 and on the environmental habits construct is EnH2. The MNSQ and PTMEA infit/outfit values for each of these items are outside the predetermined index value (Bond & Fox, 2007)(Linacre, 2018).

In this study, the criteria for item acceptance were determined by three criteria, namely infit MNSQ, outfit, MNSQ, and PTMEA. If the item meets one of the predetermined fit index criteria, then the item in the instrument can be accepted (Sumintono & Widhiarso, 2015). This result is different from the result of factor analysis and confirmatory factor. Based on these results, the loading factor values for EnA5 and EnH2 items are 0.464 and 0.721, respectively (Table 2). The loading factor value is quite large and acceptable (Prasetyo, K., Masrukan, M., & Sunawan, 2019), but based on the results of item fit analysis using RASCH, both items do not meet the criteria and are declared as invalid items. This study found that there was a discrepancy between the results of the CFA analysis and the RASCH model. According to Scoulas et al (Scoulas et al., 2021), the RASCH model can detect potential measurement problems such as item bias or local item dependencies that may arise when measuring using classical validation methods such as factor analysis. Based on this assumption, researchers tend to eliminate both items which are considered as invalid items.

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Wright Map

Wright map analysis was performed to determine the level of difficulty of the items (Saefi et al., 2020)(Scoulas et al., 2021) which is shown in Figure 2. The results of the analysis in Figure 2 show that only 4 items namely EnB9, EnV7, EnV1 and EnH2 are considered difficult by respondents in understanding green character instruments. There were no items that were categorized as difficult to be understood by the respondents in the environmental knowledge component. Overall, the questions on the instrument can be easily understood by the respondent. This shows that the green character instrument has met the criteria for a good item difficulty level.

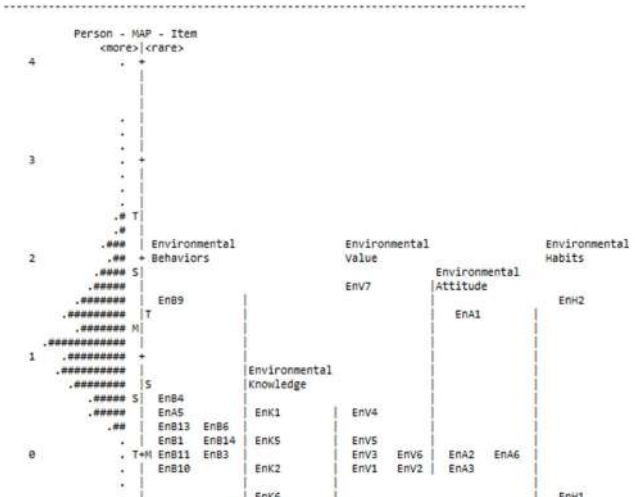

Figure 2. Wright Map respondent's perception toward the Green Character instrument

Rating scale Diagnostic

The next stage in instrument testing is done through rating scale diagnostics. This measure is used to evaluate the clarity and ease of interpretation of the response set in the instrument (Kim & Kyllonen, 2006). The rating scale visualization shown in Figure 3 shows the probability of the response category in the green character instrument according to the recommended pattern. Each category has a distinct peak at some point along the scale as expected (Scoulas et al., 2021). Thus, it can be concluded that the green character instrument response series is functioning properly (Saefi et al., 2020).

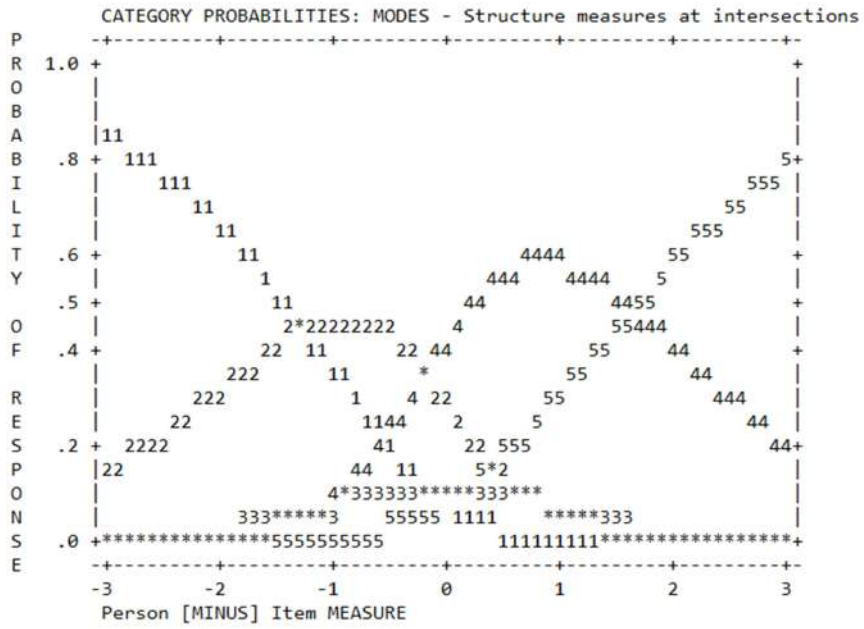

Figure 3. Probability Category curve of The green character Instrument

Differential Item Functioning (DIF) Analysis

DIF analysis was conducted to determine whether different subgroups, in this case gender, responded to items differently (Iseppi et al., 2021). In this study, DIF analysis was specifically used to reveal the ability to answer between male and female students to find out whether there was a bias from the items given. Question items that have a bias are indicated by differences in the ability to answer between male and female students. To overcome the bias in the items, Isepi et al (Iseppi et al., 2021) suggested to make two separate items, one item for men and another for women. The results of the DIF analysis of the green character instrument shown in Figure 4 show that there is no bias as evidenced by the graph of male and female responses approaching the normal line (green). This proves that the items in the instrument are free from bias and can be used to reveal green character for both male and female respondents.

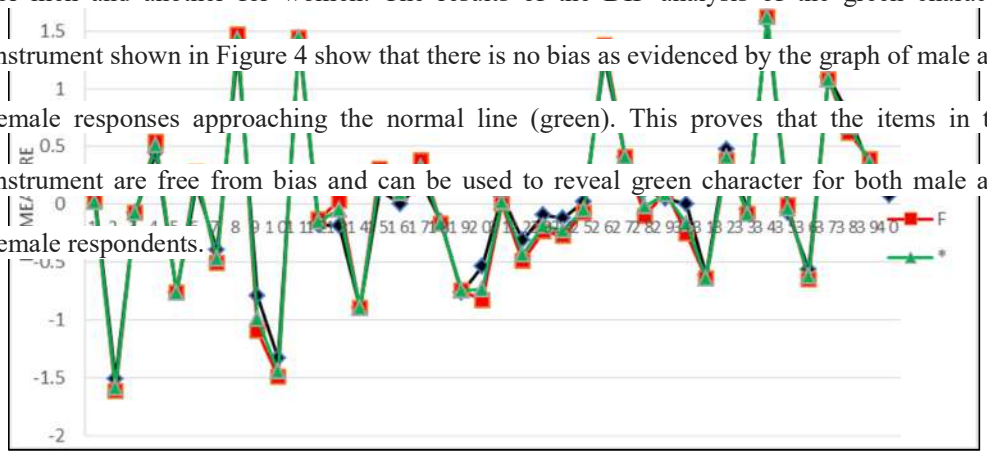

Figure 4. Graph of Person DIF of the Green Character Instrument

The result of factor analysis of 40 items of green character instrument resulted in five constructs with a total of 34 items (4 items were eliminated from EFA and CFA, and 2 items were eliminated from RASCH). The five formed constructs, namely Environmental Behavior (EnB), Environmental Knowledge (EnK), Environmental Value (EnV), Environmental Attitude (EnA), and Environmental Habits (EnH) were confirmed through the CFA and met the criteria for the Goodness of fit index (Table 4). These results indicate that the construct validity of the instrument has been met. This finding is in line with the theory that underlies this research such as the theories that have been tested by Stern (Stern, 2000) regarding Environmental Behavior, environmental knowledge (Raymond et al., 2010), environmental values (Barton, 1994), and attitudes towards the environment (Dunlap et al., 2000). Based on the results of the content validity analysis, which includes the fit item test, person-item map, and diagnostic rating scale, and the consequential validity which includes the DIF analysis, the green character instrument is declared eligible and has met the standard criteria that have been determined. However, this study revealed that one of the constructs, the Environmental Habits (EnH), experienced an item reduction to leave only one statement item. Based on these findings, the researcher believes that there is a lack of research caused by the lack of items used in this instrument. However, empirically, based on the results of the EFA, CFA and RASCH this questionnaire has met the standards in instrument development, so it can be used to measure the students' green character.

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Conclusion

Comment [A34]: Please show final form of the instrument showing factors and loading items in conclusion section.

This study shows that the green character instrument series has met the criteria for item validity and reliability using the EFA, CFA and RASCH models. The final result of this measurement produces 34 items which have met the item fit criteria. This questionnaire can reveal knowledge, behavior, values, attitudes and habits towards the environment. Although it was found that there were discrepancies in the results of measurements using factors and

RASCH, these three types of validity measurements should be used simultaneously so that they can complement one another.

Recommendations

Further research can be conducted to test the precision of the instruments that have been produced in revealing the students' green character in various demographic conditions. In addition, to obtain more comprehensive results, further research can be carried out at lower levels of education such as elementary, junior high and high school.

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Limitations

The environmental habits construct has too few items. This allows the occurrence of missing in the data. Therefore, further research can arrange more items so that they can represent constructs to get more valid and reliable results.

Acknowledgment

The researcher would like to thank the BRIN, Kemendikbud-Ristek of Republic Indonesia for support this research through the PTUP scheme.

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ISSN: 2165-8714
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Review Form

Manuscript ID:	EU-JER_ID#21111715274746	**Date:**	December 26 2021
Manuscript Title:	Validating Student's Green Character Instrument Using Factor And Rasch Model		

ABOUT MANUSCRIPT (Mark with "X" one of the options)	Accept	Weak	Refuse	Not Available
Language is clear and correct	x			
Literature is well written	x			
References are cited as directed by APA		x		
The research topic is significant to the field	x			
The article is complete, well organized and clearly written		x		
Research design and method is appropriate	x			
Analyses are appropriate to the research question		x		
Results are clearly presented		x		
A reasonable discussion of the results is presented		x		
Conclusions are clearly stated	x			
Recommendations are clearly stated	x			

GENERAL REMARKS AND RECOMMENDATIONS TO THE AUTHOR

The manuscript is related to the psychometric analysis of the green character instrument. It has some methodological and structural deficits. The following recommendations are presented:

1- Please double-check that all citations in the text and the references are fitting to APA 7.

2- Use "and" instead of "&" in the text. But it is vice versa in parentheses.

3-Please separately write results and discussion sections.

4- Firstly, report content validity results.

THE DECISION (Mark with "X" one of the options)

Accepted: Correction not required	
Accepted: Minor correction required	x
Conditionally Accepted: Major Correction Required **(Need second review after corrections)**	
Refused	

Reviewer Code: R2611 (The name of referee is hidden because of blind review)

Validating Student's Green Character Instrument Using Factor And Rasch Model

Abstract. Many researches have developed Instruments to measure one of the environmental characteristics such as attitudes, values and knowledge. However, there has not been any instrument that can be used to measure all these aspects in one comprehensive instrument. This study is meant to develop and validate a green character instrument which reveals student behavior and awareness of the environment. The instrument consists of 40 statement items consisting of 5 aspects, namely private pro-environmental behavior, public pro-environmental behavior, environmental knowledge, environmental values, and environmental attitudes. It was implemented on 1,398 students from 15 universities in Indonesia. The instrument content validation was conducted by 3 experts who were then analyzed using the content validity index (CVI). The construct validity was analyzed using exploratory factor analysis, confirmatory factor analysis, and RASCH. The content validity results obtained CVI scores ranging between 0.8 and 0.9 with a good category, while item reliability was in a fairly good category with a high level of separation index. Construct validation resulted in 34 items (4 items were eliminated from EFA and CFA, and 2 items were eliminated from RASCH) spread over five constructs, namely environmental behavior, environmental knowledge, environmental values, environmental attitudes, and environmental habits. The resulting instrument has a good level of item difficulty, with a well understood response set which can be understood easily by respondents, and without bias. Therefore, it can be used to measure the students' green character on both male and female.

Keywords: green character, instrument, factor and RASCH.

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Comment [A3]: check grammar and meaning

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Comment [A5]: Rasch Analysis

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Introduction

Character is part of humanity (Pradhan, 2009). Character can be in the form of values, beliefs, behavior, and morality (Hidayati et al., 2021). Even doing something right can also be called character (Pradhan, 2009). Character is related to habits, ways to act and is a picture of actual behavior (Ryan, 2013). Character is defined as a personality which is formed from virtue and is used to think and act (Maisardi, 2017)(Rahman et al., 2020). Character consists of good and bad habits (Ryan, 2013), mental and behavior (Rahman et al., 2020). Character need to be formed as it cannot spontaneously arise (Muharlisiani et al., 2019). Therefore, character needs to be familiarized to the younger generation through continuous learning, examples, and practices (Rahmawati et al., 2020). People with character will have good morals (Asrial et al., 2021), who consciously controls every action and behavior (Maisardi, 2017).

Good character is needed in all aspects, such as in environment. Example of good character to the environment is implemented in an attitude of caring for the environment (Sanjaya, 2021)(Pane & Patriana, 2016). The character of caring for the environment must also be made accustomed (Arent et al., 2020)(Ridlo, 2020), and it is important to be developed as the environment will have an impact on human existence (Yunesa, 2019). Environmental care character will create positive behavior towards the environment (Sukri, Rizka, et al., 2020)(Asrial et al., 2021), and reduce the negative impact of human behavior on the environment (Sukri, Efendi, et al., 2020)(Palupi & Sawitri, 2018). In addition, concerning for the environment is very important as most of the environmental damage is caused by human behavior (Sukri et al., 2018)(Faisal et al., 2014).

The term green character in this study refers to a person's behavior and awareness of the environment. Behavior refers to human activities to protect the environment or what is called pro-environmental behavior (Stern, 2000), while awareness refers to knowledge (Raymond et al., 2010), values (Barton, 1994) and attitudes to the environment (Dunlap et al.,

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2000). Therefore, caring for the environment attitude is part of a green character. The term green character was chosen to describe all positive behaviors and awareness of the environment. Frasz (Frasz, 2016) mentions environmental character as feelings, sentiments and virtues towards the environment. The term green is also used by Chankrajang (Chankrajang & Muttarak, 2017) to describe one aspect of attitude towards the environment which is pro-environmental behavior. By using the term green character, all behaviors, attitudes, knowledge, values, and all things with a positive impact on the environment can be covered which makes this term more universal.

Currently, it is difficult to find an instrument that can fully accommodate all aspects of behavior and environmental awareness. The research conducted by Stern (Stern, 2000) only developed an instrument to measure pro-environmental behavior, while Raymond et al (Raymond et al., 2010) focused on the knowledge aspect. In addition, Thompson & Borton (Barton, 1994) and Dunlap et al (Dunlap et al., 2000) only focused on values and attitudes aspects. The only similar research has been conducted by Fu et al (Fu et al., 2018), which unfortunately has some weaknesses, namely (1) limited to the behavior and awareness of the campus academic community and not generally applicable to the wider community, and (2) statement items developed in the instruments are mostly not in accordance with the conditions, context, and socio-cultural prevailing in many countries, such as in Indonesia. Whereas according to Chwialkowska et al (Chwialkowska et al., 2020) and He & Filimonau (He & Filimonau, 2020), a person's socio-cultural background influences his behavior towards the environment. For example, the statement item "I believe I know environmental issues well' presented by Fu et al (Fu et al., 2018) cannot be reduced to a concrete statement because it is not in accordance with the conditions of society in several countries with the same culture and conditions, especially Indonesia. The statement will become understandable if it is transformed into real environmental issues occuring in the community, for example

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“Illegal logging can result in the loss of clean water sources and natural disasters” and “Throwing garbage in rivers can cause damage to marine ecosystems”.

Therefore, this research is very important to be conducted to produce an instrument that can accommodate all aspects of environmental behavior and awareness. The resulting instrument can used to measure not only the knowledge, values and attitudes towards the environment, but also to measure behavior reflected in pro-environmental attitudes. The results of this study can be used as a reference for other researchers in different countries which have similar or even the same cultural and socioeconomic conditions to Indonesia, which will make this instrument will be more contextual and precise to measure the "green character" of students.

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Contribution to the literature

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- Some of the instruments developed by previous researchers were limited to certain aspects and did not cover all aspects of environmental behavior and awareness
- Instruments to measure green character have not been disclosed and have not been validated, especially in Indonesia
- Instruments validated of this study can be used to measure students' green character precisely because it is contextual and in accordance with the conditions experienced by students.

Methodology

This research is meant to develop and validate the green character instrument. The development is conducted through three steps; 1) analyzing the supporting literature and arranging the items, 2) content validation, 3) construct validation through Exploratory Factor Analyis (EFA), Confirmatory Factor Analysis (CFA), and RASCH (Saefi et al., 2020).

Literatur review and item arrangement

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Literature review is done to determine the representative variables for green character instrument. Literature analysis is based on studies or research results that have been published in reputable international journals such as research by Stern (Stern, 2000), Raymond et al (Raymond et al., 2010), Thompson & Borton (Barton, 1994), and Dunlap et al (Dunlap et al., 2000). Based on the results of the review, a draft of a green character instrument was prepared which includes 40 items. The green character instrument draft consists of private pro-environmental behavior aspects (Stern, 2000) covering 11 items; public pro-environmental behavior aspects (Stern, 2000) which consists of 8 items; environmental knowledge aspects (Raymond et al., 2010) with 6 items; environmental value aspects (Barton, 1994) with 8 items; and environmental attitudes aspects (Dunlap et al., 2000) which consists of 7 items. The student's response consisted of five answer choices; 1 = strongly disagree, 2 = disagree, 3 = indifferent, 4 = agree, and 5 = strongly agree.

Content validation

Content validity is evidence of the extent to which the elements of an assessment instrument are relevant and represent a construct targeted for a particular assessment objective (Almanasreh et al., 2019). Content validity includes four criteria; relevance, clarity, simplicity, and ambiguity (Yaghmaei, 2003). The validity of the green character questionnaire content is done by lecturers, practitioners and researchers in the environmental field as experts in their respective fields to obtain acceptable assessment. In conducting the assessment, the validator was asked to fill in four criteria which are, 1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = very relevant which was adjusted to 4 aspects of content validation. Furthermore, from the four criteria, dichotomous data was made to measure content validation using the content validity index method (Polit & Beck, 2006) with the provisions that CVI values > 0.79 were accepted, CVI values 0.70-0.79 were revised, and CVI < 0.70 were rejected (Devon et al., 2007). The results of CVI analysis on 40 green

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character instrument items show that the CVI values range from 0.8-0.9 for all aspects. Based on these results, all items in the instrument have met the valid criteria which were reviewed based on relevance, clarity, simplicity, and ambiguity.

EFA, CFA, and RASCH Analysis

Research sample

This study involved 1,398 students as respondents from 15 universities in Indonesia through random sampling (Endo et al., 2016). Respondents consisted of 972 women (69.53%) and 426 men (30.47%) with the age ranging from 19 to 22 years old. Respondents came from various regions in Indonesia including western, central and eastern Indonesia from various different majors such as social science, science, science education, engineering, humanities and business. The number of samples, 1,398 people, met the ideal limits for factor analysis (Tabachnick & Fidell, 2014) and RASCH analysis (Hagell & Westergren, 2016).

Data Analysis

The initial stage of the analysis was performed through an exploratory factor analysis (Williams et al., 2010). Prerequisite analyzes such as Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity were performed prior to EFA (Chan, L. L., & Idris, 2017). Furthermore, EFA uses the varimax rotation method (Osborne, 2015) and maximum likelihood estimation (Kassim et al., 2013) with the criteria of Eigenvalue > 1 (Yong, A. G., & Pearce, 2013), and a minimum loading factor of 0.3 (Prasetyo, K., Masrukan, M., & Sunawan, 2019). CFA was conducted to confirm the EFA results with model fit criteria based on the Root mean square error of approximation (RMSEA 0.06), Goodness of fit index (GFI 0.95), Comparative Fit Index (CFI 0.95), Tucker-Lewis Index (TLI 0.95), and X2/df < 3.00 (Sun, 2005). The RASCH analysis measures the validity of the instrument's construct in terms of content and consequential aspects (Susongko, 2016). Since the sample used is > 500 (Sumintono & Widhiarso, 2015), the item fit criteria are seen based on the mean-square infit

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and outfit values (MNSQs, between 0.6 to 1.5), and the point-measure correlation coefficient (PTMEA Corr, between 0.3 up to 0.7)(Linacre, 2018). Items that meet one of these criteria are designated as valid items, while items that do not meet the criteria will be deleted from the instrument. Furthermore, the reliability value of the items received is between 0.65 and 0.83 (Sumintono & Widhiarso, 2015) with a separation index value of 1 and > 2 (Ismail et al., 2020). In addition to reliability, Wright map analysis was also performed to determine the items' level of difficulty (Scoulas et al., 2021) followed by rating scale analysis to evaluate the clarity and ease of interpretation of the response set in the instrument (Kim & Kyllonen, 2006). Finally, to avoid bias in the instrument, a Differential Item Functioning (DIF) analysis was conducted to determine the responses of male and female students (Iseppi et al., 2021).

Result and Discussion

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Exploratory Factor Analyis (EFA)

This study will test the green character instrument consisting of 40 items which are coded from A1 to A40. The first step to test the relationship between variables in the instrument is performing factor analysis. Factor analysis serves to reduce variables that are replaced by several factors which summarize the relationship between variables (Goldberg & Velicer, 2006). The initial assumption in factor analysis is the adequacy of the sample in the analysis (Hadia et al., 2016). Sample adequacy is measured by the Kaiser-Meyer-Olkin (KMO) value which must be greater than 0.5 (Hair et al., 2010). In addition to the adequacy of the sample, the assumption that must be met in the EFA is that there should be relationship between variables in the factors (Mohd Matore et al., 2019) which is indicated by the value of Bartlett's Test of Sphericity (BTS) which must be less than 0.05 (Chan, L. L., & Idris, 2017). The results of the KMO and BTS analysis are shown in Table 1 which shows that the KMO value is 0.917 and is in the very good category (Hadia et al., 2016), while the BTS value is <.001

which indicates that both EFA assumptions are met and acceptable for further analysis (Field, 2000).

Table 1. KMO and BTS Analysis Result

Kaiser-Meyer-Olkin	Bartlett's Test of Sphericity		
Overall MSA	X^2	df	p
0.917	18800.609	780.000	<.001

After the EFA assumption test is met, the next step is to perform a factor analysis of 40 instrument items using the varimax rotation method (Osborne, 2015) and maximum likelihood estimation (Kassim et al., 2013). To determine the number of factors being formed, the parallel analysis method was used (Çokluk & Koçak, 2016). The results can be seen in Figure 1 which shows that the implementation point is formed after five factors resulted in 5 constructs which were formed from the results of factor analysis. Each item in the formed factor has a loading factor of more than 0.3. The minimum factor loading value used in this study is 0.3 to indicate that the formed factor has met the fit criteria (Prasetyo, K., Masrukan, M., & Sunawan, 2019). The loading factor and the variance that were formed are shown in Table 2.

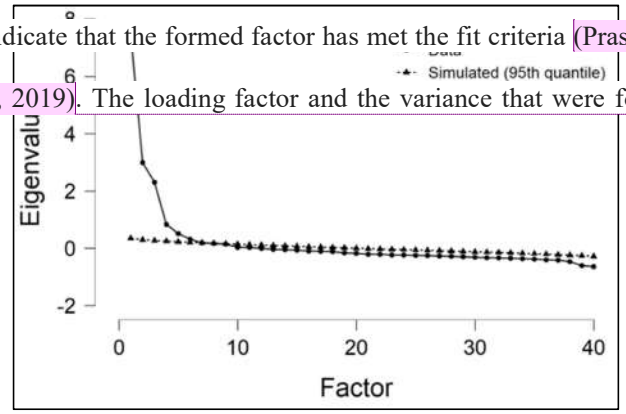

Figure 1. Scree plot Result of factor Analysis

Table 2. Loading factor and variants formed from factor analysis

Items	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
A1	0.362				
A2	0.344				

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A3	0.344				
A4	0.314				
A5	0.509				
A6	0.654				
A12	0.645				
A13	0.730				
A14	0.555				
A15	0.637				
A16	0.593				
A17	0.651				
A18	0.614				
A19	0.507				
A20		0.649			
A21		0.649			
A22		0.755			
A23		0.758			
A24		0.758			
A25		0.655			
A26			0.422		
A27			0.772		
A28			0.755		
A30			0.762		
A32			0.508		
A37			0.464		
A38			0.523		
A29				0.499	
A31				0.390	
A33				0.502	
A35				0.453	
A36				0.464	
A39				0.571	
A40				0.514	
A9					0.537
A10					0.721

Based on Table 2, several items such as items A7, A8, A11 and A34 were eliminated from the analysis because they had a loading factor of less than 0.3. Based on these results, 40 items were analyzed resulting in 5 factors. The five formed factors were then grouped and named according to the similarity of characteristics possessed by each item as follow factor 1, environmental behavior; factor 2, environmental knowledge; factor 3, environmental value; factor 4, environmental attitude; and factor 5, environmental habits. The results are strengthened by the Eigenvalue, variance, interitem correlation and Cronbach's alpha value which are presented in Table 3.

Table 3. Characteristics of the formed factors

Construct	Initial Eigen values	% of var.	Cumula -tive %	Average interitem correlation	Average interfactor correlation	Alpha Cronbach	N
Environmental Behavior (EnB)	4.77	11.90	11.90	0.31	0.03	0.85	14
Environmental Knowledge (EnK)	3.63	9.10	21.00	0.57	0.05	0.89	6
Environmental Value (EnV)	3.04	7.60	28.60	0.36	0.02	0.79	7
Environmental Attitude (EnA)	2.27	5.70	34.30	0.30	0.07	0.75	7
Environmental Habits (EnH)	1.54	3.80	38.10	0.60	0.06	0.74	2

Table 3 shows that the Eigenvalue is more than 1 (range from 1.54 to 4.77). Eigenvalue is a measure used to determine the number of factors being formed (Larsen & Warne, 2010). Based on the Eigenvalue, the 5 formed constructs are fit. This is in accordance with Yong & Pearce (Yong, A. G., & Pearce, 2013) opinion which say that the Eigenvalue value of more than 1 indicates that the factor has met the assumption of the fit criteria. Table 3 also shows the value of the variance formed on each factor (ranging from 3.80 to 11.90) with a cumulative variance of 38.10%. The cumulative variance value is relatively small as usually the cumulative variance for humanities research ranges from 50-60% (Pett et al., 2011). However, the resulting variance value is still acceptable as the other criteria have been met in the EFA analysis. The low value of this variance is thought to be caused by the maximum likelihood extraction method used. According to Costello & Osborne (Costello & Osborne, 2005), the principle component analysis (PCA) method in extraction produces a greater variance than the maximum likelihood (ML) method. This happens because PCA does not divide the unique variance from communalities so it sets all item communalities at 1.0, whereas ML estimates the level of shared variance for the items, which ranged from 0.39 to 0.70.

The range of the average interitem correlation values in the factors is 0.31 to 0.6 (Table 3). This indicates that there is a strong relationship between each item in the same factor.

According to Tabachnick et al (Tabachnick & Fidell, 2014), the interitem correlation value that exceeds 0.3 meets good factorability in the EFA. Table 3 also shows that the average value of interfactor correlation is smaller than the average value of interitem correlation in factors that range from 0.02 to 0.07. This proves that the instrument has good specificity. The intended specificity is the instrument's ability to distinguish the specificity of each factor based on its correlation value (Trumpower et al., 2010). The results of Cronbach's alpha analysis in Table 3 reveal that the reliability value ranges from 0.74 to 0.85. This shows that the instrument has good reliability. The reliability value above 0.7 proves that the instrument is reliable and acceptable (Yu & Richardson, 2015).

Confirmatory Factor Analysis (CFA)

To test the consistency of the formed factors, a confirmatory factor analysis was performed (Tomé-Fernández et al., 2020). CFA was conducted on 5 factors and 36 items. They are Environmental Behavior (EnB), Environmental Knowledge (EnK), Environmental Value (EnV), Environmental Attitude (EnA), and Environmental Habits (EnH) factors. The fit model criteria are based on the Root mean square error of approximation (RMSEA), Goodness of fit index (GFI), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and X2/df (Sun, 2005). The interpretation of the CFA fit model uses Diagonally Weighted Least Squares (DWLS), which is considered as the most suitable for not normally distributed data compared to the maximum likelihood model (Nye & Drasgow, 2011). The results of the CFA fit model analysis are shown in Table 4.

Table 4. Goodness of fit index confirmatory factor analysis

Index	Value	Cut off value	criteria
X^2/df	2.802	<3.00	Good
Root mean square error of approximation (RMSEA)	0.036	≤0.06	Good
Goodness of fit index (GFI)	0.957	≥0.95	Good
Comparative Fit Index (CFI)	0.952	≥0.95	Good
Tucker-Lewis Index (TLI)	0.948	≥0.95	Good

The results of the CFA analysis in Table 3 show that all fit criteria have been met by the model. The obtained RMSEA value is 0.036, CFI = 0.952, TLI = 0.948, GFI = 0.957, and x2/df = 2.802. All of these values have met the model fit criteria (Nye & Drasgow, 2011)(Prudon, 2014)(Hidayat et al., 2018). Therefore, the final measurement model which shows the structure of the green character instrument is shown in Figure 2. The results of this final measurement are then used for the validity and reliability of items using the RASCH model (Susongko, 2016).

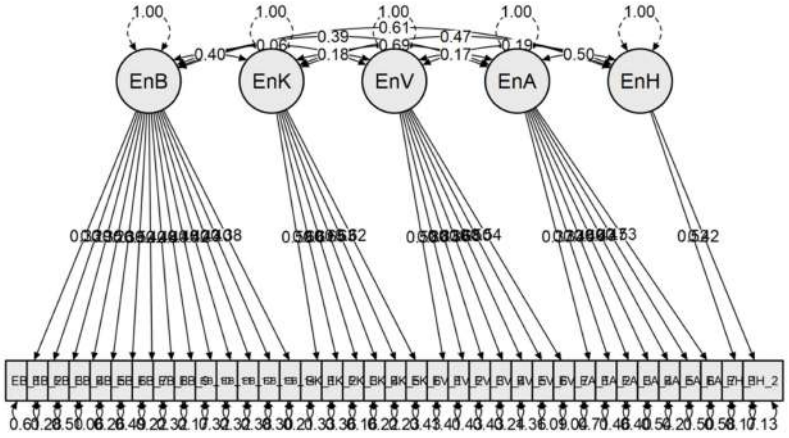

Figure 2. CFA final measurement model

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To strengthen the results of the EFA and CFA, a RASCH analysis was performed to determine the validity and reliability of the instrument following the Messick validity which includes several aspects namely content, substance, structure, external and consequential (Susongko, 2016). This research is only limited to the content and consequential aspects. The following describes the results of the RASCH analysis on the green character instrument.

Green Character Instruments Reliability

Reliability analysis was performed on five constructs, namely environmental behavior, knowledge, values, attitudes, and habits. The reliability analysis results showed that the item reliability values for each domain ranged from 0.99-1.00 with the item separation values

ranging from 9.63 to 24.44. A reliability value above 0.9 indicates that the instrument's reliability is in the good category (Saefi et al., 2020), while the separation index value of > 2.0 indicates that the measurement using RASCH can distinguish the instrument into several different groups or domains (Ismail et al., 2020). In addition, the results of the person reliability analysis ranged from 0.65 to 0.83 which include in the pretty good category (Sumintono & Widhiarso, 2015) with a separation index value ranging from 1 and above 2. These results indicate that the instrument has the capability to distinguish respondents' abilities, respondents with high and low performance (Ismail et al., 2020). The results of the measurement of reliability and separation of the item and person indices of the instrument are shown in Table 5.

Table 5. Reliability and Separation Index of Green Character Instrument

Construct	ID item	Item Measure		Person Measure	
		Reliability	Separation	Reliability	Separation
Environmental Behavior	EnB1-EnB14	1.00	16.88	0.83	2.18
Environmental Knowledge	EnK1-EnK6	0.99	9.63	0.78	1.89
Environmental Value	EnV1-EnV7	1.00	16.56	0.72	1.62
Environmental Attitude	EnA1-EnA7	1.00	23.52	0.65	1.35
Environmental Habits	EnH1-EnH2	1.00	24.44	0.66	1.40

Fit Analysis of Green Character Statistic Instrument

The fit index value indicates the quality of the items in the instrument which reveals how accurately the data fits the model (Scoulas et al., 2021). The fit model reference used in this study is the MNSQ infit/outfit value, and PTMEA, while the ZSTD infit/outfit value is ignored because the sample used in this research is > 500 (Sumintono & Widhiarso, 2015). The MNSQ value is used as an indicator of item discrepancy in the RASCH model (Ismail et al., 2020), while the PTMEA is performed to determine whether the instrument can distinguish respondents according to their response level (Saefi et al., 2020). The following describes the results of the item fit analysis for each construct shown in the Table 6.

Table 6. Item Fit Analysis Resultd of Green Character Instruments.

FACTOR	Item	Infit MNSQ	Outfit MNSQ	PTMEA
Environmental Behaviors	I bring my water bottle from home when traveling	1.0255	1.1764	0.3397
	I throw rubbish in the right place.	1.4535	1.2149	0.3775
	I ride bicycle or walk for short distance traveling.	0.8825	0.9661	0.3903
	I use public transportation for long distance traveling.	1.3165	1.6078	0.1784
	I keep my waste in my pocket or my bag when there is no trash can nearby and carry them until I find trash can.	0.8848	0.8299	0.4753
	I bring my own bag from home to reduce plastic waste when I go shopping.	0.8234	0.8759	0.4323
	I encourage my family and my colleagues to save resources	1.1317	1.0298	0.47
	I encourage my family and my colleagues to plan trees.	1.0375	0.9918	0.4587
	I support family members or colleagues activities in protecting the environment.	1.275	1.4922	0.2375
	I discuss environmental issues with family members and colleagues.	0.5566	0.6486	0.463
	I often involve in environmental cleaning activities.	0.7253	0.8411	0.4334
	I often pick up trash which scatter around public areas.	0.7584	0.7024	0.5311
	I remind family or colleagues who litter everywhere.	0.5751	0.6478	0.4271
	I throw waste from food and drinks in the right place when gathering with friends and families.	0.6102	0.6693	0.4198
Environmental Knowledge	Littering in the river can damage the sea ecosystem	0.6313	0.701	0.4039
	Using air conditioner can cause damage to the Ozon layers	0.7125	0.7815	0.4107
	Waste from motor vehicles can cause air pollution and climate change.	0.7462	0.7672	0.4929
	The extensive use of detergent can cause death for water creatures.	1.4783	1.2842	0.4844
	Illegal logging cam cause the disappearance of clean water sources and natural disaster.	0.8591	0.9089	0.4809

	Too many inhabitants can cause damage many places for housing	0.8618	0.8013	0.5501
Environmental Value	I prefer to see animal in the zoo to seeing them in the wild.	0.8494	0.7944	0.5503
	I do not need to worry about the environment damage as technology can solve that problem.	0.856	0.8029	0.5449
	Human does not always need nature to survive.	1.0492	1.0805	0.4782
	Let the environmental problem happen as it will be solved by itself.	1.0668	1.1274	0.4061
	Natural disaster such as flood, land slide, and drought do not have anything to do with environmental damage.	1.1545	1.3173	0.3169
	The environmental damage issues nowadays have been exaggerated.	0.8599	0.9589	0.404
	Human are here to rule the whole world.	1.2401	1.4703	0.1956
Environmental Attitude	I feel happy and pleased to be with nature	1.3965	1.5706	0.292
	The most important reason to protect the environment if to preserve the human sustainability.	1.554	1.5556	0.4062
	Human are part of the ecosystem just like animal.	1.4713	1.3966	0.4581
	Disturbing the nature will resulted in the damaging consequences.	1.3273	1.6123	0.316
	Plants and animals have the same right to live as how human does.	**1.9292**	**2.2336**	**0.3304**
	The balance of the nature is very sensitive and easily disturbed.	1.0766	1.2402	0.3712
	We will experience huge ecological disaster if everything continues as it is.	0.7641	0.8031	0.4858
Environmental Habits	I turn of the electricity when it is not in use.	1.1692	1.2962	0.3878
	I always turn off the tab when it is not in use.	**1.6487**	**1.9841**	**0.0954**

The results of the item fit analysis in Table 6 show that there are two items which do not meet the fit index criteria. One item on the environmental attitude construct is EnA5 and on the environmental habits construct is EnH2. The MNSQ and PTMEA infit/outfit values for each of these items are outside the predetermined index value (Bond & Fox, 2007)(Linacre, 2018).

In this study, the criteria for item acceptance were determined by three criteria, namely infit MNSQ, outfit, MNSQ, and PTMEA. If the item meets one of the predetermined fit index criteria, then the item in the instrument can be accepted (Sumintono & Widhiarso, 2015). This result is different from the result of factor analysis and confirmatory factor. Based on these results, the loading factor values for EnA5 and EnH2 items are 0.464 and 0.721, respectively (Table 2). The loading factor value is quite large and acceptable (Prasetyo, K., Masrukan, M., & Sunawan, 2019), but based on the results of item fit analysis using RASCH, both items do not meet the criteria and are declared as invalid items. This study found that there was a discrepancy between the results of the CFA analysis and the RASCH model. According to Scoulas et al (Scoulas et al., 2021), the RASCH model can detect potential measurement problems such as item bias or local item dependencies that may arise when measuring using classical validation methods such as factor analysis. Based on this assumption, researchers tend to eliminate both items which are considered as invalid items.

Comment [A32]: Use "et al."

Wright Map

Wright map analysis was performed to determine the level of difficulty of the items (Saefi et al., 2020)(Scoulas et al., 2021) which is shown in Figure 2. The results of the analysis in Figure 2 show that only 4 items namely EnB9, EnV7, EnV1 and EnH2 are considered difficult by respondents in understanding green character instruments. There were no items that were categorized as difficult to be understood by the respondents in the environmental knowledge component. Overall, the questions on the instrument can be easily understood by the respondent. This shows that the green character instrument has met the criteria for a good item difficulty level.

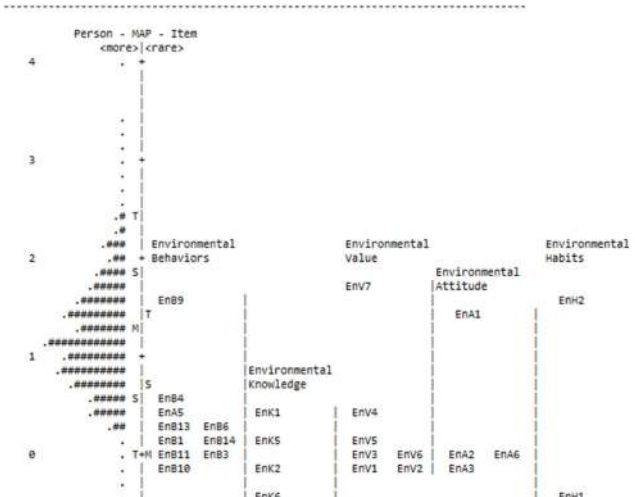

Figure 2. Wright Map respondent's perception toward the Green Character instrument

Rating scale Diagnostic

The next stage in instrument testing is done through rating scale diagnostics. This measure is used to evaluate the clarity and ease of interpretation of the response set in the instrument (Kim & Kyllonen, 2006). The rating scale visualization shown in Figure 3 shows the probability of the response category in the green character instrument according to the recommended pattern. Each category has a distinct peak at some point along the scale as expected (Scoulas et al., 2021). Thus, it can be concluded that the green character instrument response series is functioning properly (Saefi et al., 2020).

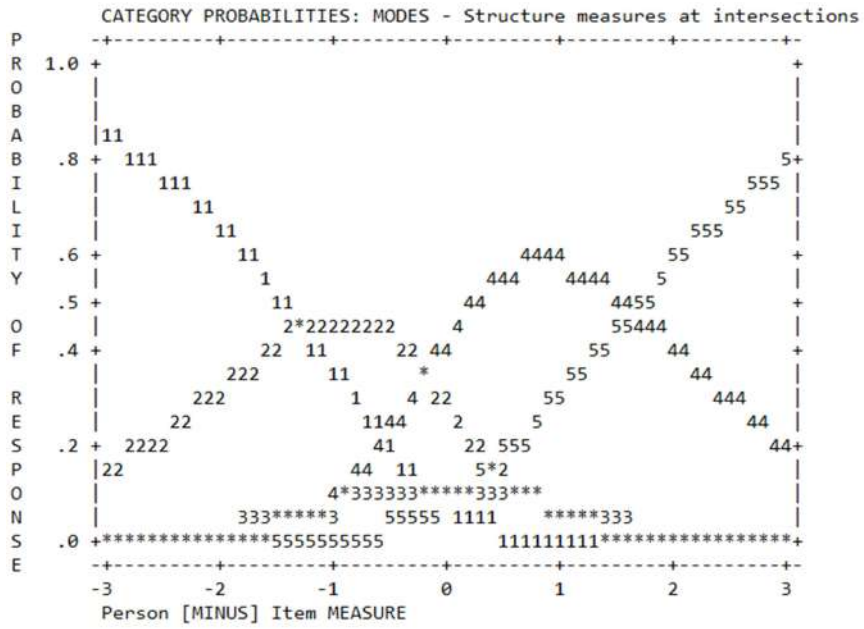

Figure 3. Probability Category curve of The green character Instrument

Differential Item Functioning (DIF) Analysis

DIF analysis was conducted to determine whether different subgroups, in this case gender, responded to items differently (Iseppi et al., 2021). In this study, DIF analysis was specifically used to reveal the ability to answer between male and female students to find out whether there was a bias from the items given. Question items that have a bias are indicated by differences in the ability to answer between male and female students. To overcome the bias in the items, Isepi et al (Iseppi et al., 2021) suggested to make two separate items, one item for men and another for women. The results of the DIF analysis of the green character instrument shown in Figure 4 show that there is no bias as evidenced by the graph of male and female responses approaching the normal line (green). This proves that the items in the instrument are free from bias and can be used to reveal green character for both male and female respondents.

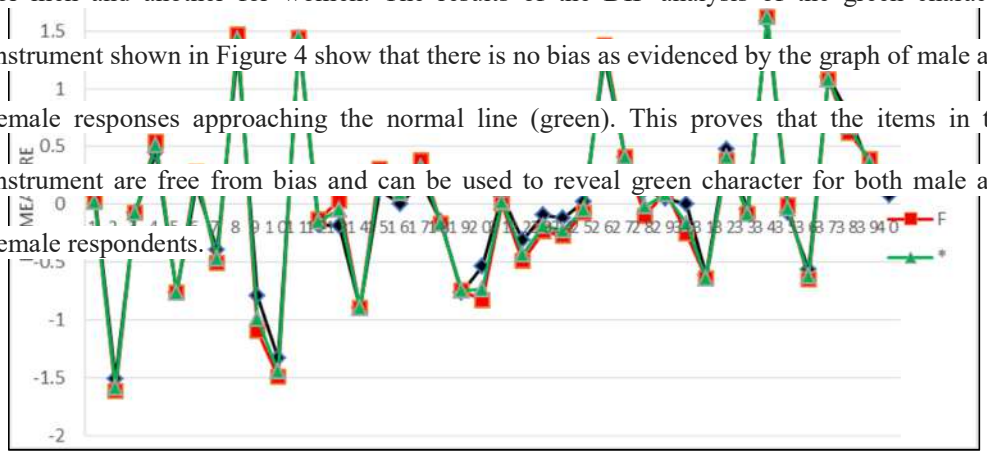

Figure 4. Graph of Person DIF of the Green Character Instrument

The result of factor analysis of 40 items of green character instrument resulted in five constructs with a total of 34 items (4 items were eliminated from EFA and CFA, and 2 items were eliminated from RASCH). The five formed constructs, namely Environmental Behavior (EnB), Environmental Knowledge (EnK), Environmental Value (EnV), Environmental Attitude (EnA), and Environmental Habits (EnH) were confirmed through the CFA and met the criteria for the Goodness of fit index (Table 4). These results indicate that the construct validity of the instrument has been met. This finding is in line with the theory that underlies this research such as the theories that have been tested by Stern (Stern, 2000) regarding Environmental Behavior, environmental knowledge (Raymond et al., 2010), environmental values (Barton, 1994), and attitudes towards the environment (Dunlap et al., 2000). Based on the results of the content validity analysis, which includes the fit item test, person-item map, and diagnostic rating scale, and the consequential validity which includes the DIF analysis, the green character instrument is declared eligible and has met the standard criteria that have been determined. However, this study revealed that one of the constructs, the Environmental Habits (EnH), experienced an item reduction to leave only one statement item. Based on these findings, the researcher believes that there is a lack of research caused by the lack of items used in this instrument. However, empirically, based on the results of the EFA, CFA and RASCH this questionnaire has met the standards in instrument development, so it can be used to measure the students' green character.

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Conclusion

Comment [A34]: Please show final form of the instrument showing factors and loading items in conclusion section.

This study shows that the green character instrument series has met the criteria for item validity and reliability using the EFA, CFA and RASCH models. The final result of this measurement produces 34 items which have met the item fit criteria. This questionnaire can reveal knowledge, behavior, values, attitudes and habits towards the environment. Although it was found that there were discrepancies in the results of measurements using factors and

RASCH, these three types of validity measurements should be used simultaneously so that they can complement one another.

Recommendations

Further research can be conducted to test the precision of the instruments that have been produced in revealing the students' green character in various demographic conditions. In addition, to obtain more comprehensive results, further research can be carried out at lower levels of education such as elementary, junior high and high school.

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Limitations

The environmental habits construct has too few items. This allows the occurrence of missing in the data. Therefore, further research can arrange more items so that they can represent constructs to get more valid and reliable results.

Acknowledgment

The researcher would like to thank the BRIN, Kemendikbud-Ristek of Republic Indonesia for support this research through the PTUP scheme.

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Validating Student's Green Character Instrument Using Factor and Rasch Model

Abstract. Many researchers have separately developed instruments to measure environmental characteristics such as attitudes, values, and knowledge. However, there is no instrument used to measure all these aspects in one comprehensive instrument. This study is meant to develop and validate a green character instrument which reveals student behavior and awareness of the environment. The instrument consists of 40 statement items consisting of 5 aspects, namely private pro-environmental behavior, public pro-environmental behavior, environmental knowledge, environmental values, and environmental attitudes. It was implemented on 1,398 students from 15 universities in Indonesia. The instrument content validation was analyzed by three experts using content validity index (CVI). The construct validity was analyzed using exploratory factor analysis, confirmatory factor analysis, and RASCH analysis. The content validity results obtained CVI scores ranging between 0.8 and 0.9 with a good category, while item reliability was in a fairly good category with a high level of separation index. Construct validation resulted in 34 items (4 items were eliminated after Exploratory and Confirmatory Factor Analysis, and 2 items were eliminated after RASCH analysis) spread over five constructs, namely environmental behavior, environmental knowledge, environmental values, environmental attitudes, and environmental habits. The resulting instrument has a good level of item difficulty, with a well understood response set which can be understood easily by respondents, and without bias. Therefore, it can be used to measure the students' green character on both male and female.

Keywords: green character, instrument, factor and RASCH Analysis.

Introduction

Character as a part of humanity (Pradhan, 2009) in the form of values, beliefs, good and bad behavior (Ryan, 2013; Rahman et al., 2020), and morality (Sari et al., 2021) is used to think and behave (Maisardi, 2017). It needs to be formed as it cannot spontaneously arise (Muharlisiani et al., 2019). Therefore, character needs to be familiarized to the younger generation through continuous learning, examples, and practices (Rahmawati et al., 2020). People with character will have good morals (Asrial et al., 2021), who consciously controls every action and behavior (Maisardi, 2017).

Good character is needed in all aspects, such as in environment. Example of good character to the environment is implemented in an attitude of caring for the environment (Pane & Patriana, 2016; Sanjaya, 2020). The character of caring for the environment must also be made accustomed (Arent et al., 2020; Masturoh & Ridlo, 2020), and it is important to be developed as the environment will have an impact on human existence (Yunesa, 2019). Environmental care character will create positive behavior towards the environment (Sukri et al., 2020; Asrial et al., 2021), and reduce the negative impact of human behavior on the environment (Palupi & Sawitri, 2018; Sukri et al., 2020). In addition, concerning for the environment is very important as most of the environmental damage is caused by human behavior (Faisal et al., 2014; Sukri et al., 2018).

The term green character in this study refers to a person's behavior and awareness of the environment. Behavior refers to human activities to protect the environment or what is called pro-environmental behavior (Stern, 2000), while awareness refers to knowledge (Raymond et al., 2010), values (Thompson & Barton, 1994) and attitudes to the environment (Dunlap et al., 2000). Therefore, caring for the environment attitude is part of a green character. The term green character was chosen to describe all positive behaviors and awareness of the environment. Frasz (2016) mentions environmental character as feelings, sentiments and virtues towards the environment. The term green is also used by Chankrajang

(2017) to describe one aspect of attitude towards the environment which is pro-environmental behavior. By using the term green character, all behaviors, attitudes, knowledge, values, and all things with a positive impact on the environment can be covered which makes this term more universal.

Currently, it is difficult to find an instrument that can fully accommodate all aspects of behavior and environmental awareness. The research conducted by Stern (2000) only developed an instrument to measure pro-environmental behavior, while Raymond et al (2010) focused on the knowledge aspect. In addition, Thompson & Barton (1994) and Dunlap et al (2000) only focused on values and attitudes aspects. The only similar research has been conducted by Fu et al (2018), which unfortunately has some weaknesses, namely (1) limited to the behavior and awareness of the campus academic community and not generally applicable to the wider community, and (2) statement items developed in the instruments are mostly not in accordance with the conditions, context, and socio-cultural prevailing in many countries, such as in Indonesia. Whereas according to Chwialkowska et al (2020) and He & Filimonau (2020), a person's socio-cultural background influences his behavior towards the environment. For example, the statement item “I believe I know environmental issues well' presented by Fu et al (2018) cannot be reduced to a concrete statement because it is not in accordance with the conditions of society in several countries with the same culture and conditions, especially Indonesia. The statement will become understandable if it is transformed into real environmental issues occuring in the community, for example “Illegal logging can result in the loss of clean water sources and natural disasters” and “Throwing garbage in rivers can cause damage to marine ecosystems”.

Therefore, this research is very important to be conducted to produce an instrument that can accommodate all aspects of environmental behavior and awareness. The resulting instrument can be used to measure not only the knowledge, values and attitudes towards the

environment, but also to measure behavior reflected in pro-environmental attitudes. The results of this study can be used as a reference for other researchers in different countries which have similar or even the same cultural and socioeconomic conditions to Indonesia, which will make this instrument will be more contextual and precise to measure the "green character" of students.

Contribution to the literature

- Some of the instruments developed by previous researchers were limited to certain aspects and did not cover all aspects of environmental behavior and awareness
- Instruments to measure green character have not been disclosed and have not been validated, especially in Indonesia
- Instruments validated of this study can be used to measure students' green character precisely because it is contextual and in accordance with the conditions experienced by students.

Methodology

This research is meant to develop and validate the green character instrument. The development is conducted through three steps; 1) analyzing the supporting literature and arranging the items, 2) content validation, 3) construct validation through Exploratory Factor Analyis (EFA), Confirmatory Factor Analysis (CFA), and RASCH (Saefi et al., 2020).

Literatur review and item arrangement

Literature review is done to determine the representative variables for green character instrument. Literature analysis is based on studies or research results that have been published in reputable international journals such as research by Stern (2000), Raymond et al (2010), Thompson & Barton (1994), and Dunlap et al (2000). Based on the results of the review, a draft of a green character instrument was prepared which includes 40 items. The green character instrument draft consists of private pro-environmental behavior aspects (Stern,

2000) covering 11 items; public pro-environmental behavior aspects (Stern, 2000) which consists of 8 items; environmental knowledge aspects (Raymond et al., 2010) with 6 items; environmental value aspects (Thompson & Barton, 1994) with 8 items; and environmental attitudes aspects (Dunlap et al., 2000) which consists of 7 items. The student's response consisted of five answer choices; 1 = strongly disagree, 2 = disagree, 3 = indifferent, 4 = agree, and 5 = strongly agree.

Content validation

Content validity is evidence of the extent to which the elements of an assessment instrument are relevant and represent a construct targeted for a particular assessment objective (Almanasreh et al., 2019). Content validity includes four criteria; relevance, clarity, simplicity, and ambiguity (Yaghmaei, 2003). The validity of the green character questionnaire content is done by lecturers, practitioners and researchers in the environmental field as experts in their respective fields to obtain acceptable assessment. In conducting the assessment, the validator was asked to fill in four criteria which are, 1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = very relevant which was adjusted to 4 aspects of content validation. Furthermore, from the four criteria, dichotomous data was made to measure content validation using the content validity index method (Polit & Beck, 2006) with the provisions that CVI values > 0.79 were accepted, CVI values 0.70-0.79 were revised, and CVI < 0.70 were rejected (Devon et al., 2007).

EFA, CFA, and RASCH Analysis

Research sample

This study involved 1,398 students as respondents from 15 universities in Indonesia through random sampling (Endo et al., 2016). Respondents consisted of 972 women (69.53%) and 426 men (30.47%) with the age ranging from 19 to 22 years old. Respondents came from various regions in Indonesia including western, central and eastern Indonesia from various different

majors such as social science, science, science education, engineering, humanities and business. The number of samples, 1,398 people, met the ideal limits for factor analysis (Tabachnick & Fidell, 2014) and RASCH analysis (Hagell & Westergren, 2016).

Data Analysis

The initial stage of the analysis was performed through an exploratory factor analysis (Williams et al., 2010). Prerequisite analyzes such as Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity were performed prior to EFA (Chan & Idris, 2017). Furthermore, EFA uses the varimax rotation method (Osborne, 2015) and maximum likelihood estimation (Kassim et al., 2013) with the criteria of Eigenvalue > 1 (Yong & Pearce, 2013), and a minimum loading factor of 0.3 (Prasetyo et al., 2019). CFA was conducted to confirm the EFA results with model fit criteria based on the Root mean square error of approximation (RMSEA 0.06), Goodness of fit index (GFI 0.95), Comparative Fit Index (CFI 0.95), Tucker-Lewis Index (TLI 0.95), and X2/df < 3.00 (Sun, 2005). The RASCH analysis measures the validity of the instrument's construct in terms of content and consequential aspects (Susongko, 2016). Since the sample used is > 500 (Sumintono & Widhiarso, 2015), the item fit criteria are seen based on the mean-square infit and outfit values (MNSQs, between 0.6 to 1.5), and the point-measure correlation coefficient (PTMEA Corr, between 0.3 up to 0.7)(Linacre, 2018). Items that meet one of these criteria are designated as valid items, while items that do not meet the criteria will be deleted from the instrument. Furthermore, the reliability value of the items received is between 0.65 and 0.83 (Sumintono & Widhiarso, 2015) with a separation index value of 1 and > 2 (Ismail et al., 2020). In addition to reliability, Wright map analysis was also performed to determine the items' level of difficulty (Scoulas et al., 2021) followed by rating scale analysis to evaluate the clarity and ease of interpretation of the response set in the instrument (Kim & Kyllonen, 2006). Finally, to avoid bias in the

instrument, a Differential Item Functioning (DIF) analysis was conducted to determine the responses of male and female students (Iseppi et al., 2021).

Results

Content validation

The results of CVI analysis on 40 green character instrument items show that the CVI values range from 0.8-0.9 for all aspects. Based on these results, all items in the instrument have met the valid criteria which were reviewed based on relevance, clarity, simplicity, and ambiguity.

Exploratory Factor Analysis (EFA)

Factor analysis serves to reduce variables that are replaced by several factors which summarize the relationship between variables (Goldberg & Velicer, 2006). The initial assumption in factor analysis is the adequacy of the sample in the analysis (UI Hadia et al., 2016). Sample adequacy is measured by the Kaiser-Meyer-Olkin (KMO) value which must be greater than 0.5 (Hair et al., 2010). In addition to the adequacy of the sample, the assumption that must be met in the EFA is that there should be relationship between variables in the factors (Matore et al., 2019) which is indicated by the value of Bartlett's Test of Sphericity (BTS) which must be less than 0.05 (Chan & Idris, 2017). The results of the KMO and BTS analysis are shown in Table 1 which shows that the KMO value is 0.917 and is in the very good category (UI Hadia et al., 2016), while the BTS value is <.001 which indicates that both EFA assumptions are met and acceptable for further analysis (Field, 2000).

Table 1. KMO and BTS analysis result

Kaiser-Meyer-Olkin	Bartlett's Test of Sphericity		
Overall MSA	X^2	df	p
0.917	18800.609	780.000	<.001

After the EFA assumption test is met, the next step is to perform a factor analysis of 40 instrument items using the varimax rotation method (Osborne, 2015) and maximum likelihood estimation (Kassim et al., 2013). To determine the number of factors being formed,

the parallel analysis method was conducted (Çokluk & Koçak, 2016). The results can be seen in Figure 1 which shows that the implementation point is formed after five factors resulted in 5 constructs which were formed from the results of factor analysis. Each item in the formed factor has a loading factor of more than 0.3. The minimum factor loading value used in this study is 0.3 to indicate that the formed factor has met the fit criteria (Prasetyo et al., 2019). The loading factor that were formed are shown in Table 2.

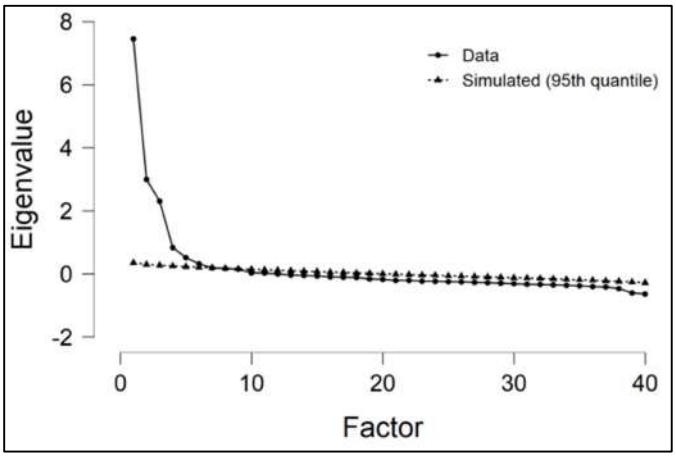

Figure 1. Scree plot result of factor analysis

Table 2. Loading factor formed from factor analysis

Items	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
A1	0.362				
A2	0.344				
A3	0.344				
A4	0.314				
A5	0.509				
A6	0.654				
A12	0.645				
A13	0.730				
A14	0.555				
A15	0.637				
A16	0.593				
A17	0.651				
A18	0.614				
A19	0.507				
A20		0.649			
A21		0.649			
A22		0.755			
A23		0.758			
A24		0.758			
A25		0.655			
A26			0.422		

A27	0.772		
A28	0.755		
A30	0.762		
A32	0.508		
A37	0.464		
A38	0.523		
A29		0.499	
A31		0.390	
A33		0.502	
A35		0.453	
A36		0.464	
A39		0.571	
A40		0.514	
A9			0.537
A10			0.721

Based on Table 2, several items such as items A7, A8, A11 and A34 were eliminated from the analysis because they had a loading factor of less than 0.3. Based on these results, 40 items were analyzed resulting in 5 factors. The five formed factors were then grouped and named according to the similarity of characteristics possessed by each item as follow factor 1, environmental behavior; factor 2, environmental knowledge; factor 3, environmental value; factor 4, environmental attitude; and factor 5, environmental habits. The results are strengthened by the Eigenvalue, variance, interitem correlation and Cronbach's alpha value which are presented in Table 3.

Table 3. Characteristics of the formed factors

Construct	Initial Eigen values	% of var.	Cumula -tive %	Average interitem correlation	Average interfactor correlation	Alpha Cronbach	N
Environmental Behavior (EnB)	4.77	11.90	11.90	0.31	0.03	0.85	14
Environmental Knowledge (EnK)	3.63	9.10	21.00	0.57	0.05	0.89	6
Environmental Value (EnV)	3.04	7.60	28.60	0.36	0.02	0.79	7
Environmental Attitude (EnA)	2.27	5.70	34.30	0.30	0.07	0.75	7
Environmental Habits (EnH)	1.54	3.80	38.10	0.60	0.06	0.74	2

Confirmatory Factor Analysis (CFA)

The interpretation of the CFA fit model uses Diagonally Weighted Least Squares (DWLS), which is considered as the most suitable for not normally distributed data compared to the maximum likelihood model (Nye & Drasgow, 2011). The results of the CFA fit model and final measurement model are shown in Table 4 and Figure 2.

Table 4. Goodness of fit index confirmatory factor analysis

Index	Value	Cut off value	criteria
X^2/df	2.802	<3.00	Good
Root mean square error of approximation (RMSEA)	0.036	≤0.06	Good
Goodness of fit index (GFI)	0.957	≥0.95	Good
Comparative Fit Index (CFI)	0.952	≥0.95	Good
Tucker-Lewis Index (TLI)	0.948	≥0.95	Good

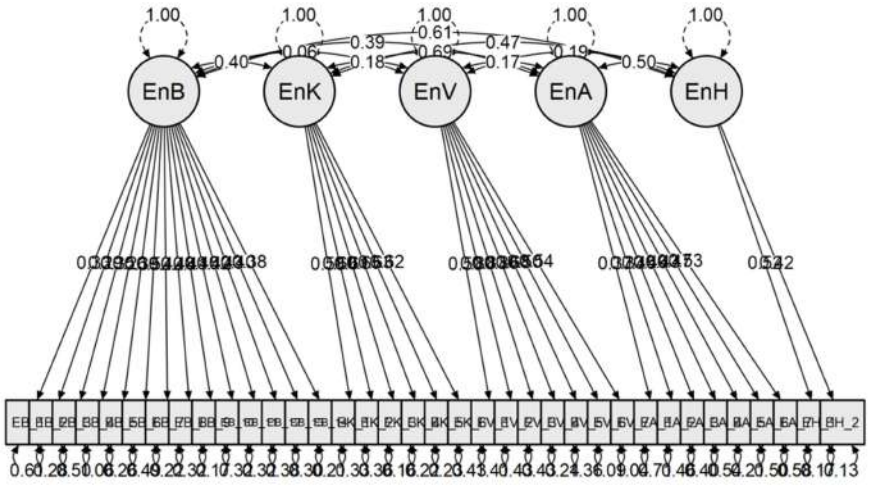

Figure 2. CFA final measurement model

To strengthen the results of the EFA and CFA, a RASCH analysis was performed to determine the validity and reliability of the instrument following the Messick validity which includes several aspects namely content, substance, structure, external and consequential (Susongko, 2016). This research is only limited to the content and consequential aspects. The following describes the results of the RASCH analysis on the green character instrument.

Green Character Instruments Reliability

The results of the measurement of reliability and separation of the item and person indices of the instrument are shown in Table 5.

Table 5. Reliability and separation index of green character instrument

Construct	ID item	Item Measure		Person Measure	
		Reliability	Separation	Reliability	Separation
Environmental Behavior	EnB1-EnB14	1.00	16.88	0.83	2.18
Environmental Knowledge	EnK1-EnK6	0.99	9.63	0.78	1.89
Environmental Value	EnV1-EnV7	1.00	16.56	0.72	1.62
Environmental Attitude	EnA1-EnA7	1.00	23.52	0.65	1.35
Environmental Habits	EnH1-EnH2	1.00	24.44	0.66	1.40

Fit Analysis of Green Character Statistic Instrument

The results of the item fit analysis of the green character instrument are shown in Table 6.

Table 6. Item fit analysis result of green character instruments

FACTOR	**Item**	**Infit MNSQ**	**Outfit MNSQ**	**PTMEA**
Environmental Behaviors	I bring my water bottle from home when traveling	1.0255	1.1764	0.3397
	I throw rubbish in the right place.	1.4535	1.2149	0.3775
	I ride bicycle or walk for short distance traveling.	0.8825	0.9661	0.3903
	I use public transportation for long distance traveling.	1.3165	1.6078	0.1784
	I keep my waste in my pocket or my bag when there is no trash can nearby and carry them until I find trash can.	0.8848	0.8299	0.4753
	I bring my own bag from home to reduce plastic waste when I go shopping.	0.8234	0.8759	0.4323
	I encourage my family and my colleagues to save resources	1.1317	1.0298	0.47
	I encourage my family and my colleagues to plan trees.	1.0375	0.9918	0.4587
	I support family members or colleagues activities in protecting the environment.	1.275	1.4922	0.2375
	I discuss environmental issues with family members and colleagues.	0.5566	0.6486	0.463

	I often involve in environmental cleaning activities.	0.7253	0.8411	0.4334
	I often pick up trash which scatter around public areas.	0.7584	0.7024	0.5311
	I remind family or colleagues who litter everywhere.	0.5751	0.6478	0.4271
	I throw waste from food and drinks in the right place when gathering with friends and families.	0.6102	0.6693	0.4198
Environmental Knowledge	Littering in the river can damage the sea ecosystem	0.6313	0.701	0.4039
	Using air conditioner can cause damage to the Ozon layers	0.7125	0.7815	0.4107
	Waste from motor vehicles can cause air pollution and climate change.	0.7462	0.7672	0.4929
	The extensive use of detergent can cause death for water creatures.	1.4783	1.2842	0.4844
	Illegal logging cam cause the disappearance of clean water sources and natural disaster.	0.8591	0.9089	0.4809
	Too many inhabitants can cause damage many places for housing	0.8618	0.8013	0.5501
Environmental Value	I prefer to see animal in the zoo to seeing them in the wild.	0.8494	0.7944	0.5503
	I do not need to worry about the environment damage as technology can solve that problem.	0.856	0.8029	0.5449
	Human does not always need nature to survive.	1.0492	1.0805	0.4782
	Let the environmental problem happen as it will be solved by itself.	1.0668	1.1274	0.4061
	Natural disaster such as flood, land slide, and drought do not have anything to do with environmental damage.	1.1545	1.3173	0.3169
	The environmental damage issues nowadays have been exaggerated.	0.8599	0.9589	0.404
	Human are here to rule the whole world.	1.2401	1.4703	0.1956
Environmental Attitude	I feel happy and pleased to be with nature	1.3965	1.5706	0.292
	The most important reason to protect the environment if to preserve the human sustainability.	1.554	1.5556	0.4062
	Human are part of the ecosystem just like animal.	1.4713	1.3966	0.4581

	Disturbing the nature will resulted in the damaging consequences.	1.3273	1.6123	0.316
	Plants and animals have the same right to live as how human does.	**1.9292**	**2.2336**	**0.3304**
	The balance of the nature is very sensitive and easily disturbed.	1.0766	1.2402	0.3712
	We will experience huge ecological disaster if everything continues as it is.	0.7641	0.8031	0.4858
Environmental Habits	I turn of the electricity when it is not in use.	1.1692	1.2962	0.3878
	I always turn off the tab when it is not in use.	**1.6487**	**1.9841**	**0.0954**

Wright Map

Wright map analysis was performed to determine the level of difficulty of the items (Saefi et al., 2020; Scoulas et al., 2021). Wright map analysis is shown in Figure 3.

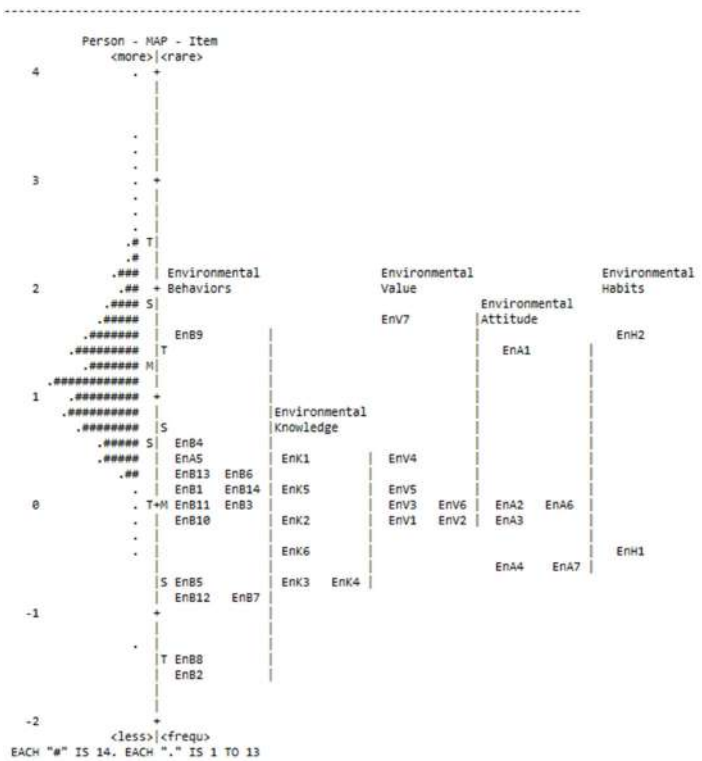

Figure 3. Wright map respondent's perception toward the green character instrument

Rating Scale Diagnostic

The next stage in instrument testing is done through rating scale diagnostics. This measure is used to evaluate the clarity and ease of interpretation of the response set in the instrument (Kim & Kyllonen, 2006). The results of the diagnostic scale rating are shown in Figure 4.

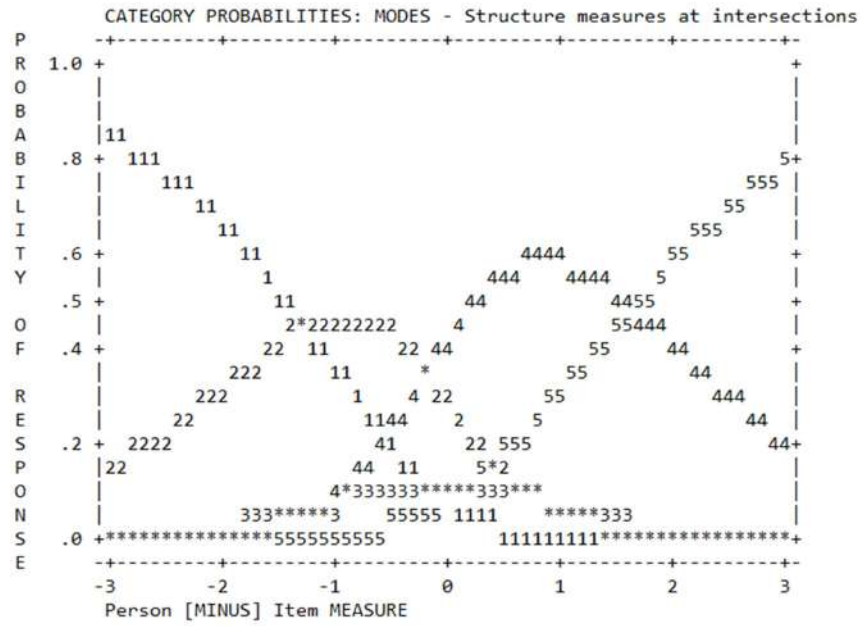

Figure 4. Probability category curve of the green character instrument

Differential Item Functioning (DIF) Analysis

DIF analysis was conducted to determine whether different subgroups, in this case gender, responded to items differently (Iseppi et al., 2021). The results of the DIF analysis are shown in Figure 5.

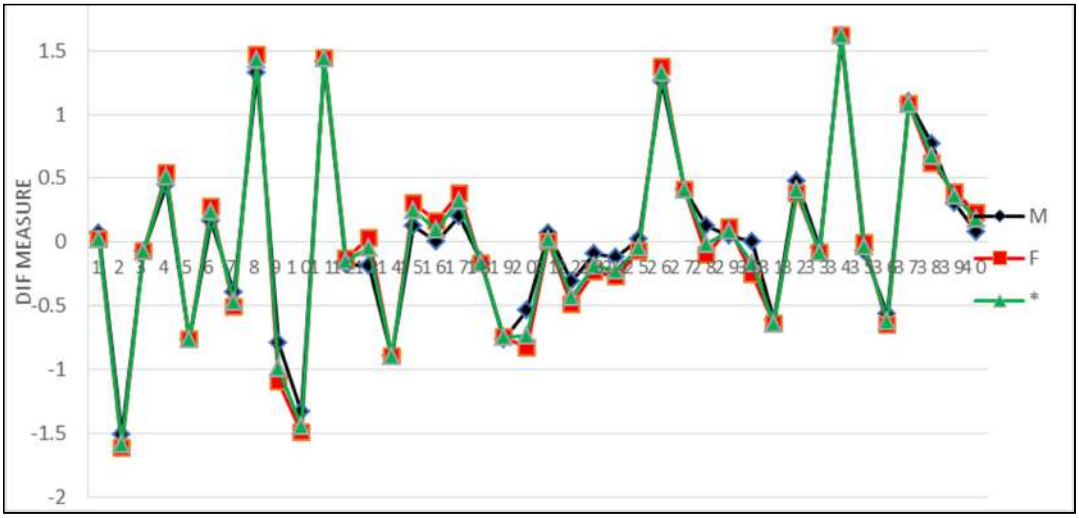

Figure 5. Graph of person DIF of the green character instrument

Discussion

This study will test the green character instrument consisting of 40 items which are coded from A1 to A40. The first step to test the relationship between variables in the instrument is performing factor analysis. EFA analysis results on Table 3 shows that the Eigenvalue is more than 1 (range from 1.54 to 4.77). Eigenvalue is a measure used to determine the number of factors being formed (Larsen & Warne, 2010). Based on the Eigenvalue, the 5 formed constructs are fit. This is in accordance with Yong & Pearce (2013) opinion which say that the Eigenvalue value of more than 1 indicates that the factor has met the assumption of the fit criteria. Table 3 also shows the value of the variance formed on each factor (ranging from 3.80 to 11.90) with a cumulative variance of 38.10%. The cumulative variance value is relatively small as usually the cumulative variance for humanities research ranges from 50-60% (Pett et al., 2011). However, the resulting variance value is still acceptable as the other criteria have been met in the EFA analysis. The low value of this variance is thought to be caused by the maximum likelihood extraction method used. According to Costello & Osborne (2005), the principle component analysis (PCA) method in extraction produces a greater variance than the maximum likelihood (ML) method. This happens because PCA does not

divide the unique variance from communalities so it sets all item communalities at 1.0, whereas ML estimates the level of shared variance for the items, which ranged from 0.39 to 0.70.

The range of the average interitem correlation values in the factors is 0.31 to 0.6 (Table 3). This indicates that there is a strong relationship between each item in the same factor. According to Tabachnick et al (2014), the interitem correlation value that exceeds 0.3 meets good factorability in the EFA. Table 3 also shows that the average value of interfactor correlation is smaller than the average value of interitem correlation in factors that range from 0.02 to 0.07. This proves that the instrument has good specificity. The intended specificity is the instrument's ability to distinguish the specificity of each factor based on its correlation value (Trumpower et al., 2010). The results of Cronbach's alpha analysis in Table 3 reveal that the reliability value ranges from 0.74 to 0.85. This shows that the instrument has good reliability. The reliability value above 0.7 proves that the instrument is reliable and acceptable (Yu & Richardson, 2015).

To test the consistency of the formed factors, a confirmatory factor analysis was performed (Tomé-Fernández et al., 2020). CFA was conducted on 5 factors and 36 items. They are Environmental Behavior (EnB), Environmental Knowledge (EnK), Environmental Value (EnV), Environmental Attitude (EnA), and Environmental Habits (EnH) factors. The fit model criteria are based on the Root mean square error of approximation (RMSEA), Goodness of fit index (GFI), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and X2/df (Sun, 2005). The results of the CFA analysis in Table 4 show that all fit criteria have been met by the model. The obtained RMSEA value is 0.036, CFI = 0.952, TLI = 0.948, GFI = 0.957, and x2/df = 2.802. All of these values have met the model fit criteria (Nye & Drasgow, 2011; Prudon, 2014; Hidayat et al., 2018). The results of this final measurement are then used for the validity and reliability of items using the RASCH model (Susongko, 2016).

The analysis using the RASCH model includes (1) instrument reliability, (2) instrument item quality, (3) level of difficulty of the items, (4) evaluate the clarity of items, and (5) items bias.

Instrument reliability was performed on five constructs, namely environmental behavior, knowledge, values, attitudes, and habits. The reliability analysis results showed that the item reliability values for each domain ranged from 0.99-1.00 with the item separation values ranging from 9.63 to 24.44. A reliability value above 0.9 indicates that the instrument's reliability is in the good category (Saefi et al., 2020), while the separation index value of > 2.0 indicates that the measurement using RASCH can distinguish the instrument into several different groups or domains (Ismail et al., 2020). In addition, the results of the person reliability analysis ranged from 0.65 to 0.83 which include in the pretty good category (Sumintono & Widhiarso, 2015) with a separation index value ranging from 1 and above 2. These results indicate that the instrument has the capability to distinguish respondents' abilities, respondents with high and low performance (Ismail et al., 2020).

The fit index value indicates the quality of the items in the instrument which reveals how accurately the data fits the model (Scoulas et al., 2021). The fit model reference used in this study is the MNSQ infit/outfit value, and PTMEA, while the ZSTD infit/outfit value is ignored because the sample used in this research is > 500 (Sumintono & Widhiarso, 2015). The MNSQ value is used as an indicator of item discrepancy in the RASCH model (Ismail et al., 2020), while the PTMEA is performed to determine whether the instrument can distinguish respondents according to their response level (Saefi et al., 2020).

The results of the item fit analysis in Table 6 show that there are two items which do not meet the fit index criteria. One item on the environmental attitude construct is EnA5 and on the environmental habits construct is EnH2. The MNSQ and PTMEA infit/outfit values for each of these items are outside the predetermined index value (Bond & Fox, 2007; Linacre, 2018).

In this study, the criteria for item acceptance were determined by three criteria, namely infit MNSQ, outfit, MNSQ, and PTMEA. If the item meets one of the predetermined fit index criteria, then the item in the instrument can be accepted (Sumintono & Widhiarso, 2015). This result is different from the result of factor analysis and confirmatory factor. Based on these results, the loading factor values for EnA5 and EnH2 items are 0.464 and 0.721, respectively (Table 2). The loading factor value is quite large and acceptable (Prasetyo et al., 2019), but based on the results of item fit analysis using RASCH, both items do not meet the criteria and are declared as invalid items. This study found that there was a discrepancy between the results of the CFA analysis and the RASCH model. According to Scoulas et al (Scoulas et al., 2021), the RASCH model can detect potential measurement problems such as item bias or local item dependencies that may arise when measuring using classical validation methods such as factor analysis. Based on this assumption, researchers tend to eliminate both items which are considered as invalid items.

The analysis of the items difficulty level through the wright map in Figure 3 showed that only 4 items namely EnB9, EnV7, EnV1 and EnH2 are considered difficult by respondents in understanding green character instruments. There were no items that were categorized as difficult to be understood by the respondents in the environmental knowledge component. Overall, the questions on the instrument can be easily understood by the respondent. This shows that the green character instrument has met the criteria for a good item difficulty level.

The rating scale visualization shown in Figure 4 shows the probability of the response category in the green character instrument according to the recommended pattern. Each category has a distinct peak at some point along the scale as expected (Scoulas et al., 2021). Thus, it can be concluded that the green character instrument response series is functioning properly (Saefi et al., 2020). The final stage of testing items used the DIF test to determine the instrument items bias. DIF analysis was specifically used to reveal the ability to answer

between male and female students to find out whether there was a bias from the items given. Question items that have a bias are indicated by differences in the ability to answer between male and female students. To overcome the bias in the items, Isepi et al (2021) suggested to make two separate items, one item for men and another for women. The results of the DIF analysis of the green character instrument shown in Figure 5 show that there is no bias as evidenced by the graph of male and female responses approaching the normal line (green). This proves that the items in the instrument are free from bias and can be used to reveal green character for both male and female respondents.

The final result of the green character instrument found in five constructs with a total of 34 items (4 items were eliminated after EFA and CFA, and 2 items were eliminated after RASCH). The five formed constructs, namely Environmental Behavior (EnB), Environmental Knowledge (EnK), Environmental Value (EnV), Environmental Attitude (EnA), and Environmental Habits (EnH) were confirmed through the CFA and met the criteria for the Goodness of fit index (Table 4). These results indicate that the construct validity of the instrument has been met. This finding is in line with the theory that underlies this research such as the theories that have been tested by Stern (2000) regarding Environmental Behavior, environmental knowledge (Raymond et al., 2010), environmental values (Thompson & Barton, 1994), and attitudes towards the environment (Dunlap et al., 2000). Based on the results of the content validity analysis, which includes the fit item test, person-item map, and diagnostic rating scale, and the consequential validity which includes the DIF analysis, the green character instrument is declared eligible and has met the standard criteria that have been determined. However, this study revealed that one of the constructs, the Environmental Habits (EnH), experienced an item reduction to leave only one statement item. Based on these findings, the researcher believes that there is a lack of research caused by the lack of items used in this instrument. However, empirically, based on the results of the EFA, CFA and

RASCH this questionnaire has met the standards in instrument development, so it can be used to measure the students' green character.

Conclusion

This study showed that the green character instrument series had met the criteria for item validity and reliability using the EFA, CFA and RASCH models. The EFA showed the loading factor was approximately on 0.314-0.772 with the initial eigenvalues in the interval of 1.54-4.77. It had a good goodness of fit index with X^2/df, RMSEA, GFI, CFI and TLI in the category of good after confirmed through CFA. The EFA and CFA analysis resulted 36 items after eliminating 4 unstandardised items. A further analysis using RASCH on 36 items remained 34, 2 out of 36 was deleted due to not reach the standard value of MNSQ and PTMEA infit/outfit. The final result of this measurement found that the 34 items reached a fit model of EFA, CFA, and RASCH. This instrument can reveal knowledge, behavior, values, attitudes and habits towards the environment. Although it was found that there were discrepancies in the results of measurements using factors and RASCH, these three types of validity measurements should be used simultaneously so that they can complement one another.

Recommendations

Further research can be conducted to test the precision of the instruments that have been produced in revealing the students' green character in various demographic conditions. In addition, to obtain more comprehensive results, further research can be carried out at lower levels of education such as elementary, junior high and high school. For teachers, the green character instrument can be applied through a modified instrument for suitable materials and topics.

Limitations

The environmental habits construct has too few items. This allows the occurrence of missing in the data. Therefore, further research can arrange more items so that they can represent constructs to get more valid and reliable results.

Acknowledgment

The researcher would like to thank the Kemendikbud-Ristek of Republic Indonesia for support this research through the PTUPT scheme for 2021.

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CORRECTION REPORT			
No	**Reviewer Code**	**Reviews**	**Corrections made by the author**
1	R2611	Please double-check that all citations in the text and the references are fitting to APA 7	We have checked all the citations in the manuscript and have corrected the incorrect citations according to the reviewer's input, and changed the citation to APA 7 form as recommended (see reference page 21)
2	R2611	Use "and" instead of "&" in the text. But it is vice versa in parentheses.	According to the reviewer's suggestion, we have corrected the sentences in the text that use "&" and replaced them with the word "and", while for citations, the word "and" has been replaced using "&" according to APA 7 (for example see the introduction in the second paragraph; ……caring for the environment **(Pane & Patriana, 2016)**
3	R2611	Please separately write results and discussion sections.	According to the reviewer's recommendation, the 'results' and 'discussion' sections have been separated in the manuscript text (see page 7 for the results section, while page 15 for the discussion section)
4	R2611	Firstly, report content validity results.	In the results section, improvements have been made according to the reviewer's suggestions, namely displaying the results of the content validity first and then continuing with an explanation of other results (see the results section of the first paragraph)
5	R2613	In-text citations are incorrect. Author surnames are duplicated. Please refer APA 7 manual for in-text citation style.	Revisions have been made according to the reviewer's suggestions. Wrong quotes in the text such as …in the form of values, beliefs, good and bad behavior (Ryan, 2013) (Rahman et al., 2020) have been corrected to…in the form of values, beliefs, good and bad behavior (Ryan, 2013; Rahman et al., 2020). Likewise, errors in writing the last name of authors such as Borton (1994) have been changed according to APA 7.
6	R2613	Please rewrite discussion part separately.	According to the reviewer's recommendation, the 'results' and 'discussion' sections have been separated in the manuscript text (see page 7 for the results section, while page 15 for the discussion section)
7	R2613	Use lowercase in the word **and**: Validating Student's Green Character Instrument Using Factor **And** Rasch Model	The title has been changed to: Validating Student's Green Character Instrument Using Factor and Rasch Model
8	R2613	Check grammar and meaning: However, there has not been any instrument that can be used to measure all these aspects in one comprehensive instrument	Sentences have been changed to: Many researchers have separately developed instruments to measure environmental characteristics such as attitudes, values, and knowledge. However, there is no instrument used to measure all these aspects in one comprehensive instrument.

9	R2613	Check grammar : The instrument content validation was conducted by 3 experts who were then analyzed using the content validity index (CVI).	Sentences have been changed to: The instrument content validation was analyzed by three experts using content validity index (CVI).
10	R2613	Change to 'after EFA and CFA analysis': Construct validation resulted in 34 items (4 items were eliminated from EFA and CFA, and 2 items were eliminated from RASCH	Sentences have been changed to: Construct validation resulted in 34 items (4 items were eliminated after Exploratory and Confirmatory Factor Analysis, and 2 items were eliminated after RASCH analysis)….
11	R2613	Too many "Character …" sentences. This may disturb readers. Would you consider reorganizing this paragraph and sentences? Character is part of humanity (Pradhan, 2009). Character can be in the form of values, beliefs, behavior, and morality (Hidayati et al., 2021). Even doing something right can also be called character (Pradhan, 2009). Character is related to habits, ways to act and is a picture of actual behavior (Ryan, 2013). Character is defined as a personality which is formed from virtue and is used to think and act (Maisardi, 2017)(Rahman et al., 2020). Character consists of good and bad habits (Ryan, 2013), mental and behavior (Rahman et al., 2020). Character need to be formed as it cannot spontaneously arise (Muharlisiani et al., 2019).	Sentences have been changed to: Character as a part of humanity (Pradhan, 2009) in the form of values, beliefs, good and bad behavior (Ryan, 2013; Rahman et al., 2020), and morality (Sari et al., 2021) is used to think and behave (Maisardi, 2017). It needs to be formed as it cannot spontaneously arise (Muharlisiani et al., 2019).
12	R2613	Put multiple citation in the same parentheses. Check other multiple citations and fix this error, if any: (Sukri, Efendi, et al., 2020)(Palupi & Sawitri, 2018).	Errors in writing citations in the manuscript text have been changed according to the reviewer's recommendation. The results of re-checking showed many errors in writing citations in the manuscript. We have corrected the error and we have adapted it to APA 7 (see all citations in text and references on page 21)
13	R2613	All subtitles should be left aligned, italic and not bold according to the journal's paper template. Edit all.	All subtitles have been left aligned, italicized and not bold according to the journal template (see the results section on page 7)
14	R2613	Figure title should be written in title case. Check other figure titles and fix errors, if any. Table title should be written in title case and italic. Check other table titles and fix errors, if any.	The title of the figure and table has been corrected according to the reviewer's suggestion (for example see figure 1 and table 2 on page 8)
15	R2613	Please show final form of the instrument showing factors and loading items in conclusion section.	The conclusion section has been improved according to the reviewer's recommendation by describing the final form of the instrument that shows the factors and contains loading items (see the conclusion section on page 20).
16	R2613	Please add recommendations for practioners.	The recommendations section has followed reviewers' suggestions by adding recommendations for practitioners (See recommendations section on page 20)

17	R2613	I wonder if you conducted CFA, EFA and RASCH analysis again after eliminating those items (4 + 2). The factor, Environmental Habits, had two items before RASCH analysis. What happened to this factor after eliminating one of the items? If only one item is left (even a factor with two items is arguable) then measuring "Environmental Habits" with only one item is not very valid and reliable.	The results of the EFA, CFA, and RASCH analysis yielded 34 valid and reliable items. After finding deleted items based on the results of EFA, CFA and RASCH, further analysis was carried out to determine changes in constructs or the validity and reliability of instrument items. The final results after 6 items were discarded in the analysis showed the same pattern as the previous results. The formed factor remains the same, but has a goodness of fit index value that is better than the previous analysis, but is still in the good category and meets the fit criteria as the results obtained in the previous analysis. We also tried to carry out further analysis after one of the items in the 'environmetal habbits' construct was eliminated. The results show the same pattern of factors as the previous analysis. Based on these findings, we consider it unnecessary to present this final result because it has the same pattern as the results of the previous analysis.

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manuscript ID# 21111715274746_Revised

Editor - European Journal of Educational Research <editor@eu-jer.com> 12 Januari 2022 pukul 15.24
Kepada: akhmad sukri <akhmadsukri@undikma.ac.id>

Dear Dr. Sukri ,

Thank you for your email.

We have received your revised paper and correction report filled out.

As you can see in my previous email, we ask to highlight the changed parts. However, we couldn't see the highlighted parts in your revised paper.

Please highlight the edited parts in different colors for each reviewer on your revised paper. Also please blind your paper from author' information. Because we will send them to our reviewers in order to check.

We are looking forward to getting your highlighted and blinded paper and the correction report again. The deadline for your sending your revised paper is **January 14, 2022.**

Best regards,

Ahmet Savas, Ph.D.

Editor, European Journal of Educational Research

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[Kutipan teks disembunyikan]

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manuscript ID# 21111715274746_Revised

akhmad sukri <akhmadsukri@undikma.ac.id> 12 Januari 2022 pukul 21.13
Kepada: Editor - European Journal of Educational Research <editor@eu-jer.com>

Dear editor in chief
European Journal of Educational Research

Thank you for your suggestion. We have edited the manuscript by highlighting the edited section using yellow for reviewer R2613, while blue for reviewer R2611. In addition, we have blinded the author's information on the manuscript. Here we attach a revised manuscript file and a correction report.

Best regards
Akhmad Sukri

[Kutipan teks disembunyikan]

2 lampiran

EUJER Manuscript_ID# 21111715274746_ Revised.docx
657K

CORRECTION REPORT_Manuscript ID# 21111715274746.docx
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Validating Student's Green Character Instrument Using Factor and Rasch Model

Abstract. Many researchers have separately developed instruments to measure environmental characteristics such as attitudes, values, and knowledge. However, there is no instrument used to measure all these aspects in one comprehensive instrument. This study is meant to develop and validate a green character instrument which reveals student behavior and awareness of the environment. The instrument consists of 40 statement items consisting of 5 aspects, namely private pro-environmental behavior, public pro-environmental behavior, environmental knowledge, environmental values, and environmental attitudes. It was implemented on 1,398 students from 15 universities in Indonesia. The instrument content validation was analyzed by three experts using content validity index (CVI). The construct validity was analyzed using exploratory factor analysis, confirmatory factor analysis, and RASCH analysis. The content validity results obtained CVI scores ranging between 0.8 and 0.9 with a good category, while item reliability was in a fairly good category with a high level of separation index. Construct validation resulted in 34 items (4 items were eliminated after Exploratory and Confirmatory Factor Analysis, and 2 items were eliminated after RASCH analysis) spread over five constructs, namely environmental behavior, environmental knowledge, environmental values, environmental attitudes, and environmental habits. The resulting instrument has a good level of item difficulty, with a well understood response set which can be understood easily by respondents, and without bias. Therefore, it can be used to measure the students' green character on both male and female.

Keywords: green character, instrument, factor and RASCH Analysis.

Introduction

Character as a part of humanity (Pradhan, 2009) in the form of values, beliefs, good and bad behavior (Ryan, 2013; Rahman et al., 2020), and morality (Sari et al., 2021) is used to think and behave (Maisardi, 2017). It needs to be formed as it cannot spontaneously arise (Muharlisiani et al., 2019). Therefore, character needs to be familiarized to the younger generation through continuous learning, examples, and practices (Rahmawati et al., 2020). People with character will have good morals (Asrial et al., 2021), who consciously controls every action and behavior (Maisardi, 2017).

Good character is needed in all aspects, such as in environment. Example of good character to the environment is implemented in an attitude of caring for the environment (Pane & Patriana, 2016; Sanjaya, 2020). The character of caring for the environment must also be made accustomed (Arent et al., 2020; Masturoh & Ridlo, 2020), and it is important to be developed as the environment will have an impact on human existence (Yunesa, 2019). Environmental care character will create positive behavior towards the environment (Sukri et al., 2020; Asrial et al., 2021), and reduce the negative impact of human behavior on the environment (Palupi & Sawitri, 2018; Sukri et al., 2020). In addition, concerning for the environment is very important as most of the environmental damage is caused by human behavior (Faisal et al., 2014; Sukri et al., 2018).

The term green character in this study refers to a person's behavior and awareness of the environment. Behavior refers to human activities to protect the environment or what is called pro-environmental behavior (Stern, 2000), while awareness refers to knowledge (Raymond et al., 2010), values (Thompson & Barton, 1994) and attitudes to the environment (Dunlap et al., 2000). Therefore, caring for the environment attitude is part of a green character. The term green character was chosen to describe all positive behaviors and awareness of the environment. Frasz (2016) mentions environmental character as feelings, sentiments and virtues towards the environment. The term green is also used by Chankrajang

(2017) to describe one aspect of attitude towards the environment which is pro-environmental behavior. By using the term green character, all behaviors, attitudes, knowledge, values, and all things with a positive impact on the environment can be covered which makes this term more universal.

Currently, it is difficult to find an instrument that can fully accommodate all aspects of behavior and environmental awareness. The research conducted by Stern (2000) only developed an instrument to measure pro-environmental behavior, while Raymond et al (2010) focused on the knowledge aspect. In addition, Thompson & Barton (1994) and Dunlap et al (2000) only focused on values and attitudes aspects. The only similar research has been conducted by Fu et al (2018), which unfortunately has some weaknesses, namely (1) limited to the behavior and awareness of the campus academic community and not generally applicable to the wider community, and (2) statement items developed in the instruments are mostly not in accordance with the conditions, context, and socio-cultural prevailing in many countries, such as in Indonesia. Whereas according to Chwialkowska et al (2020) and He & Filimonau (2020), a person's socio-cultural background influences his behavior towards the environment. For example, the statement item “I believe I know environmental issues well' presented by Fu et al (2018) cannot be reduced to a concrete statement because it is not in accordance with the conditions of society in several countries with the same culture and conditions, especially Indonesia. The statement will become understandable if it is transformed into real environmental issues occuring in the community, for example “Illegal logging can result in the loss of clean water sources and natural disasters” and “Throwing garbage in rivers can cause damage to marine ecosystems”.

Therefore, this research is very important to be conducted to produce an instrument that can accommodate all aspects of environmental behavior and awareness. The resulting instrument can be used to measure not only the knowledge, values and attitudes towards the

environment, but also to measure behavior reflected in pro-environmental attitudes. The results of this study can be used as a reference for other researchers in different countries which have similar or even the same cultural and socioeconomic conditions to Indonesia, which will make this instrument will be more contextual and precise to measure the "green character" of students.

Contribution to the literature

- Some of the instruments developed by previous researchers were limited to certain aspects and did not cover all aspects of environmental behavior and awareness
- Instruments to measure green character have not been disclosed and have not been validated, especially in Indonesia
- Instruments validated of this study can be used to measure students' green character precisely because it is contextual and in accordance with the conditions experienced by students.

Methodology

This research is meant to develop and validate the green character instrument. The development is conducted through three steps; 1) analyzing the supporting literature and arranging the items, 2) content validation, 3) construct validation through Exploratory Factor Analyis (EFA), Confirmatory Factor Analysis (CFA), and RASCH (Saefi et al., 2020).

Literatur review and item arrangement

Literature review is done to determine the representative variables for green character instrument. Literature analysis is based on studies or research results that have been published in reputable international journals such as research by Stern (2000), Raymond et al (2010), Thompson & Barton (1994), and Dunlap et al (2000). Based on the results of the review, a draft of a green character instrument was prepared which includes 40 items. The green character instrument draft consists of private pro-environmental behavior aspects (Stern,

2000) covering 11 items; public pro-environmental behavior aspects (Stern, 2000) which consists of 8 items; environmental knowledge aspects (Raymond et al., 2010) with 6 items; environmental value aspects (Thompson & Barton, 1994) with 8 items; and environmental attitudes aspects (Dunlap et al., 2000) which consists of 7 items. The student's response consisted of five answer choices; 1 = strongly disagree, 2 = disagree, 3 = indifferent, 4 = agree, and 5 = strongly agree.

Content validation

Content validity is evidence of the extent to which the elements of an assessment instrument are relevant and represent a construct targeted for a particular assessment objective (Almanasreh et al., 2019). Content validity includes four criteria; relevance, clarity, simplicity, and ambiguity (Yaghmaei, 2003). The validity of the green character questionnaire content is done by lecturers, practitioners and researchers in the environmental field as experts in their respective fields to obtain acceptable assessment. In conducting the assessment, the validator was asked to fill in four criteria which are, 1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = very relevant which was adjusted to 4 aspects of content validation. Furthermore, from the four criteria, dichotomous data was made to measure content validation using the content validity index method (Polit & Beck, 2006) with the provisions that CVI values > 0.79 were accepted, CVI values 0.70-0.79 were revised, and CVI < 0.70 were rejected (Devon et al., 2007).

EFA, CFA, and RASCH Analysis

Research sample

This study involved 1,398 students as respondents from 15 universities in Indonesia through random sampling (Endo et al., 2016). Respondents consisted of 972 women (69.53%) and 426 men (30.47%) with the age ranging from 19 to 22 years old. Respondents came from various regions in Indonesia including western, central and eastern Indonesia from various different

majors such as social science, science, science education, engineering, humanities and business. The number of samples, 1,398 people, met the ideal limits for factor analysis (Tabachnick & Fidell, 2014) and RASCH analysis (Hagell & Westergren, 2016).

Data Analysis

The initial stage of the analysis was performed through an exploratory factor analysis (Williams et al., 2010). Prerequisite analyzes such as Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity were performed prior to EFA (Chan & Idris, 2017). Furthermore, EFA uses the varimax rotation method (Osborne, 2015) and maximum likelihood estimation (Kassim et al., 2013) with the criteria of Eigenvalue > 1 (Yong & Pearce, 2013), and a minimum loading factor of 0.3 (Prasetyo et al., 2019). CFA was conducted to confirm the EFA results with model fit criteria based on the Root mean square error of approximation (RMSEA 0.06), Goodness of fit index (GFI 0.95), Comparative Fit Index (CFI 0.95), Tucker-Lewis Index (TLI 0.95), and X2/df < 3.00 (Sun, 2005). The RASCH analysis measures the validity of the instrument's construct in terms of content and consequential aspects (Susongko, 2016). Since the sample used is > 500 (Sumintono & Widhiarso, 2015), the item fit criteria are seen based on the mean-square infit and outfit values (MNSQs, between 0.6 to 1.5), and the point-measure correlation coefficient (PTMEA Corr, between 0.3 up to 0.7)(Linacre, 2018). Items that meet one of these criteria are designated as valid items, while items that do not meet the criteria will be deleted from the instrument. Furthermore, the reliability value of the items received is between 0.65 and 0.83 (Sumintono & Widhiarso, 2015) with a separation index value of 1 and > 2 (Ismail et al., 2020). In addition to reliability, Wright map analysis was also performed to determine the items' level of difficulty (Scoulas et al., 2021) followed by rating scale analysis to evaluate the clarity and ease of interpretation of the response set in the instrument (Kim & Kyllonen, 2006). Finally, to avoid bias in the

instrument, a Differential Item Functioning (DIF) analysis was conducted to determine the responses of male and female students (Iseppi et al., 2021).

Results

Content validation

The results of CVI analysis on 40 green character instrument items show that the CVI values range from 0.8-0.9 for all aspects. Based on these results, all items in the instrument have met the valid criteria which were reviewed based on relevance, clarity, simplicity, and ambiguity.

Exploratory Factor Analysis (EFA)

Factor analysis serves to reduce variables that are replaced by several factors which summarize the relationship between variables (Goldberg & Velicer, 2006). The initial assumption in factor analysis is the adequacy of the sample in the analysis (UI Hadia et al., 2016). Sample adequacy is measured by the Kaiser-Meyer-Olkin (KMO) value which must be greater than 0.5 (Hair et al., 2010). In addition to the adequacy of the sample, the assumption that must be met in the EFA is that there should be relationship between variables in the factors (Matore et al., 2019) which is indicated by the value of Bartlett's Test of Sphericity (BTS) which must be less than 0.05 (Chan & Idris, 2017). The results of the KMO and BTS analysis are shown in Table 1 which shows that the KMO value is 0.917 and is in the very good category (UI Hadia et al., 2016), while the BTS value is <.001 which indicates that both EFA assumptions are met and acceptable for further analysis (Field, 2000).

Table 1. KMO and BTS analysis result

Kaiser-Meyer-Olkin	Bartlett's Test of Sphericity		
Overall MSA	X^2	df	p
0.917	18800.609	780.000	<.001

After the EFA assumption test is met, the next step is to perform a factor analysis of 40 instrument items using the varimax rotation method (Osborne, 2015) and maximum likelihood estimation (Kassim et al., 2013). To determine the number of factors being formed,

the parallel analysis method was conducted (Çokluk & Koçak, 2016). The results can be seen in Figure 1 which shows that the implementation point is formed after five factors resulted in 5 constructs which were formed from the results of factor analysis. Each item in the formed factor has a loading factor of more than 0.3. The minimum factor loading value used in this study is 0.3 to indicate that the formed factor has met the fit criteria (Prasetyo et al., 2019). The loading factor that were formed are shown in Table 2.

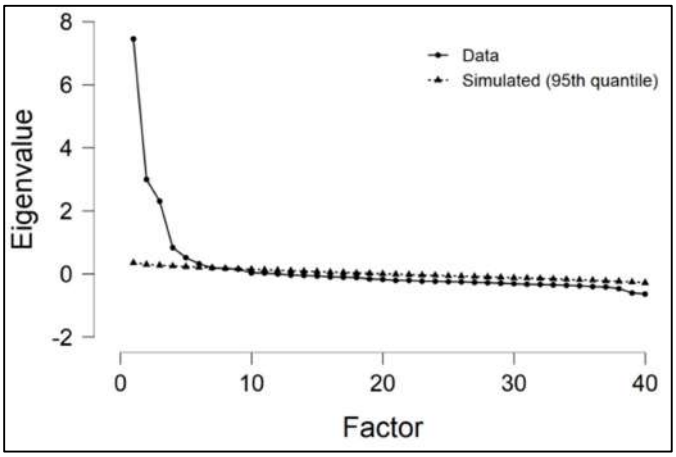

Figure 1. Scree plot result of factor analysis

Table 2. Loading factor formed from factor analysis

Items	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
A1	0.362				
A2	0.344				
A3	0.344				
A4	0.314				
A5	0.509				
A6	0.654				
A12	0.645				
A13	0.730				
A14	0.555				
A15	0.637				
A16	0.593				
A17	0.651				
A18	0.614				
A19	0.507				
A20		0.649			
A21		0.649			
A22		0.755			
A23		0.758			
A24		0.758			
A25		0.655			
A26			0.422		

A27	0.772		
A28	0.755		
A30	0.762		
A32	0.508		
A37	0.464		
A38	0.523		
A29		0.499	
A31		0.390	
A33		0.502	
A35		0.453	
A36		0.464	
A39		0.571	
A40		0.514	
A9			0.537
A10			0.721

Based on Table 2, several items such as items A7, A8, A11 and A34 were eliminated from the analysis because they had a loading factor of less than 0.3. Based on these results, 40 items were analyzed resulting in 5 factors. The five formed factors were then grouped and named according to the similarity of characteristics possessed by each item as follow factor 1, environmental behavior; factor 2, environmental knowledge; factor 3, environmental value; factor 4, environmental attitude; and factor 5, environmental habits. The results are strengthened by the Eigenvalue, variance, interitem correlation and Cronbach's alpha value which are presented in Table 3.

Table 3. Characteristics of the formed factors

Construct	Initial Eigen values	% of var.	Cumula -tive %	Average interitem correlation	Average interfactor correlation	Alpha Cronbach	N
Environmental Behavior (EnB)	4.77	11.90	11.90	0.31	0.03	0.85	14
Environmental Knowledge (EnK)	3.63	9.10	21.00	0.57	0.05	0.89	6
Environmental Value (EnV)	3.04	7.60	28.60	0.36	0.02	0.79	7
Environmental Attitude (EnA)	2.27	5.70	34.30	0.30	0.07	0.75	7
Environmental Habits (EnH)	1.54	3.80	38.10	0.60	0.06	0.74	2

Confirmatory Factor Analysis (CFA)

The interpretation of the CFA fit model uses Diagonally Weighted Least Squares (DWLS), which is considered as the most suitable for not normally distributed data compared to the maximum likelihood model (Nye & Drasgow, 2011). The results of the CFA fit model and final measurement model are shown in Table 4 and Figure 2.

Table 4. Goodness of fit index confirmatory factor analysis

Index	Value	Cut off value	criteria
X^2/df	2.802	<3.00	Good
Root mean square error of approximation (RMSEA)	0.036	≤0.06	Good
Goodness of fit index (GFI)	0.957	≥0.95	Good
Comparative Fit Index (CFI)	0.952	≥0.95	Good
Tucker-Lewis Index (TLI)	0.948	≥0.95	Good

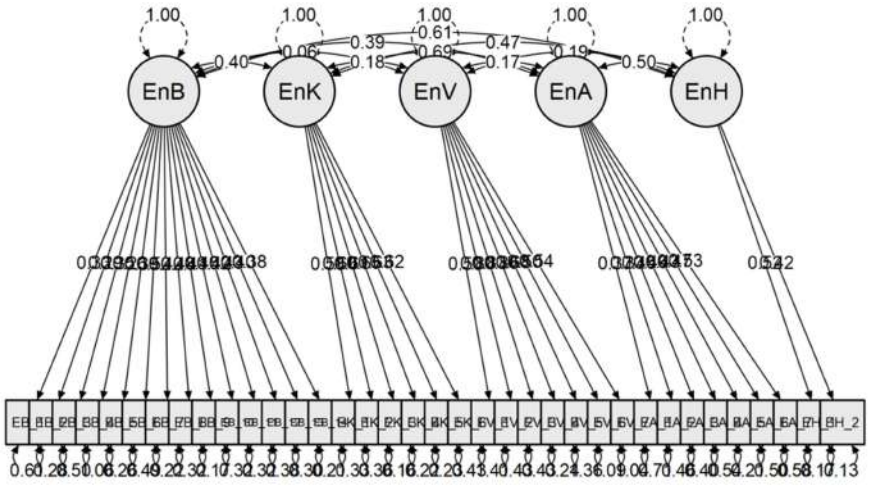

Figure 2. CFA final measurement model

To strengthen the results of the EFA and CFA, a RASCH analysis was performed to determine the validity and reliability of the instrument following the Messick validity which includes several aspects namely content, substance, structure, external and consequential (Susongko, 2016). This research is only limited to the content and consequential aspects. The following describes the results of the RASCH analysis on the green character instrument.

Green Character Instruments Reliability

The results of the measurement of reliability and separation of the item and person indices of the instrument are shown in Table 5.

Table 5. Reliability and separation index of green character instrument

Construct	ID item	Item Measure		Person Measure	
		Reliability	Separation	Reliability	Separation
Environmental Behavior	EnB1-EnB14	1.00	16.88	0.83	2.18
Environmental Knowledge	EnK1-EnK6	0.99	9.63	0.78	1.89
Environmental Value	EnV1-EnV7	1.00	16.56	0.72	1.62
Environmental Attitude	EnA1-EnA7	1.00	23.52	0.65	1.35
Environmental Habits	EnH1-EnH2	1.00	24.44	0.66	1.40

Fit Analysis of Green Character Statistic Instrument

The results of the item fit analysis of the green character instrument are shown in Table 6.

Table 6. Item fit analysis result of green character instruments

FACTOR	**Item**	**Infit MNSQ**	**Outfit MNSQ**	**PTMEA**
Environmental Behaviors	I bring my water bottle from home when traveling	1.0255	1.1764	0.3397
	I throw rubbish in the right place.	1.4535	1.2149	0.3775
	I ride bicycle or walk for short distance traveling.	0.8825	0.9661	0.3903
	I use public transportation for long distance traveling.	1.3165	1.6078	0.1784
	I keep my waste in my pocket or my bag when there is no trash can nearby and carry them until I find trash can.	0.8848	0.8299	0.4753
	I bring my own bag from home to reduce plastic waste when I go shopping.	0.8234	0.8759	0.4323
	I encourage my family and my colleagues to save resources	1.1317	1.0298	0.47
	I encourage my family and my colleagues to plan trees.	1.0375	0.9918	0.4587
	I support family members or colleagues activities in protecting the environment.	1.275	1.4922	0.2375
	I discuss environmental issues with family members and colleagues.	0.5566	0.6486	0.463

	I often involve in environmental cleaning activities.	0.7253	0.8411	0.4334
	I often pick up trash which scatter around public areas.	0.7584	0.7024	0.5311
	I remind family or colleagues who litter everywhere.	0.5751	0.6478	0.4271
	I throw waste from food and drinks in the right place when gathering with friends and families.	0.6102	0.6693	0.4198
Environmental Knowledge	Littering in the river can damage the sea ecosystem	0.6313	0.701	0.4039
	Using air conditioner can cause damage to the Ozon layers	0.7125	0.7815	0.4107
	Waste from motor vehicles can cause air pollution and climate change.	0.7462	0.7672	0.4929
	The extensive use of detergent can cause death for water creatures.	1.4783	1.2842	0.4844
	Illegal logging cam cause the disappearance of clean water sources and natural disaster.	0.8591	0.9089	0.4809
	Too many inhabitants can cause damage many places for housing	0.8618	0.8013	0.5501
Environmental Value	I prefer to see animal in the zoo to seeing them in the wild.	0.8494	0.7944	0.5503
	I do not need to worry about the environment damage as technology can solve that problem.	0.856	0.8029	0.5449
	Human does not always need nature to survive.	1.0492	1.0805	0.4782
	Let the environmental problem happen as it will be solved by itself.	1.0668	1.1274	0.4061
	Natural disaster such as flood, land slide, and drought do not have anything to do with environmental damage.	1.1545	1.3173	0.3169
	The environmental damage issues nowadays have been exaggerated.	0.8599	0.9589	0.404
	Human are here to rule the whole world.	1.2401	1.4703	0.1956
Environmental Attitude	I feel happy and pleased to be with nature	1.3965	1.5706	0.292
	The most important reason to protect the environment if to preserve the human sustainability.	1.554	1.5556	0.4062
	Human are part of the ecosystem just like animal.	1.4713	1.3966	0.4581

	Disturbing the nature will resulted in the damaging consequences.	1.3273	1.6123	0.316
	Plants and animals have the same right to live as how human does.	**1.9292**	**2.2336**	**0.3304**
	The balance of the nature is very sensitive and easily disturbed.	1.0766	1.2402	0.3712
	We will experience huge ecological disaster if everything continues as it is.	0.7641	0.8031	0.4858
Environmental Habits	I turn of the electricity when it is not in use.	1.1692	1.2962	0.3878
	I always turn off the tab when it is not in use.	**1.6487**	**1.9841**	**0.0954**

Wright Map

Wright map analysis was performed to determine the level of difficulty of the items (Saefi et al., 2020; Scoulas et al., 2021). Wright map analysis is shown in Figure 3.

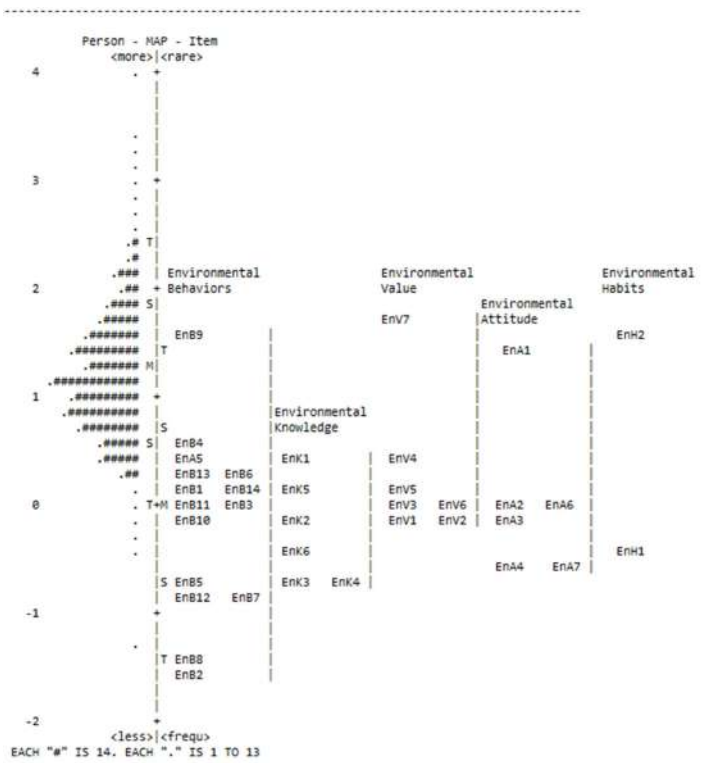

Figure 3. Wright map respondent's perception toward the green character instrument

Rating Scale Diagnostic

The next stage in instrument testing is done through rating scale diagnostics. This measure is used to evaluate the clarity and ease of interpretation of the response set in the instrument (Kim & Kyllonen, 2006). The results of the diagnostic scale rating are shown in Figure 4.

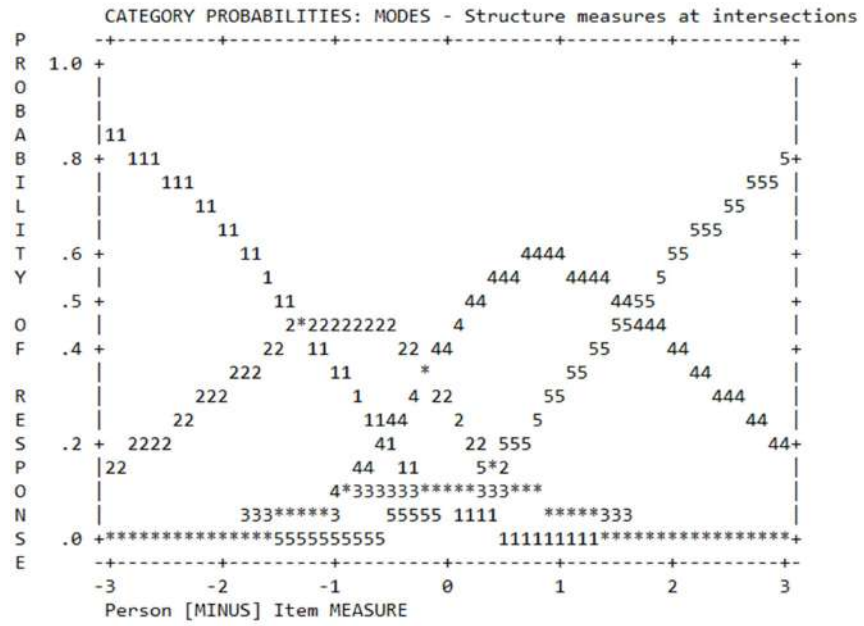

Figure 4. Probability category curve of the green character instrument

Differential Item Functioning (DIF) Analysis

DIF analysis was conducted to determine whether different subgroups, in this case gender, responded to items differently (Iseppi et al., 2021). The results of the DIF analysis are shown in Figure 5.

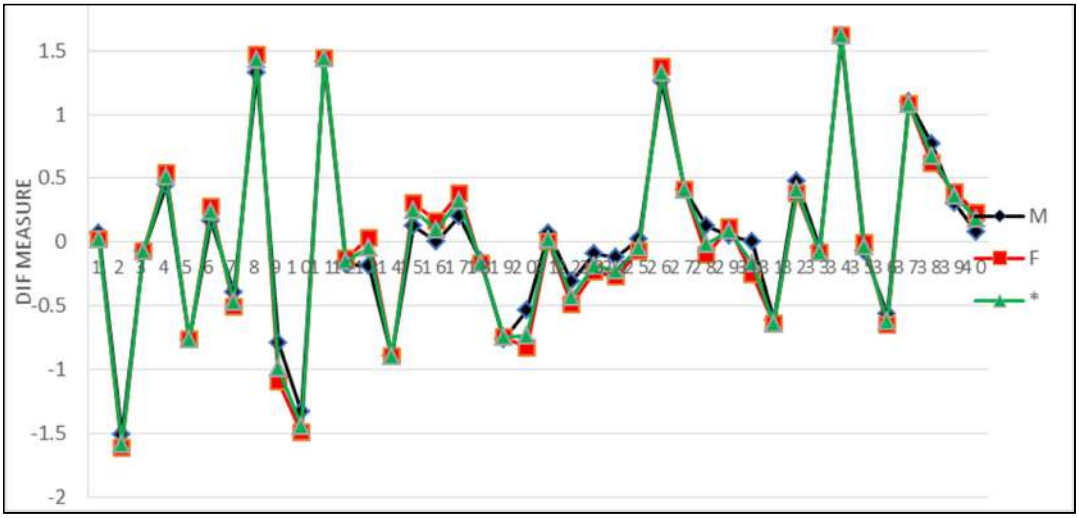

Figure 5. Graph of person DIF of the green character instrument

Discussion

This study will test the green character instrument consisting of 40 items which are coded from A1 to A40. The first step to test the relationship between variables in the instrument is performing factor analysis. EFA analysis results on Table 3 shows that the Eigenvalue is more than 1 (range from 1.54 to 4.77). Eigenvalue is a measure used to determine the number of factors being formed (Larsen & Warne, 2010). Based on the Eigenvalue, the 5 formed constructs are fit. This is in accordance with Yong & Pearce (2013) opinion which say that the Eigenvalue value of more than 1 indicates that the factor has met the assumption of the fit criteria. Table 3 also shows the value of the variance formed on each factor (ranging from 3.80 to 11.90) with a cumulative variance of 38.10%. The cumulative variance value is relatively small as usually the cumulative variance for humanities research ranges from 50-60% (Pett et al., 2011). However, the resulting variance value is still acceptable as the other criteria have been met in the EFA analysis. The low value of this variance is thought to be caused by the maximum likelihood extraction method used. According to Costello & Osborne (2005), the principle component analysis (PCA) method in extraction produces a greater variance than the maximum likelihood (ML) method. This happens because PCA does not

divide the unique variance from communalities so it sets all item communalities at 1.0, whereas ML estimates the level of shared variance for the items, which ranged from 0.39 to 0.70.

The range of the average interitem correlation values in the factors is 0.31 to 0.6 (Table 3). This indicates that there is a strong relationship between each item in the same factor. According to Tabachnick et al (2014), the interitem correlation value that exceeds 0.3 meets good factorability in the EFA. Table 3 also shows that the average value of interfactor correlation is smaller than the average value of interitem correlation in factors that range from 0.02 to 0.07. This proves that the instrument has good specificity. The intended specificity is the instrument's ability to distinguish the specificity of each factor based on its correlation value (Trumpower et al., 2010). The results of Cronbach's alpha analysis in Table 3 reveal that the reliability value ranges from 0.74 to 0.85. This shows that the instrument has good reliability. The reliability value above 0.7 proves that the instrument is reliable and acceptable (Yu & Richardson, 2015).

To test the consistency of the formed factors, a confirmatory factor analysis was performed (Tomé-Fernández et al., 2020). CFA was conducted on 5 factors and 36 items. They are Environmental Behavior (EnB), Environmental Knowledge (EnK), Environmental Value (EnV), Environmental Attitude (EnA), and Environmental Habits (EnH) factors. The fit model criteria are based on the Root mean square error of approximation (RMSEA), Goodness of fit index (GFI), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and X2/df (Sun, 2005). The results of the CFA analysis in Table 4 show that all fit criteria have been met by the model. The obtained RMSEA value is 0.036, CFI = 0.952, TLI = 0.948, GFI = 0.957, and x2/df = 2.802. All of these values have met the model fit criteria (Nye & Drasgow, 2011; Prudon, 2014; Hidayat et al., 2018). The results of this final measurement are then used for the validity and reliability of items using the RASCH model (Susongko, 2016).

The analysis using the RASCH model includes (1) instrument reliability, (2) instrument item quality, (3) level of difficulty of the items, (4) evaluate the clarity of items, and (5) items bias.

Instrument reliability was performed on five constructs, namely environmental behavior, knowledge, values, attitudes, and habits. The reliability analysis results showed that the item reliability values for each domain ranged from 0.99-1.00 with the item separation values ranging from 9.63 to 24.44. A reliability value above 0.9 indicates that the instrument's reliability is in the good category (Saefi et al., 2020), while the separation index value of > 2.0 indicates that the measurement using RASCH can distinguish the instrument into several different groups or domains (Ismail et al., 2020). In addition, the results of the person reliability analysis ranged from 0.65 to 0.83 which include in the pretty good category (Sumintono & Widhiarso, 2015) with a separation index value ranging from 1 and above 2. These results indicate that the instrument has the capability to distinguish respondents' abilities, respondents with high and low performance (Ismail et al., 2020).

The fit index value indicates the quality of the items in the instrument which reveals how accurately the data fits the model (Scoulas et al., 2021). The fit model reference used in this study is the MNSQ infit/outfit value, and PTMEA, while the ZSTD infit/outfit value is ignored because the sample used in this research is > 500 (Sumintono & Widhiarso, 2015). The MNSQ value is used as an indicator of item discrepancy in the RASCH model (Ismail et al., 2020), while the PTMEA is performed to determine whether the instrument can distinguish respondents according to their response level (Saefi et al., 2020).

The results of the item fit analysis in Table 6 show that there are two items which do not meet the fit index criteria. One item on the environmental attitude construct is EnA5 and on the environmental habits construct is EnH2. The MNSQ and PTMEA infit/outfit values for each of these items are outside the predetermined index value (Bond & Fox, 2007; Linacre, 2018).

In this study, the criteria for item acceptance were determined by three criteria, namely infit MNSQ, outfit, MNSQ, and PTMEA. If the item meets one of the predetermined fit index criteria, then the item in the instrument can be accepted (Sumintono & Widhiarso, 2015). This result is different from the result of factor analysis and confirmatory factor. Based on these results, the loading factor values for EnA5 and EnH2 items are 0.464 and 0.721, respectively (Table 2). The loading factor value is quite large and acceptable (Prasetyo et al., 2019), but based on the results of item fit analysis using RASCH, both items do not meet the criteria and are declared as invalid items. This study found that there was a discrepancy between the results of the CFA analysis and the RASCH model. According to Scoulas et al (Scoulas et al., 2021), the RASCH model can detect potential measurement problems such as item bias or local item dependencies that may arise when measuring using classical validation methods such as factor analysis. Based on this assumption, researchers tend to eliminate both items which are considered as invalid items.

The analysis of the items difficulty level through the wright map in Figure 3 showed that only 4 items namely EnB9, EnV7, EnV1 and EnH2 are considered difficult by respondents in understanding green character instruments. There were no items that were categorized as difficult to be understood by the respondents in the environmental knowledge component. Overall, the questions on the instrument can be easily understood by the respondent. This shows that the green character instrument has met the criteria for a good item difficulty level.

The rating scale visualization shown in Figure 4 shows the probability of the response category in the green character instrument according to the recommended pattern. Each category has a distinct peak at some point along the scale as expected (Scoulas et al., 2021). Thus, it can be concluded that the green character instrument response series is functioning properly (Saefi et al., 2020). The final stage of testing items used the DIF test to determine the instrument items bias. DIF analysis was specifically used to reveal the ability to answer

between male and female students to find out whether there was a bias from the items given. Question items that have a bias are indicated by differences in the ability to answer between male and female students. To overcome the bias in the items, Isepi et al (2021) suggested to make two separate items, one item for men and another for women. The results of the DIF analysis of the green character instrument shown in Figure 5 show that there is no bias as evidenced by the graph of male and female responses approaching the normal line (green). This proves that the items in the instrument are free from bias and can be used to reveal green character for both male and female respondents.

The final result of the green character instrument found in five constructs with a total of 34 items (4 items were eliminated after EFA and CFA, and 2 items were eliminated after RASCH). The five formed constructs, namely Environmental Behavior (EnB), Environmental Knowledge (EnK), Environmental Value (EnV), Environmental Attitude (EnA), and Environmental Habits (EnH) were confirmed through the CFA and met the criteria for the Goodness of fit index (Table 4). These results indicate that the construct validity of the instrument has been met. This finding is in line with the theory that underlies this research such as the theories that have been tested by Stern (2000) regarding Environmental Behavior, environmental knowledge (Raymond et al., 2010), environmental values (Thompson & Barton, 1994), and attitudes towards the environment (Dunlap et al., 2000). Based on the results of the content validity analysis, which includes the fit item test, person-item map, and diagnostic rating scale, and the consequential validity which includes the DIF analysis, the green character instrument is declared eligible and has met the standard criteria that have been determined. However, this study revealed that one of the constructs, the Environmental Habits (EnH), experienced an item reduction to leave only one statement item. Based on these findings, the researcher believes that there is a lack of research caused by the lack of items used in this instrument. However, empirically, based on the results of the EFA, CFA and

RASCH this questionnaire has met the standards in instrument development, so it can be used to measure the students' green character.

Conclusion

This study showed that the green character instrument series had met the criteria for item validity and reliability using the EFA, CFA and RASCH models. The EFA showed the loading factor was approximately on 0.314-0.772 with the initial eigenvalues in the interval of 1.54-4.77. It had a good goodness of fit index with X^2/df, RMSEA, GFI, CFI and TLI in the category of good after confirmed through CFA. The EFA and CFA analysis resulted 36 items after eliminating 4 unstandardised items. A further analysis using RASCH on 36 items remained 34, 2 out of 36 was deleted due to not reach the standard value of MNSQ and PTMEA infit/outfit. The final result of this measurement found that the 34 items reached a fit model of EFA, CFA, and RASCH. This instrument can reveal knowledge, behavior, values, attitudes and habits towards the environment. Although it was found that there were discrepancies in the results of measurements using factors and RASCH, these three types of validity measurements should be used simultaneously so that they can complement one another.

Recommendations

Further research can be conducted to test the precision of the instruments that have been produced in revealing the students' green character in various demographic conditions. In addition, to obtain more comprehensive results, further research can be carried out at lower levels of education such as elementary, junior high and high school. For teachers, the green character instrument can be applied through a modified instrument for suitable materials and topics.

Limitations

The environmental habits construct has too few items. This allows the occurrence of missing in the data. Therefore, further research can arrange more items so that they can represent constructs to get more valid and reliable results.

Acknowledgment

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CORRECTION REPORT			
No	**Reviewer Code**	**Reviews**	**Corrections made by the author**
1	R2611	Please double-check that all citations in the text and the references are fitting to APA 7	We have checked all the citations in the manuscript and have corrected the incorrect citations according to the reviewer's input, and changed the citation to APA 7 form as recommended (see reference page 21)
2	R2611	Use "and" instead of "&" in the text. But it is vice versa in parentheses.	According to the reviewer's suggestion, we have corrected the sentences in the text that use "&" and replaced them with the word "and", while for citations, the word "and" has been replaced using "&" according to APA 7 (for example see the introduction in the second paragraph; ……caring for the environment **(Pane & Patriana, 2016)**
3	R2611	Please separately write results and discussion sections.	According to the reviewer's recommendation, the 'results' and 'discussion' sections have been separated in the manuscript text (see page 7 for the results section, while page 15 for the discussion section)
4	R2611	Firstly, report content validity results.	In the results section, improvements have been made according to the reviewer's suggestions, namely displaying the results of the content validity first and then continuing with an explanation of other results (see the results section of the first paragraph)
5	R2613	In-text citations are incorrect. Author surnames are duplicated. Please refer APA 7 manual for in-text citation style.	Revisions have been made according to the reviewer's suggestions. Wrong quotes in the text such as …in the form of values, beliefs, good and bad behavior (Ryan, 2013) (Rahman et al., 2020) have been corrected to…in the form of values, beliefs, good and bad behavior (Ryan, 2013; Rahman et al., 2020). Likewise, errors in writing the last name of authors such as Borton (1994) have been changed according to APA 7.
6	R2613	Please rewrite discussion part separately.	According to the reviewer's recommendation, the 'results' and 'discussion' sections have been separated in the manuscript text (see page 7 for the results section, while page 15 for the discussion section)
7	R2613	Use lowercase in the word **and**: Validating Student's Green Character Instrument Using Factor **And** Rasch Model	The title has been changed to: Validating Student's Green Character Instrument Using Factor and Rasch Model
8	R2613	Check grammar and meaning: However, there has not been any instrument that can be used to measure all these aspects in one comprehensive instrument	Sentences have been changed to: Many researchers have separately developed instruments to measure environmental characteristics such as attitudes, values, and knowledge. However, there is no instrument used to measure all these aspects in one comprehensive instrument.

9	R2613	Check grammar : The instrument content validation was conducted by 3 experts who were then analyzed using the content validity index (CVI).	Sentences have been changed to: The instrument content validation was analyzed by three experts using content validity index (CVI).
10	R2613	Change to 'after EFA and CFA analysis': Construct validation resulted in 34 items (4 items were eliminated from EFA and CFA, and 2 items were eliminated from RASCH	Sentences have been changed to: Construct validation resulted in 34 items (4 items were eliminated after Exploratory and Confirmatory Factor Analysis, and 2 items were eliminated after RASCH analysis)….
11	R2613	Too many "Character …" sentences. This may disturb readers. Would you consider reorganizing this paragraph and sentences? Character is part of humanity (Pradhan, 2009). Character can be in the form of values, beliefs, behavior, and morality (Hidayati et al., 2021). Even doing something right can also be called character (Pradhan, 2009). Character is related to habits, ways to act and is a picture of actual behavior (Ryan, 2013). Character is defined as a personality which is formed from virtue and is used to think and act (Maisardi, 2017)(Rahman et al., 2020). Character consists of good and bad habits (Ryan, 2013), mental and behavior (Rahman et al., 2020). Character need to be formed as it cannot spontaneously arise (Muharlisiani et al., 2019).	Sentences have been changed to: Character as a part of humanity (Pradhan, 2009) in the form of values, beliefs, good and bad behavior (Ryan, 2013; Rahman et al., 2020), and morality (Sari et al., 2021) is used to think and behave (Maisardi, 2017). It needs to be formed as it cannot spontaneously arise (Muharlisiani et al., 2019).
12	R2613	Put multiple citation in the same parentheses. Check other multiple citations and fix this error, if any: (Sukri, Efendi, et al., 2020)(Palupi & Sawitri, 2018).	Errors in writing citations in the manuscript text have been changed according to the reviewer's recommendation. The results of re-checking showed many errors in writing citations in the manuscript. We have corrected the error and we have adapted it to APA 7 (see all citations in text and references on page 21)
13	R2613	All subtitles should be left aligned, italic and not bold according to the journal's paper template. Edit all.	All subtitles have been left aligned, italicized and not bold according to the journal template (see the results section on page 7)
14	R2613	Figure title should be written in title case. Check other figure titles and fix errors, if any. Table title should be written in title case and italic. Check other table titles and fix errors, if any.	The title of the figure and table has been corrected according to the reviewer's suggestion (for example see figure 1 and table 2 on page 8)
15	R2613	Please show final form of the instrument showing factors and loading items in conclusion section.	The conclusion section has been improved according to the reviewer's recommendation by describing the final form of the instrument that shows the factors and contains loading items (see the conclusion section on page 20).
16	R2613	Please add recommendations for practioners.	The recommendations section has followed reviewers' suggestions by adding recommendations for practitioners (See recommendations section on page 20)

17	R2613	I wonder if you conducted CFA, EFA and RASCH analysis again after eliminating those items (4 + 2). The factor, Environmental Habits, had two items before RASCH analysis. What happened to this factor after eliminating one of the items? If only one item is left (even a factor with two items is arguable) then measuring "Environmental Habits" with only one item is not very valid and reliable.	The results of the EFA, CFA, and RASCH analysis yielded 34 valid and reliable items. After finding deleted items based on the results of EFA, CFA and RASCH, further analysis was carried out to determine changes in constructs or the validity and reliability of instrument items. The final results after 6 items were discarded in the analysis showed the same pattern as the previous results. The formed factor remains the same, but has a goodness of fit index value that is better than the previous analysis, but is still in the good category and meets the fit criteria as the results obtained in the previous analysis. We also tried to carry out further analysis after one of the items in the 'environmetal habbits' construct was eliminated. The results show the same pattern of factors as the previous analysis. Based on these findings, we consider it unnecessary to present this final result because it has the same pattern as the results of the previous analysis.

Gmail

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manuscript ID# 21111715274746_Revised

Editor - European Journal of Educational Research <editor@eu-jer.com> 14 Januari 2022 pukul 15.43
Kepada: akhmad sukri <akhmadsukri@undikma.ac.id>

Dear Dr. Sukri,

We have received your revised paper and correction report. We have sent them to our reviewers again in order to check. We will inform you when we get the result from our reviewers.

If the reviewers confirm your revised paper, we will send the acceptance letter to you.

Thank you for your patience.

Best regards,

Ahmet Savas, Ph.D.
Editor, European Journal of Educational Research
editor@eu-jer.com
www.eu-jer.com

[Kutipan teks disembunyikan]

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akhmad sukri <akhmadsukri@undikma.ac.id>

Acceptance Letter for the Manuscript ID# 21111715274746

Editor - European Journal of Educational Research <editor@eu-jer.com> 18 Januari 2022 pukul 00.55
Kepada: akhmad sukri <akhmadsukri@undikma.ac.id>
Cc: m.ariefrizka@undikma.ac.id, elly@umm.ac.id, sitiramdiah@stkipbjm.ac.id, lukitasari@unipma.ac.id

Dear Dr. Akhmad Sukri,

Congratulation! After a thorough double-blind review, I am pleased to inform you that your manuscript entitled *"Validating Student's Green Character Instrument Using Factor And Rasch Model" (Manuscript EU-JER ID#21111715274746)* has been accepted. It is scheduled for publication in the Volume 11 Issue 2 of the "*European Journal of Educational Research*".

We kindly ask you to pay the article processing fee USD 600 via bank wire transfer. Kindly acknowledge invoice of this acceptance letter. Payment due date: **January 20, 2022.**

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PS: Please do the attached additional minor corrections and send your finalized paper in 2 days.

Best regards.

Ahmet C. Savas Ph.D.

Editor, European Journal of Educational Research

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On 12-Jan-22 4:13 PM, akhmad sukri wrote:

> Dear editor in chief
> European Journal of Educational Research
>
> Thank you for your suggestion. We have edited the manuscript by highlighting the edited section using yellow for reviewer R2613, while blue for reviewer R2611. In addition, we have blinded the author's information on the manuscript. Here we attach a revised manuscript file and a correction report.
>
> Best regards
> Akhmad Sukri

Pada tanggal Rab, 12 Jan 2022 pukul 15.24 Editor - European Journal of Educational Research <editor@eu-jer.com> menulis:

> Dear Dr. Sukri ,
>
> Thank you for your email.
>
> We have received your revised paper and correction report filled out.
>
> As you can see in my previous email, we ask to highlight the changed parts. However, we couldn't see the highlighted parts in your revised paper.
>
> Please highlight the edited parts in different colors for each reviewer on your revised paper. Also please blind your paper from author' information. Because we will send them to our reviewers in order to check.
>
> We are looking forward to getting your highlighted and blinded paper and the correction report again. The deadline for your sending your revised paper is **January 14, 2022.**
>
> Best regards,
>
> Ahmet Savas, Ph.D.
>
> Editor, European Journal of Educational Research
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> On 12-Jan-22 1:45 AM, akhmad sukri wrote:
>
> > Dear editor in chief
> >
> > European Journal of Educational Research
> >
> > We have made revisions to manuscript ID# 21111715274746. Revisions to the manuscript following the input and recommendations given by the reviewer. We have recorded all the improvements in the correction report file. You can browse all the revisions we made in the file. We also attach a revised manuscript and make improvements according to your suggestions to re-check the language, and arrange references according to APA 7. If there are things that need improvement after this, we are ready to accept your input. Hopefully, the results of this revision can be accepted and become a consideration for publishing our manuscript in the next issue.

Best regards

Akhmad Sukri

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European Journal of Educational Research

www.eu-jer.com ISSN: 2165-8714

January 17, 2022

Acceptance Letter for the Manuscript ID# 21111715274746

Dear Dr. Akhmad Sukri,

Congratulation! After a thorough double-blind review, I am pleased to inform you that your manuscript entitled *"Validating Student's Green Character Instrument Using Factor And Rasch Model" (Manuscript EU-JER ID#21111715274746)* has been accepted. It is scheduled for publication in the Volume 11 Issue 2 of the "*European Journal of Educational Research*".

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Please let us know, when you get this email. We looking forward to getting your payment in order to continue the editorial process.

PS: Please do the attached additional minor corrections and send your finalized paper in 2 days.

Best regards.

AHMET CEZMİ SAVAŞ

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Research Article https://doi.org/10.12973/eu-jer.11.2.859

European Journal of Educational Research
Volume 11, Issue 2, 859 - 872.
ISSN: 2165-8714
http://www.eu-jer.com/

Validating Student's Green Character Instrument Using Factor and Rasch Model

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Received: October 11, 2021 ▪ Revised: December 8, 2021 ▪ Accepted: January 26, 2022

Abstract: Many researchers have separately developed instruments to measure environmental characteristics such as attitudes, values, and knowledge. However, there is no instrument used to measure all these aspects in one comprehensive instrument. This study is meant to develop and validate a green character instrument which reveals student behavior and awareness of the environment. The instrument consists of 40 statement items consisting of 5 aspects, namely private pro-environmental behavior, public pro-environmental behavior, environmental knowledge, environmental values, and environmental attitudes. It was implemented on 1,398 students from 15 universities in Indonesia. The instrument content validation was analyzed by three experts using content validity index (CVI). The construct validity was analyzed using exploratory factor analysis, confirmatory factor analysis, and RASCH analysis. The content validity results obtained CVI scores ranging between 0.8 and 0.9 with a good category, while item reliability was in a fairly good category with a high level of separation index. Construct validation resulted in 34 items (4 items were eliminated after Exploratory and Confirmatory Factor Analysis, and 2 items were eliminated after RASCH analysis) spread over five constructs, namely environmental behavior, environmental knowledge, environmental values, environmental attitudes, and environmental habits. The resulting instrument has a good level of item difficulty, with a well understood response set which can be understood easily by respondents, and without bias. Therefore, it can be used to measure the students' green character on both male and female.

Keywords: *Green character, instrument, factor and Rasch Analysis.*

To cite this article: Sukri, A., Rizka, M. A., Purwanti, E., Ramdiah, S., & Lukitasari, M. (2022). Validating student's green character instrument using factor and Rasch model. *European Journal of Educational Research, 11*(2), 859-872. https://doi.org/10.12973/eu-jer.11.2.859

Introduction

Character as a part of humanity (Pradhan, 2009) in the form of values, beliefs, good and bad behavior (Rahman et al., 2020; Ryan, 2013), and morality (Sari et al., 2021) is used to think and behave (Maisardi, 2017). It needs to be formed as it cannot spontaneously arise (Muharlisiani et al., 2019). Therefore, character needs to be familiarized to the younger generation through continuous learning, examples, and practices (Rahmawati et al., 2020). People with character will have good morals (Asrial et al., 2021), who consciously controls every action and behavior (Maisardi, 2017).

Good character is needed in all aspects, such as in environment. Example of good character to the environment is implemented in an attitude of caring for the environment (Pane & Patriana, 2016; Sanjaya, 2021). The character of caring for the environment must also be made accustomed (Arent et al., 2020; Masturoh & Ridlo, 2020), and it is important to be developed as the environment will have an impact on human existence (Yunesa, 2019). Environmental care character will create positive behavior towards the environment (Asrial et al., 2021; Sukri et al., 2020a), and reduce the negative impact of human behavior on the environment (Palupi & Sawitri, 2018; Sukri et al., 2020b). In addition, concerning for the environment is very important as most of the environmental damage is caused by human behavior (El Faisal et al., 2018; Sukri et al., 2018).

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The term green character in this study refers to a person's behavior and awareness of the environment. Behavior refers to human activities to protect the environment or what is called pro-environmental behavior (Stern, 2000), while awareness refers to knowledge (Raymond et al., 2010), values (Thompson & Barton, 1994) and attitudes to the environment (Dunlap et al., 2000). Therefore, caring for the environment attitude is part of a green character. The term green character was chosen to describe all positive behaviors and awareness of the environment. Frasz (2016) mentions environmental character as feelings, sentiments and virtues towards the environment. The term green is also used by Chankrajang and Muttarak (2017) to describe one aspect of attitude towards the environment which is pro-environmental behavior. By using the term green character, all behaviors, attitudes, knowledge, values, and all things with a positive impact on the environment can be covered which makes this term more universal.

Currently, it is difficult to find an instrument that can fully accommodate all aspects of behavior and environmental awareness. The research conducted by Stern (2000) only developed an instrument to measure pro-environmental behavior, while Raymond et al. (2010) focused on the knowledge aspect. In addition, Thompson and Barton (1994) and Dunlap et al. (2000) only focused on values and attitudes aspects. The only similar research has been conducted by Fu et al. (2018), which unfortunately has some weaknesses, namely (1) limited to the behavior and awareness of the campus academic community and not generally applicable to the wider community, and (2) statement items developed in the instruments are mostly not in accordance with the conditions, context, and socio-cultural prevailing in many countries, such as in Indonesia. Whereas according to He and Filimonau (2020) and Chwialkowska et al. (2020), a person's socio-cultural background influences his behavior towards the environment. For example, the statement item "I believe I know environmental issues well' presented by Fu et al. (2018) cannot be reduced to a concrete statement because it is not in accordance with the conditions of society in several countries with the same culture and conditions, especially Indonesia. The statement will become understandable if it is transformed into real environmental issues occuring in the community, for example "Illegal logging can result in the loss of clean water sources and natural disasters" and "Throwing garbage in rivers can cause damage to marine ecosystems".

Therefore, this research is very important to be conducted to produce an instrument that can accommodate all aspects of environmental behavior and awareness. The resulting instrument can be used to measure not only the knowledge, values and attitudes towards the environment, but also to measure behavior reflected in pro-environmental attitudes. The results of this study can be used as a reference for other researchers in different countries which have similar or even the same cultural and socioeconomic conditions to Indonesia, which will make this instrument will be more contextual and precise to measure the "green character" of students.

Contribution to the Literature

- Some of the instruments developed by previous researchers were limited to certain aspects and did not cover all aspects of environmental behavior and awareness
- Instruments to measure green character have not been disclosed and have not been validated, especially in Indonesia
- Instruments validated of this study can be used to measure students' green character precisely because it is contextual and in accordance with the conditions experienced by students.

Methodology

This research is meant to develop and validate the green character instrument. The development is conducted through three steps; 1) analyzing the supporting literature and arranging the items, 2) content validation, 3) construct validation through Exploratory Factor Analyis (EFA), Confirmatory Factor Analysis (CFA), and RASCH (Saefi et al., 2020).

Literatur Review and Item Arrangement

Literature review is done to determine the representative variables for green character instrument. Literature analysis is based on studies or research results that have been published in reputable international journals such as research by Stern (2000), Raymond et al. (2010), Thompson and Barton (1994), and Dunlap et al. (2000). Based on the results of the review, a draft of a green character instrument was prepared which includes 40 items. The green character instrument draft consists of private pro-environmental behavior aspects (Stern, 2000) covering 11 items; public pro-environmental behavior aspects (Stern, 2000) which consists of 8 items; environmental knowledge aspects (Raymond et al., 2010) with 6 items; environmental value aspects (Thompson & Barton, 1994) with 8 items; and environmental attitudes aspects (Dunlap et al., 2000) which consists of 7 items. The student's response consisted of five answer choices; 1 = strongly disagree, 2 = disagree, 3 = indifferent, 4 = agree, and 5 = strongly agree.

Content Validation

Content validity is evidence of the extent to which the elements of an assessment instrument are relevant and represent a construct targeted for a particular assessment objective (Almanasreh et al., 2019). Content validity includes four

criteria; relevance, clarity, simplicity, and ambiguity (Yaghmaei, 2003). The validity of the green character questionnaire content is done by lecturers, practitioners and researchers in the environmental field as experts in their respective fields to obtain acceptable assessment. In conducting the assessment, the validator was asked to fill in four criteria which are, 1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = very relevant which was adjusted to 4 aspects of content validation. Furthermore, from the four criteria, dichotomous data was made to measure content validation using the content validity index method (Polit & Beck, 2006) with the provisions that CVI values > 0.79 were accepted, CVI values 0.70-0.79 were revised, and CVI < 0.70 were rejected (Devon et al., 2007).

EFA, CFA, and RASCH Analysis

Research Sample

This study involved 1,398 students as respondents from 15 universities in Indonesia through random sampling (Endo et al., 2016). Respondents consisted of 972 women (69.53%) and 426 men (30.47%) with the age ranging from 19 to 22 years old. Respondents came from various regions in Indonesia including western, central and eastern Indonesia from various different majors such as social science, science, science education, engineering, humanities and business. The number of samples, 1,398 people, met the ideal limits for factor analysis (Tabachnick & Fidell, 2014) and RASCH analysis (Hagell & Westergren, 2016).

Data Analysis

The initial stage of the analysis was performed through an exploratory factor analysis (Williams et al., 2010). Prerequisite analyzes such as Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity were performed prior to EFA (Chan & Idris, 2017). Furthermore, EFA uses the varimax rotation method (Osborne, 2015) and maximum likelihood estimation (Kassim et al., 2013) with the criteria of Eigenvalue > 1 (Yong & Pearce, 2013), and a minimum loading factor of 0.3 (Prasetyo et al., 2019). CFA was conducted to confirm the EFA results with model fit criteria based on the Root mean square error of approximation (RMSEA 0.06), Goodness of fit index (GFI 0.95), Comparative Fit Index (CFI 0.95), Tucker-Lewis Index (TLI 0.95), and X2/df < 3.00 (Sun, 2005). The RASCH analysis measures the validity of the instrument's construct in terms of content and consequential aspects (Susongko, 2016). Since the sample used is > 500 (Sumintono & Widhiarso, 2015), the item fit criteria are seen based on the mean-square infit and outfit values (MNSQs, between 0.6 to 1.5), and the point-measure correlation coefficient (PTMEA Corr, between 0.3 up to 0.7) (Linacre, 2018). Items that meet one of these criteria are designated as valid items, while items that do not meet the criteria will be deleted from the instrument. Furthermore, the reliability value of the items received is between 0.65 and 0.83 (Sumintono & Widhiarso, 2015) with a separation index value of 1 and > 2 (Ismail et al., 2020). In addition to reliability, Wright map analysis was also performed to determine the items' level of difficulty (Scoulas et al., 2021) followed by rating scale analysis to evaluate the clarity and ease of interpretation of the response set in the instrument (Kim & Kyllonen, 2006). Finally, to avoid bias in the instrument, a Differential Item Functioning (DIF) analysis was conducted to determine the responses of male and female students (Iseppi et al., 2021).

Results

Content Validation

The results of CVI analysis on 40 green character instrument items show that the CVI values range from 0.8-0.9 for all aspects. Based on these results, all items in the instrument have met the valid criteria which were reviewed based on relevance, clarity, simplicity, and ambiguity.

Exploratory Factor Analysis (EFA)

Factor analysis serves to reduce variables that are replaced by several factors which summarize the relationship between variables (Goldberg & Velicer, 2006). The initial assumption in factor analysis is the adequacy of the sample in the analysis (UI Hadia et al., 2016). Sample adequacy is measured by the Kaiser-Meyer-Olkin (KMO) value which must be greater than 0.5 (Hair et al., 2010). In addition to the adequacy of the sample, the assumption that must be met in the EFA is that there should be relationship between variables in the factors (Matore et al., 2019) which is indicated by the value of Bartlett's Test of Sphericity (BTS) which must be less than 0.05 (Chan & Idris, 2017). The results of the KMO and BTS analysis are shown in Table 1 which shows that the KMO value is 0.917 and is in the very good category (UI Hadia et al., 2016), while the BTS value is <.001 which indicates that both EFA assumptions are met and acceptable for further analysis (Field, 2000).

Table 1. KMO and BTS Analysis Result

Kaiser-Meyer-Olkin	**Bartlett's Test of Sphericity**		
Overall MSA	**X^2**	**df**	**p**
0.917	18800.609	780.000	<.001

After the EFA assumption test is met, the next step is to perform a factor analysis of 40 instrument items using the varimax rotation method (Osborne, 2015) and maximum likelihood estimation (Kassim et al., 2013). To determine the number of factors being formed, the parallel analysis method was conducted (Çokluk & Koçak, 2016). The results can be seen in Figure 1 which shows that the implementation point is formed after five factors resulted in 5 constructs which were formed from the results of factor analysis. Each item in the formed factor has a loading factor of more than 0.3. The minimum factor loading value used in this study is 0.3 to indicate that the formed factor has met the fit criteria (Prasetyo et al., 2019). The loading factor that were formed are shown in Table 2.

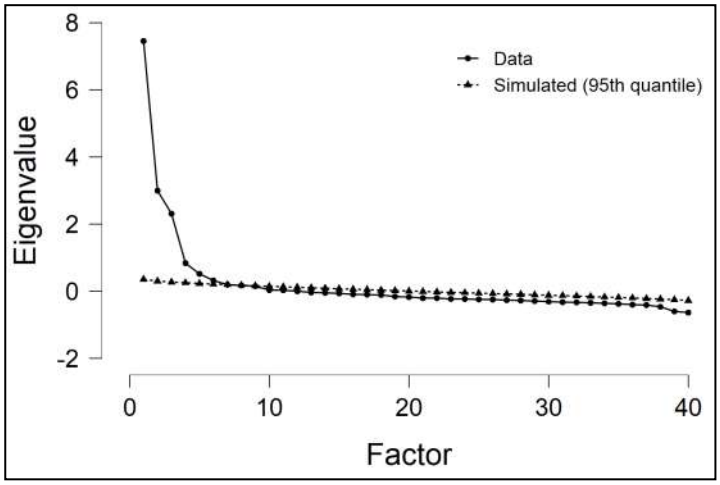

Figure 1. Scree Plot Result of Factor Analysis

Table 2. Loading Factor Formed from Factor Analysis

Items	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
A1	0.362				
A2	0.344				
A3	0.344				
A4	0.314				
A5	0.509				
A6	0.654				
A12	0.645				
A13	0.730				
A14	0.555				
A15	0.637				
A16	0.593				
A17	0.651				
A18	0.614				
A19	0.507				
A20		0.649			
A21		0.649			
A22		0.755			
A23		0.758			
A24		0.758			
A25		0.655			
A26			0.422		
A27			0.772		
A28			0.755		
A30			0.762		
A32			0.508		
A37			0.464		
A38			0.523		
A29				0.499	
A31				0.390	
A33				0.502	
A35				0.453	
A36				0.464	
A39				0.571	
A40				0.514	
A9					0.537
A10					0.721

Based on Table 2, several items such as items A7, A8, A11 and A34 were eliminated from the analysis because they had a loading factor of less than 0.3. Based on these results, 40 items were analyzed resulting in 5 factors. The five formed factors were then grouped and named according to the similarity of characteristics possessed by each item as follow factor 1, environmental behavior; factor 2, environmental knowledge; factor 3, environmental value; factor 4, environmental attitude; and factor 5, environmental habits. The results are strengthened by the Eigenvalue, variance, interitem correlation and Cronbach's alpha value which are presented in Table 3.

Table 3. Characteristics of the Formed Factors

Construct	Initial Eigen values	% of var.	Cumulative %	Average interitem correlation	Average interfactor correlation	Cronbach's Alpha	N
Environmental Behavior (EnB)	4.77	11.90	11.90	0.31	0.03	0.85	14
Environmental Knowledge (EnK)	3.63	9.10	21.00	0.57	0.05	0.89	6
Environmental Value (EnV)	3.04	7.60	28.60	0.36	0.02	0.79	7
Environmental Attitude (EnA)	2.27	5.70	34.30	0.30	0.07	0.75	7
Environmental Habits (EnH)	1.54	3.80	38.10	0.60	0.06	0.74	2

Confirmatory Factor Analysis (CFA)

The interpretation of the CFA fit model uses Diagonally Weighted Least Squares (DWLS), which is considered as the most suitable for not normally distributed data compared to the maximum likelihood model (Nye & Drasgow, 2011). The results of the CFA fit model and final measurement model are shown in Table 4 and Figure 2.

Table 4. Goodness of Fit Index Confirmatory Factor Analysis

Index	Value	Cut off value	criteria
X^2/df	2.802	<3.00	Good
Root mean square error of approximation (RMSEA)	0.036	≤0.06	Good
Goodness of fit index (GFI)	0.957	≥0.95	Good
Comparative Fit Index (CFI)	0.952	≥0.95	Good
Tucker-Lewis Index (TLI)	0.948	≥0.95	Good

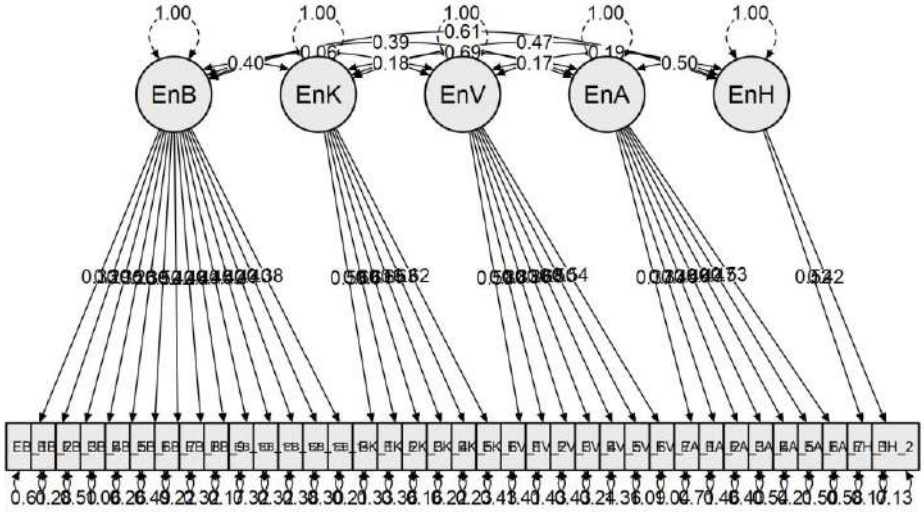

Figure 2. CFA Final Measurement Model

To strengthen the results of the EFA and CFA, a RASCH analysis was performed to determine the validity and reliability of the instrument following the Messick validity which includes several aspects namely content, substance, structure,

external and consequential (Susongko, 2016). This research is only limited to the content and consequential aspects. The following describes the results of the RASCH analysis on the green character instrument.

Green Character Instruments Reliability

The results of the measurement of reliability and separation of the item and person indices of the instrument are shown in Table 5.

Table 5. Reliability and Separation Index of Green Character Instrument

Construct	ID item	Item Measure		Person Measure	
		Reliability	Separation	Reliability	Separation
Environmental Behavior	EnB1-EnB14	1.00	16.88	0.83	2.18
Environmental Knowledge	EnK1-EnK6	0.99	9.63	0.78	1.89
Environmental Value	EnV1-EnV7	1.00	16.56	0.72	1.62
Environmental Attitude	EnA1-EnA7	1.00	23.52	0.65	1.35
Environmental Habits	EnH1-EnH2	1.00	24.44	0.66	1.40

Fit Analysis of Green Character Statistic Instrument

The results of the item fit analysis of the green character instrument are shown in Table 6.

Table 6. Item Fit Analysis Result of Green Character Instruments

FACTOR	Item	Infit MNSQ	Outfit MNSQ	PTMEA
Environmental Behaviors	I bring my water bottle from home when traveling	1.0255	1.1764	0.3397
	I throw rubbish in the right place.	1.4535	1.2149	0.3775
	I ride bicycle or walk for short distance traveling.	0.8825	0.9661	0.3903
	I use public transportation for long distance traveling.	1.3165	1.6078	0.1784
	I keep my waste in my pocket or my bag when there is no trash can nearby and carry them until I find trash can.	0.8848	0.8299	0.4753
	I bring my own bag from home to reduce plastic waste when I go shopping.	0.8234	0.8759	0.4323
	I encourage my family and my colleagues to save resources	1.1317	1.0298	0.47
	I encourage my family and my colleagues to plan trees.	1.0375	0.9918	0.4587
	I support family members or colleagues activities in protecting the environment.	1.275	1.4922	0.2375
	I discuss environmental issues with family members and colleagues.	0.5566	0.6486	0.463
	I often involve in environmental cleaning activities.	0.7253	0.8411	0.4334
	I often pick up trash which scatter around public areas.	0.7584	0.7024	0.5311
	I remind family or colleagues who litter everywhere.	0.5751	0.6478	0.4271
	I throw waste from food and drinks in the right place when gathering with friends and families.	0.6102	0.6693	0.4198
Environmental Knowledge	Littering in the river can damage the sea ecosystem	0.6313	0.701	0.4039
	Using air conditioner can cause damage to the Ozon layers	0.7125	0.7815	0.4107
	Waste from motor vehicles can cause air pollution and climate change.	0.7462	0.7672	0.4929
	The extensive use of detergent can cause death for water creatures.	1.4783	1.2842	0.4844
	Illegal logging cam cause the disappearance of clean water sources and natural disaster.	0.8591	0.9089	0.4809
	Too many inhabitants can cause damage many places for housing	0.8618	0.8013	0.5501

Table 6. Continued

FACTOR	Item	Infit MNSQ	Outfit MNSQ	PTMEA
Environmental Value	I prefer to see animal in the zoo to seeing them in the wild.	0.8494	0.7944	0.5503
	I do not need to worry about the environment damage as technology can solve that problem.	0.856	0.8029	0.5449
	Human does not always need nature to survive.	1.0492	1.0805	0.4782
	Let the environmental problem happen as it will be solved by itself.	1.0668	1.1274	0.4061
	Natural disaster such as flood, land slide, and drought do not have anything to do with environmental damage.	1.1545	1.3173	0.3169
	The environmental damage issues nowadays have been exaggerated.	0.8599	0.9589	0.404
	Human are here to rule the whole world.	1.2401	1.4703	0.1956
Environmental Attitude	I feel happy and pleased to be with nature	1.3965	1.5706	0.292
	The most important reason to protect the environment if to preserve the human sustainability.	1.554	1.5556	0.4062
	Human are part of the ecosystem just like animal.	1.4713	1.3966	0.4581
	Disturbing the nature will resulted in the damaging consequences.	1.3273	1.6123	0.316
	Plants and animals have the same right to live as how human does.	**1.9292**	**2.2336**	**0.3304**
	The balance of the nature is very sensitive and easily disturbed.	1.0766	1.2402	0.3712
	We will experience huge ecological disaster if everything continues as it is.	0.7641	0.8031	0.4858
Environmental Habits	I turn of the electricity when it is not in use.	1.1692	1.2962	0.3878
	I always turn off the tab when it is not in use.	**1.6487**	**1.9841**	**0.0954**

Wright Map

Wright map analysis was performed to determine the level of difficulty of the items (Saefi et al., 2020; Scoulas et al., 2021). Wright map analysis is shown in Figure 3.

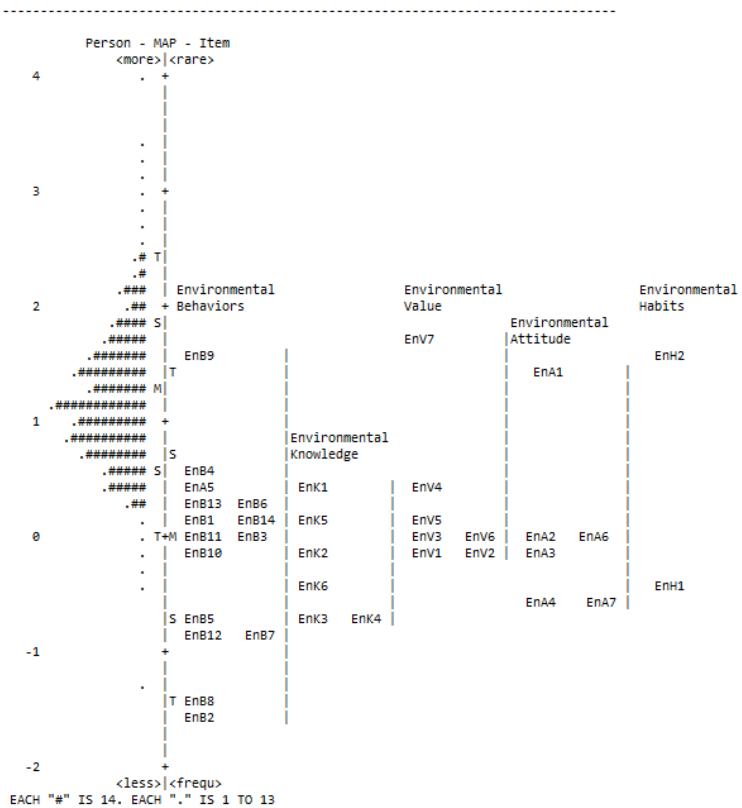

Figure 3. Wright Map Respondent's Perception Toward the Green Character Instrument

Rating Scale Diagnostic

The next stage in instrument testing is done through rating scale diagnostics. This measure is used to evaluate the clarity and ease of interpretation of the response set in the instrument (Kim & Kyllonen, 2006). The results of the diagnostic scale rating are shown in Figure 4.

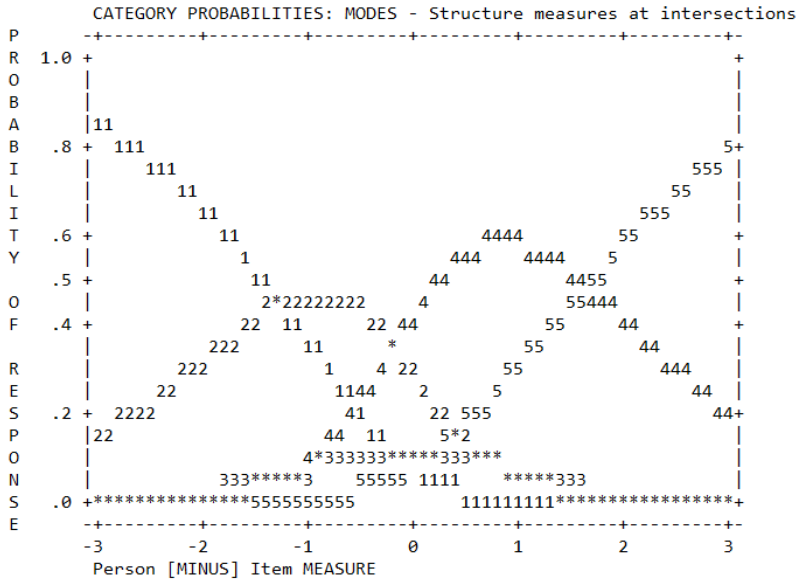

Figure 4. Probability Category Curve of The Green Character Instrument

Differential Item Functioning (DIF) Analysis

DIF analysis was conducted to determine whether different subgroups, in this case gender, responded to items differently (Iseppi et al., 2021). The results of the DIF analysis are shown in Figure 5.

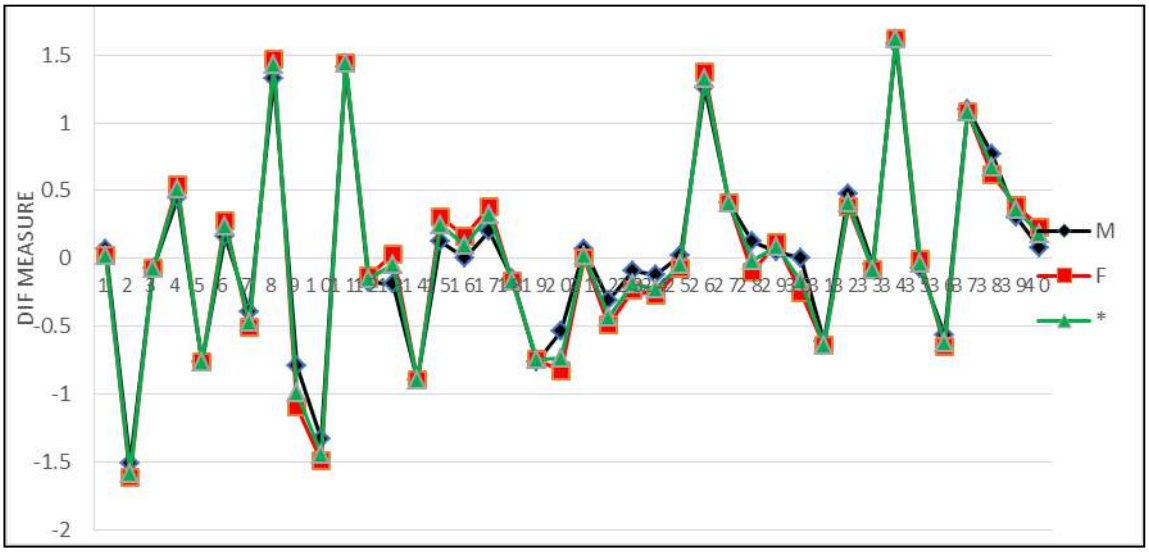

Figure 5. Graph of Person DIF of The Green Character Instrument

Discussion

This study will test the green character instrument consisting of 40 items which are coded from A1 to A40. The first step to test the relationship between variables in the instrument is performing factor analysis. EFA analysis results on Table 3 shows that the Eigenvalue is more than 1 (range from 1.54 to 4.77). Eigenvalue is a measure used to determine the number of factors being formed (Larsen & Warne, 2010). Based on the Eigenvalue, the 5 formed constructs are fit. This is in accordance with Yong and Pearce (2013) opinion which say that the Eigenvalue value of more than 1 indicates that the factor has met the assumption of the fit criteria. Table 3 also shows the value of the variance formed on each factor (ranging from 3.80 to 11.90) with a cumulative variance of 38.10%. The cumulative variance value is relatively small as usually the cumulative variance for humanities research ranges from 50-60% (Pett et al., 2011). However, the resulting variance value is still acceptable as the other criteria have been met in the EFA analysis. The low

value of this variance is thought to be caused by the maximum likelihood extraction method used. According to Costello and Osborne (2005), the principal component analysis (PCA) method in extraction produces a greater variance than the maximum likelihood (ML) method. This happens because PCA does not divide the unique variance from communalities so it sets all item communalities at 1.0, whereas ML estimates the level of shared variance for the items, which ranged from 0.39 to 0.70.

The range of the average interitem correlation values in the factors is 0.31 to 0.6 (Table 3). This indicates that there is a strong relationship between each item in the same factor. According to Tabachnick and Fidell (2014), the interitem correlation value that exceeds 0.3 meets good factorability in the EFA. Table 3 also shows that the average value of interfactor correlation is smaller than the average value of interitem correlation in factors that range from 0.02 to 0.07. This proves that the instrument has good specificity. The intended specificity is the instrument's ability to distinguish the specificity of each factor based on its correlation value (Trumpower et al., 2010). The results of Cronbach's alpha analysis in Table 3 reveal that the reliability value ranges from 0.74 to 0.85. This shows that the instrument has good reliability. The reliability value above 0.7 proves that the instrument is reliable and acceptable (Yu & Richardson, 2015).

To test the consistency of the formed factors, a confirmatory factor analysis was performed (Tomé-Fernández et al., 2020). CFA was conducted on 5 factors and 36 items. They are Environmental Behavior (EnB), Environmental Knowledge (EnK), Environmental Value (EnV), Environmental Attitude (EnA), and Environmental Habits (EnH) factors. The fit model criteria are based on the Root mean square error of approximation (RMSEA), Goodness of fit index (GFI), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and X2/df (Sun, 2005). The results of the CFA analysis in Table 4 show that all fit criteria have been met by the model. The obtained RMSEA value is 0.036, CFI = 0.952, TLI = 0.948, GFI = 0.957, and x2/df = 2.802. All of these values have met the model fit criteria (Hidayat et al., 2018; Nye & Drasgow, 2011; Prudon, 2014). The results of this final measurement are then used for the validity and reliability of items using the RASCH model (Susongko, 2016). The analysis using the RASCH model includes (1) instrument reliability, (2) instrument item quality, (3) level of difficulty of the items, (4) evaluate the clarity of items, and (5) items bias.

Instrument reliability was performed on five constructs, namely environmental behavior, knowledge, values, attitudes, and habits. The reliability analysis results showed that the item reliability values for each domain ranged from 0.99-1.00 with the item separation values ranging from 9.63 to 24.44. A reliability value above 0.9 indicates that the instrument's reliability is in the good category (Saefi et al., 2020), while the separation index value of > 2.0 indicates that the measurement using RASCH can distinguish the instrument into several different groups or domains (Ismail et al., 2020). In addition, the results of the person reliability analysis ranged from 0.65 to 0.83 which include in the pretty good category (Sumintono & Widhiarso, 2015) with a separation index value ranging from 1 and above 2. These results indicate that the instrument has the capability to distinguish respondents' abilities, respondents with high and low performance (Ismail et al., 2020).

The fit index value indicates the quality of the items in the instrument which reveals how accurately the data fits the model (Scoulas et al., 2021). The fit model reference used in this study is the MNSQ infit/outfit value, and PTMEA, while the ZSTD infit/outfit value is ignored because the sample used in this research is > 500 (Sumintono & Widhiarso, 2015). The MNSQ value is used as an indicator of item discrepancy in the RASCH model (Ismail et al., 2020), while the PTMEA is performed to determine whether the instrument can distinguish respondents according to their response level (Saefi et al., 2020).

The results of the item fit analysis in Table 6 show that there are two items which do not meet the fit index criteria. One item on the environmental attitude construct is EnA5 and on the environmental habits construct is EnH2. The MNSQ and PTMEA infit/outfit values for each of these items are outside the predetermined index value (Bond & Fox, 2007; Linacre, 2018). In this study, the criteria for item acceptance were determined by three criteria, namely infit MNSQ, outfit, MNSQ, and PTMEA. If the item meets one of the predetermined fit index criteria, then the item in the instrument can be accepted (Sumintono & Widhiarso, 2015). This result is different from the result of factor analysis and confirmatory factor. Based on these results, the loading factor values for EnA5 and EnH2 items are 0.464 and 0.721, respectively (Table 2). The loading factor value is quite large and acceptable (Prasetyo et al., 2019), but based on the results of item fit analysis using RASCH, both items do not meet the criteria and are declared as invalid items. This study found that there was a discrepancy between the results of the CFA analysis and the RASCH model. According to Scoulas et al. (2021), the RASCH model can detect potential measurement problems such as item bias or local item dependencies that may arise when measuring using classical validation methods such as factor analysis. Based on this assumption, researchers tend to eliminate both items which are considered as invalid items.

The analysis of the items difficulty level through the wright map in Figure 3 showed that only 4 items namely EnB9, EnV7, EnV1 and EnH2 are considered difficult by respondents in understanding green character instruments. There were no items that were categorized as difficult to be understood by the respondents in the environmental knowledge component. Overall, the questions on the instrument can be easily understood by the respondent. This shows that the green character instrument has met the criteria for a good item difficulty level.

The rating scale visualization shown in Figure 4 shows the probability of the response category in the green character instrument according to the recommended pattern. Each category has a distinct peak at some point along the scale as expected (Scoulas et al., 2021). Thus, it can be concluded that the green character instrument response series is functioning properly (Saefi et al., 2020). The final stage of testing items used the DIF test to determine the instrument items bias. DIF analysis was specifically used to reveal the ability to answer between male and female students to find out whether there was a bias from the items given. Question items that have a bias are indicated by differences in the ability to answer between male and female students. To overcome the bias in the items, Iseppi et al. (2021) suggested to make two separate items, one item for men and another for women. The results of the DIF analysis of the green character instrument shown in Figure 5 show that there is no bias as evidenced by the graph of male and female responses approaching the normal line (green). This proves that the items in the instrument are free from bias and can be used to reveal green character for both male and female respondents.

The final result of the green character instrument found in five constructs with a total of 34 items (4 items were eliminated after EFA and CFA, and 2 items were eliminated after RASCH). The five formed constructs, namely Environmental Behavior (EnB), Environmental Knowledge (EnK), Environmental Value (EnV), Environmental Attitude (EnA), and Environmental Habits (EnH) were confirmed through the CFA and met the criteria for the Goodness of fit index (Table 4). These results indicate that the construct validity of the instrument has been met. This finding is in line with the theory that underlies this research such as the theories that have been tested by Stern (2000) regarding Environmental Behavior, environmental knowledge (Raymond et al., 2010), environmental values (Thompson & Barton, 1994), and attitudes towards the environment (Dunlap et al., 2000). Based on the results of the content validity analysis, which includes the fit item test, person-item map, and diagnostic rating scale, and the consequential validity which includes the DIF analysis, the green character instrument is declared eligible and has met the standard criteria that have been determined. However, this study revealed that one of the constructs, the Environmental Habits (EnH), experienced an item reduction to leave only one statement item. Based on these findings, the researcher believes that there is a lack of research caused by the lack of items used in this instrument. However, empirically, based on the results of the EFA, CFA and RASCH this questionnaire has met the standards in instrument development, so it can be used to measure the students' green character.

Conclusion

This study showed that the green character instrument series had met the criteria for item validity and reliability using the EFA, CFA and RASCH models. The EFA showed the loading factor was approximately on 0.314-0.772 with the initial eigenvalues in the interval of 1.54-4.77. It had a good goodness of fit index with X^2/df, RMSEA, GFI, CFI and TLI in the category of good after confirmed through CFA. The EFA and CFA analysis resulted 36 items after eliminating 4 unstandardised items. A further analysis using RASCH on 36 items remained 34, 2 out of 36 was deleted due to not reach the standard value of MNSQ and PTMEA infit/outfit. The final result of this measurement found that the 34 items reached a fit model of EFA, CFA, and RASCH. This instrument can reveal knowledge, behavior, values, attitudes and habits towards the environment. Although it was found that there were discrepancies in the results of measurements using factors and RASCH, these three types of validity measurements should be used simultaneously so that they can complement one another.

Recommendations

Further research can be conducted to test the precision of the instruments that have been produced in revealing the students' green character in various demographic conditions. In addition, to obtain more comprehensive results, further research can be carried out at lower levels of education such as elementary, junior high and high school. For teachers, the green character instrument can be applied through a modified instrument for suitable materials and topics.

Limitations

The environmental habits construct has too few items. This allows the occurrence of missing in the data. Therefore, further research can arrange more items so that they can represent constructs to get more valid and reliable results.

Acknowledgment

The researcher would like to thank the Kemendikbud-Ristek of Republic Indonesia for support this research.

Authorship Contribution Statement

Sukri: Conceptualization, data analysis, writing. Rizka: design and data analysis. Purwanti: data acquisition. Siti Ramdiah: reviewing, technical or material support. Lukitasari: Editing, supervision and final approval.

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Jumlah dikirim/*Amount*		600 USD
Biaya/*Charges* ***		
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Receiver : CHASUS33XXX

Transaction Reference : 0052020055369l

Amount : 600

Currency : USD

Tracking (UETR) Number : f0140a17-c300-42c7-a8c6-3c5a22cdb0b8

Time : 2022-01-20 11:17:04 (GMT+7)

Message Text

F20 : Sender's Reference

0052020055369l

F23B : Bank Operation Code

CRED

F32A : Value Date/Currency/Interbank Settled Amount

Date : 220120 2022 Jan 20

Currency : USD US DOLLAR

Amount : 600 #600#

F50K : Ordering Customer - Account - Name And Address

Account :

/0052010357095l9

Name And Address :

AKHMAD SUKRI

Pagutan MATARAM Indonesia

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Tipe Biaya	OUR	Nominal Biaya
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Dear Dr. Akhmad Sukri,

We are pleased to announce that our latest issue (Vol.11 Iss.1) has been released on January 15, 2022 and online now (https://www.eu-jer.com/volume-11-issue-1-january-2022).

We have published the valuable articles from 25 different countries (Austria, Bahrain, Brazil, Chile, Colombia, Germany, Hungary, Indonesia, Jordan, Kenya, Kuwait, Malaysia, Pakistan, Peru, Philippines, Rwanda, Saudi Arabia, Slovenia, Spain, Thailand, Turkey, Uganda, USA, Vietnam and Yemen).

EU-JER will publish the next issue (Vol.11- Iss.2) on April 15, 2022. All submissions should be made via EU-JER Manuscript Submission System:
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EU-JER has been indexed in SCOPUS, ERIC, DOAJ, ERIHPLUS, & INDEX COPERNICUS research databases.

PS. The other journal of our publishing house, International Journal of Educational Methodology (www.ijem.com) has been accepted for Scopus (See https://suggestor.step.scopus.com/progressTracker/?trackingID=F2C5ED124203D3F6). I am aslo editor in this journal. You can submit your papers to this journal as well.

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Research Article https://doi.org/10.12973/eu-jer.11.2.859

European Journal of Educational Research
Volume 11, Issue 2, 859 - 872.
ISSN: 2165-8714
http://www.eu-jer.com/

Validating Student's Green Character Instrument Using Factor and Rasch Model

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Received: October 11, 2021 ▪ Revised: December 8, 2021 ▪ Accepted: January 26, 2022

Abstract: Many researchers have separately developed instruments to measure environmental characteristics such as attitudes, values, and knowledge. However, there is no instrument used to measure all these aspects in one comprehensive instrument. This study is meant to develop and validate a green character instrument which reveals student behavior and awareness of the environment. The instrument consists of 40 statement items consisting of 5 aspects, namely private pro-environmental behavior, public pro-environmental behavior, environmental knowledge, environmental values, and environmental attitudes. It was implemented on 1,398 students from 15 universities in Indonesia. The instrument content validation was analyzed by three experts using content validity index (CVI). The construct validity was analyzed using exploratory factor analysis, confirmatory factor analysis, and RASCH analysis. The content validity results obtained CVI scores ranging between 0.8 and 0.9 with a good category, while item reliability was in a fairly good category with a high level of separation index. Construct validation resulted in 34 items (4 items were eliminated after Exploratory and Confirmatory Factor Analysis, and 2 items were eliminated after RASCH analysis) spread over five constructs, namely environmental behavior, environmental knowledge, environmental values, environmental attitudes, and environmental habits. The resulting instrument has a good level of item difficulty, with a well understood response set which can be understood easily by respondents, and without bias. Therefore, it can be used to measure the students' green character on both male and female.

Keywords: *Green character, instrument, factor and Rasch Analysis.*

To cite this article: Sukri, A., Rizka, M. A., Purwanti, E., Ramdiah, S., & Lukitasari, M. (2022). Validating student's green character instrument using factor and Rasch model. *European Journal of Educational Research, 11*(2), 859-872. https://doi.org/10.12973/eu-jer.11.2.859

Introduction

Character as a part of humanity (Pradhan, 2009) in the form of values, beliefs, good and bad behavior (Rahman et al., 2020; Ryan, 2013), and morality (Sari et al., 2021) is used to think and behave (Maisardi, 2017). It needs to be formed as it cannot spontaneously arise (Muharlisiani et al., 2019). Therefore, character needs to be familiarized to the younger generation through continuous learning, examples, and practices (Rahmawati et al., 2020). People with character will have good morals (Asrial et al., 2021), who consciously controls every action and behavior (Maisardi, 2017).

Good character is needed in all aspects, such as in environment. Example of good character to the environment is implemented in an attitude of caring for the environment (Pane & Patriana, 2016; Sanjaya, 2021). The character of caring for the environment must also be made accustomed (Arent et al., 2020; Masturoh & Ridlo, 2020), and it is important to be developed as the environment will have an impact on human existence (Yunesa, 2019). Environmental care character will create positive behavior towards the environment (Asrial et al., 2021; Sukri et al., 2020a), and reduce the negative impact of human behavior on the environment (Palupi & Sawitri, 2018; Sukri et al., 2020b). In addition, concerning for the environment is very important as most of the environmental damage is caused by human behavior (El Faisal et al., 2018; Sukri et al., 2018).

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The term green character in this study refers to a person's behavior and awareness of the environment. Behavior refers to human activities to protect the environment or what is called pro-environmental behavior (Stern, 2000), while awareness refers to knowledge (Raymond et al., 2010), values (Thompson & Barton, 1994) and attitudes to the environment (Dunlap et al., 2000). Therefore, caring for the environment attitude is part of a green character. The term green character was chosen to describe all positive behaviors and awareness of the environment. Frasz (2016) mentions environmental character as feelings, sentiments and virtues towards the environment. The term green is also used by Chankrajang and Muttarak (2017) to describe one aspect of attitude towards the environment which is pro-environmental behavior. By using the term green character, all behaviors, attitudes, knowledge, values, and all things with a positive impact on the environment can be covered which makes this term more universal.

Currently, it is difficult to find an instrument that can fully accommodate all aspects of behavior and environmental awareness. The research conducted by Stern (2000) only developed an instrument to measure pro-environmental behavior, while Raymond et al. (2010) focused on the knowledge aspect. In addition, Thompson and Barton (1994) and Dunlap et al. (2000) only focused on values and attitudes aspects. The only similar research has been conducted by Fu et al. (2018), which unfortunately has some weaknesses, namely (1) limited to the behavior and awareness of the campus academic community and not generally applicable to the wider community, and (2) statement items developed in the instruments are mostly not in accordance with the conditions, context, and socio-cultural prevailing in many countries, such as in Indonesia. Whereas according to He and Filimonau (2020) and Chwialkowska et al. (2020), a person's socio-cultural background influences his behavior towards the environment. For example, the statement item "I believe I know environmental issues well' presented by Fu et al. (2018) cannot be reduced to a concrete statement because it is not in accordance with the conditions of society in several countries with the same culture and conditions, especially Indonesia. The statement will become understandable if it is transformed into real environmental issues occuring in the community, for example "Illegal logging can result in the loss of clean water sources and natural disasters" and "Throwing garbage in rivers can cause damage to marine ecosystems".

Therefore, this research is very important to be conducted to produce an instrument that can accommodate all aspects of environmental behavior and awareness. The resulting instrument can be used to measure not only the knowledge, values and attitudes towards the environment, but also to measure behavior reflected in pro-environmental attitudes. The results of this study can be used as a reference for other researchers in different countries which have similar or even the same cultural and socioeconomic conditions to Indonesia, which will make this instrument will be more contextual and precise to measure the "green character" of students.

Contribution to the Literature

- Some of the instruments developed by previous researchers were limited to certain aspects and did not cover all aspects of environmental behavior and awareness
- Instruments to measure green character have not been disclosed and have not been validated, especially in Indonesia
- Instruments validated of this study can be used to measure students' green character precisely because it is contextual and in accordance with the conditions experienced by students.

Methodology

This research is meant to develop and validate the green character instrument. The development is conducted through three steps; 1) analyzing the supporting literature and arranging the items, 2) content validation, 3) construct validation through Exploratory Factor Analyis (EFA), Confirmatory Factor Analysis (CFA), and RASCH (Saefi et al., 2020).

Literatur Review and Item Arrangement

Literature review is done to determine the representative variables for green character instrument. Literature analysis is based on studies or research results that have been published in reputable international journals such as research by Stern (2000), Raymond et al. (2010), Thompson and Barton (1994), and Dunlap et al. (2000). Based on the results of the review, a draft of a green character instrument was prepared which includes 40 items. The green character instrument draft consists of private pro-environmental behavior aspects (Stern, 2000) covering 11 items; public pro-environmental behavior aspects (Stern, 2000) which consists of 8 items; environmental knowledge aspects (Raymond et al., 2010) with 6 items; environmental value aspects (Thompson & Barton, 1994) with 8 items; and environmental attitudes aspects (Dunlap et al., 2000) which consists of 7 items. The student's response consisted of five answer choices; 1 = strongly disagree, 2 = disagree, 3 = indifferent, 4 = agree, and 5 = strongly agree.

Content Validation

Content validity is evidence of the extent to which the elements of an assessment instrument are relevant and represent a construct targeted for a particular assessment objective (Almanasreh et al., 2019). Content validity includes four

criteria; relevance, clarity, simplicity, and ambiguity (Yaghmaei, 2003). The validity of the green character questionnaire content is done by lecturers, practitioners and researchers in the environmental field as experts in their respective fields to obtain acceptable assessment. In conducting the assessment, the validator was asked to fill in four criteria which are, 1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = very relevant which was adjusted to 4 aspects of content validation. Furthermore, from the four criteria, dichotomous data was made to measure content validation using the content validity index method (Polit & Beck, 2006) with the provisions that CVI values > 0.79 were accepted, CVI values 0.70-0.79 were revised, and CVI < 0.70 were rejected (Devon et al., 2007).

EFA, CFA, and RASCH Analysis

Research Sample

This study involved 1,398 students as respondents from 15 universities in Indonesia through random sampling (Endo et al., 2016). Respondents consisted of 972 women (69.53%) and 426 men (30.47%) with the age ranging from 19 to 22 years old. Respondents came from various regions in Indonesia including western, central and eastern Indonesia from various different majors such as social science, science, science education, engineering, humanities and business. The number of samples, 1,398 people, met the ideal limits for factor analysis (Tabachnick & Fidell, 2014) and RASCH analysis (Hagell & Westergren, 2016).

Data Analysis

The initial stage of the analysis was performed through an exploratory factor analysis (Williams et al., 2010). Prerequisite analyzes such as Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity were performed prior to EFA (Chan & Idris, 2017). Furthermore, EFA uses the varimax rotation method (Osborne, 2015) and maximum likelihood estimation (Kassim et al., 2013) with the criteria of Eigenvalue > 1 (Yong & Pearce, 2013), and a minimum loading factor of 0.3 (Prasetyo et al., 2019). CFA was conducted to confirm the EFA results with model fit criteria based on the Root mean square error of approximation (RMSEA 0.06), Goodness of fit index (GFI 0.95), Comparative Fit Index (CFI 0.95), Tucker-Lewis Index (TLI 0.95), and X2/df < 3.00 (Sun, 2005). The RASCH analysis measures the validity of the instrument's construct in terms of content and consequential aspects (Susongko, 2016). Since the sample used is > 500 (Sumintono & Widhiarso, 2015), the item fit criteria are seen based on the mean-square infit and outfit values (MNSQs, between 0.6 to 1.5), and the point-measure correlation coefficient (PTMEA Corr, between 0.3 up to 0.7) (Linacre, 2018). Items that meet one of these criteria are designated as valid items, while items that do not meet the criteria will be deleted from the instrument. Furthermore, the reliability value of the items received is between 0.65 and 0.83 (Sumintono & Widhiarso, 2015) with a separation index value of 1 and > 2 (Ismail et al., 2020). In addition to reliability, Wright map analysis was also performed to determine the items' level of difficulty (Scoulas et al., 2021) followed by rating scale analysis to evaluate the clarity and ease of interpretation of the response set in the instrument (Kim & Kyllonen, 2006). Finally, to avoid bias in the instrument, a Differential Item Functioning (DIF) analysis was conducted to determine the responses of male and female students (Iseppi et al., 2021).

Results

Content Validation

The results of CVI analysis on 40 green character instrument items show that the CVI values range from 0.8-0.9 for all aspects. Based on these results, all items in the instrument have met the valid criteria which were reviewed based on relevance, clarity, simplicity, and ambiguity.

Exploratory Factor Analysis (EFA)

Factor analysis serves to reduce variables that are replaced by several factors which summarize the relationship between variables (Goldberg & Velicer, 2006). The initial assumption in factor analysis is the adequacy of the sample in the analysis (UI Hadia et al., 2016). Sample adequacy is measured by the Kaiser-Meyer-Olkin (KMO) value which must be greater than 0.5 (Hair et al., 2010). In addition to the adequacy of the sample, the assumption that must be met in the EFA is that there should be relationship between variables in the factors (Matore et al., 2019) which is indicated by the value of Bartlett's Test of Sphericity (BTS) which must be less than 0.05 (Chan & Idris, 2017). The results of the KMO and BTS analysis are shown in Table 1 which shows that the KMO value is 0.917 and is in the very good category (UI Hadia et al., 2016), while the BTS value is <.001 which indicates that both EFA assumptions are met and acceptable for further analysis (Field, 2000).

Table 1. KMO and BTS Analysis Result

Kaiser-Meyer-Olkin	**Bartlett's Test of Sphericity**		
Overall MSA	**X^2**	**df**	**p**
0.917	18800.609	780.000	<.001

After the EFA assumption test is met, the next step is to perform a factor analysis of 40 instrument items using the varimax rotation method (Osborne, 2015) and maximum likelihood estimation (Kassim et al., 2013). To determine the number of factors being formed, the parallel analysis method was conducted (Çokluk & Koçak, 2016). The results can be seen in Figure 1 which shows that the implementation point is formed after five factors resulted in 5 constructs which were formed from the results of factor analysis. Each item in the formed factor has a loading factor of more than 0.3. The minimum factor loading value used in this study is 0.3 to indicate that the formed factor has met the fit criteria (Prasetyo et al., 2019). The loading factor that were formed are shown in Table 2.

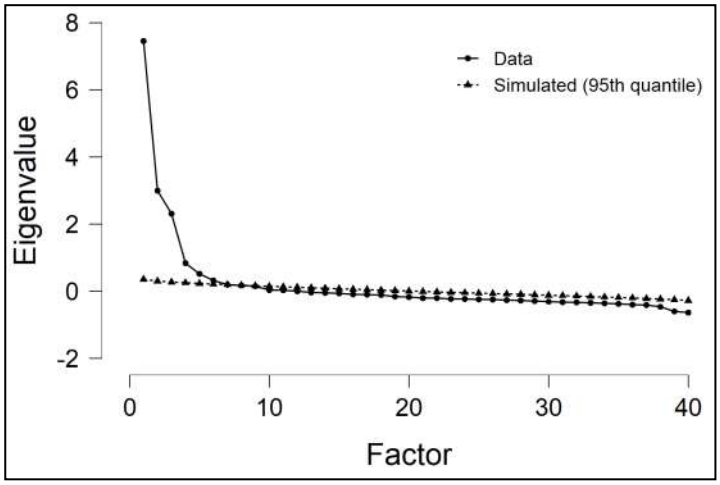

Figure 1. Scree Plot Result of Factor Analysis

Table 2. Loading Factor Formed from Factor Analysis

Items	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
A1	0.362				
A2	0.344				
A3	0.344				
A4	0.314				
A5	0.509				
A6	0.654				
A12	0.645				
A13	0.730				
A14	0.555				
A15	0.637				
A16	0.593				
A17	0.651				
A18	0.614				
A19	0.507				
A20		0.649			
A21		0.649			
A22		0.755			
A23		0.758			
A24		0.758			
A25		0.655			
A26			0.422		
A27			0.772		
A28			0.755		
A30			0.762		
A32			0.508		
A37			0.464		
A38			0.523		
A29				0.499	
A31				0.390	
A33				0.502	
A35				0.453	
A36				0.464	
A39				0.571	
A40				0.514	
A9					0.537
A10					0.721

Based on Table 2, several items such as items A7, A8, A11 and A34 were eliminated from the analysis because they had a loading factor of less than 0.3. Based on these results, 40 items were analyzed resulting in 5 factors. The five formed factors were then grouped and named according to the similarity of characteristics possessed by each item as follow factor 1, environmental behavior; factor 2, environmental knowledge; factor 3, environmental value; factor 4, environmental attitude; and factor 5, environmental habits. The results are strengthened by the Eigenvalue, variance, interitem correlation and Cronbach's alpha value which are presented in Table 3.

Table 3. Characteristics of the Formed Factors

Construct	Initial Eigen values	% of var.	Cumulative %	Average interitem correlation	Average interfactor correlation	Cronbach's Alpha	N
Environmental Behavior (EnB)	4.77	11.90	11.90	0.31	0.03	0.85	14
Environmental Knowledge (EnK)	3.63	9.10	21.00	0.57	0.05	0.89	6
Environmental Value (EnV)	3.04	7.60	28.60	0.36	0.02	0.79	7
Environmental Attitude (EnA)	2.27	5.70	34.30	0.30	0.07	0.75	7
Environmental Habits (EnH)	1.54	3.80	38.10	0.60	0.06	0.74	2

Confirmatory Factor Analysis (CFA)

The interpretation of the CFA fit model uses Diagonally Weighted Least Squares (DWLS), which is considered as the most suitable for not normally distributed data compared to the maximum likelihood model (Nye & Drasgow, 2011). The results of the CFA fit model and final measurement model are shown in Table 4 and Figure 2.

Table 4. Goodness of Fit Index Confirmatory Factor Analysis

Index	Value	Cut off value	criteria
X^2/df	2.802	<3.00	Good
Root mean square error of approximation (RMSEA)	0.036	≤0.06	Good
Goodness of fit index (GFI)	0.957	≥0.95	Good
Comparative Fit Index (CFI)	0.952	≥0.95	Good
Tucker-Lewis Index (TLI)	0.948	≥0.95	Good

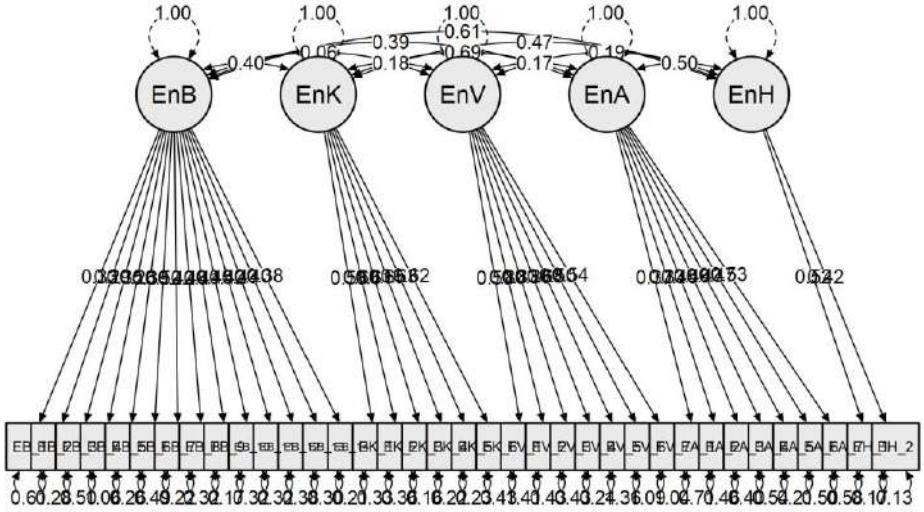

Figure 2. CFA Final Measurement Model

To strengthen the results of the EFA and CFA, a RASCH analysis was performed to determine the validity and reliability of the instrument following the Messick validity which includes several aspects namely content, substance, structure,

external and consequential (Susongko, 2016). This research is only limited to the content and consequential aspects. The following describes the results of the RASCH analysis on the green character instrument.

Green Character Instruments Reliability

The results of the measurement of reliability and separation of the item and person indices of the instrument are shown in Table 5.

Table 5. Reliability and Separation Index of Green Character Instrument

Construct	ID item	Item Measure		Person Measure	
		Reliability	Separation	Reliability	Separation
Environmental Behavior	EnB1-EnB14	1.00	16.88	0.83	2.18
Environmental Knowledge	EnK1-EnK6	0.99	9.63	0.78	1.89
Environmental Value	EnV1-EnV7	1.00	16.56	0.72	1.62
Environmental Attitude	EnA1-EnA7	1.00	23.52	0.65	1.35
Environmental Habits	EnH1-EnH2	1.00	24.44	0.66	1.40

Fit Analysis of Green Character Statistic Instrument

The results of the item fit analysis of the green character instrument are shown in Table 6.

Table 6. Item Fit Analysis Result of Green Character Instruments

FACTOR	Item	Infit MNSQ	Outfit MNSQ	PTMEA
Environmental Behaviors	I bring my water bottle from home when traveling	1.0255	1.1764	0.3397
	I throw rubbish in the right place.	1.4535	1.2149	0.3775
	I ride bicycle or walk for short distance traveling.	0.8825	0.9661	0.3903
	I use public transportation for long distance traveling.	1.3165	1.6078	0.1784
	I keep my waste in my pocket or my bag when there is no trash can nearby and carry them until I find trash can.	0.8848	0.8299	0.4753
	I bring my own bag from home to reduce plastic waste when I go shopping.	0.8234	0.8759	0.4323
	I encourage my family and my colleagues to save resources	1.1317	1.0298	0.47
	I encourage my family and my colleagues to plan trees.	1.0375	0.9918	0.4587
	I support family members or colleagues activities in protecting the environment.	1.275	1.4922	0.2375
	I discuss environmental issues with family members and colleagues.	0.5566	0.6486	0.463
	I often involve in environmental cleaning activities.	0.7253	0.8411	0.4334
	I often pick up trash which scatter around public areas.	0.7584	0.7024	0.5311
	I remind family or colleagues who litter everywhere.	0.5751	0.6478	0.4271
	I throw waste from food and drinks in the right place when gathering with friends and families.	0.6102	0.6693	0.4198
Environmental Knowledge	Littering in the river can damage the sea ecosystem	0.6313	0.701	0.4039
	Using air conditioner can cause damage to the Ozon layers	0.7125	0.7815	0.4107
	Waste from motor vehicles can cause air pollution and climate change.	0.7462	0.7672	0.4929
	The extensive use of detergent can cause death for water creatures.	1.4783	1.2842	0.4844
	Illegal logging cam cause the disappearance of clean water sources and natural disaster.	0.8591	0.9089	0.4809
	Too many inhabitants can cause damage many places for housing	0.8618	0.8013	0.5501

Table 6. Continued

FACTOR	Item	Infit MNSQ	Outfit MNSQ	PTMEA
Environmental Value	I prefer to see animal in the zoo to seeing them in the wild.	0.8494	0.7944	0.5503
	I do not need to worry about the environment damage as technology can solve that problem.	0.856	0.8029	0.5449
	Human does not always need nature to survive.	1.0492	1.0805	0.4782
	Let the environmental problem happen as it will be solved by itself.	1.0668	1.1274	0.4061
	Natural disaster such as flood, land slide, and drought do not have anything to do with environmental damage.	1.1545	1.3173	0.3169
	The environmental damage issues nowadays have been exaggerated.	0.8599	0.9589	0.404
	Human are here to rule the whole world.	1.2401	1.4703	0.1956
Environmental Attitude	I feel happy and pleased to be with nature	1.3965	1.5706	0.292
	The most important reason to protect the environment if to preserve the human sustainability.	1.554	1.5556	0.4062
	Human are part of the ecosystem just like animal.	1.4713	1.3966	0.4581
	Disturbing the nature will resulted in the damaging consequences.	1.3273	1.6123	0.316
	Plants and animals have the same right to live as how human does.	**1.9292**	**2.2336**	**0.3304**
	The balance of the nature is very sensitive and easily disturbed.	1.0766	1.2402	0.3712
	We will experience huge ecological disaster if everything continues as it is.	0.7641	0.8031	0.4858
Environmental Habits	I turn of the electricity when it is not in use.	1.1692	1.2962	0.3878
	I always turn off the tab when it is not in use.	**1.6487**	**1.9841**	**0.0954**

Wright Map

Wright map analysis was performed to determine the level of difficulty of the items (Saefi et al., 2020; Scoulas et al., 2021). Wright map analysis is shown in Figure 3.

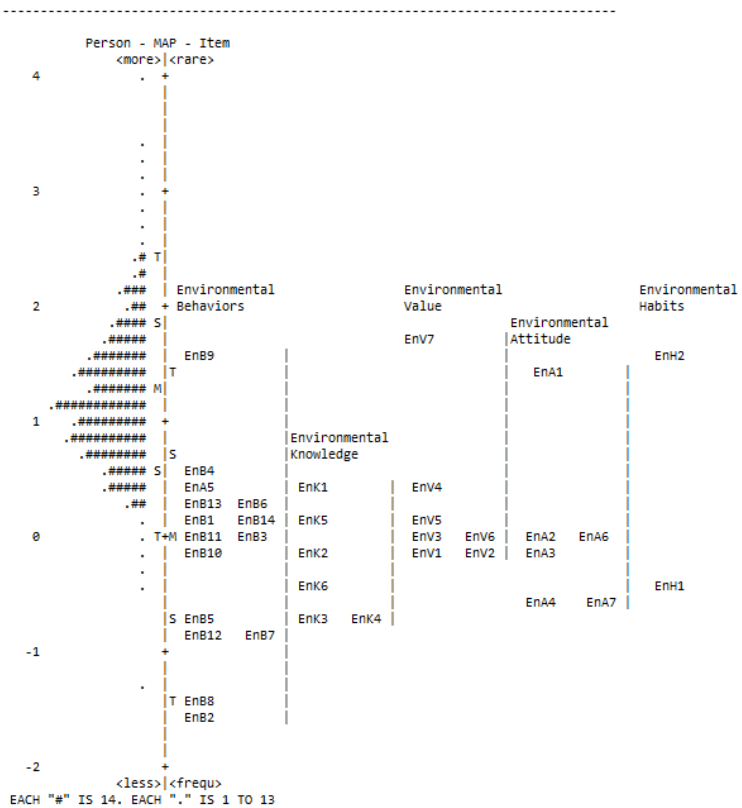

Figure 3. Wright Map Respondent's Perception Toward the Green Character Instrument

Rating Scale Diagnostic

The next stage in instrument testing is done through rating scale diagnostics. This measure is used to evaluate the clarity and ease of interpretation of the response set in the instrument (Kim & Kyllonen, 2006). The results of the diagnostic scale rating are shown in Figure 4.

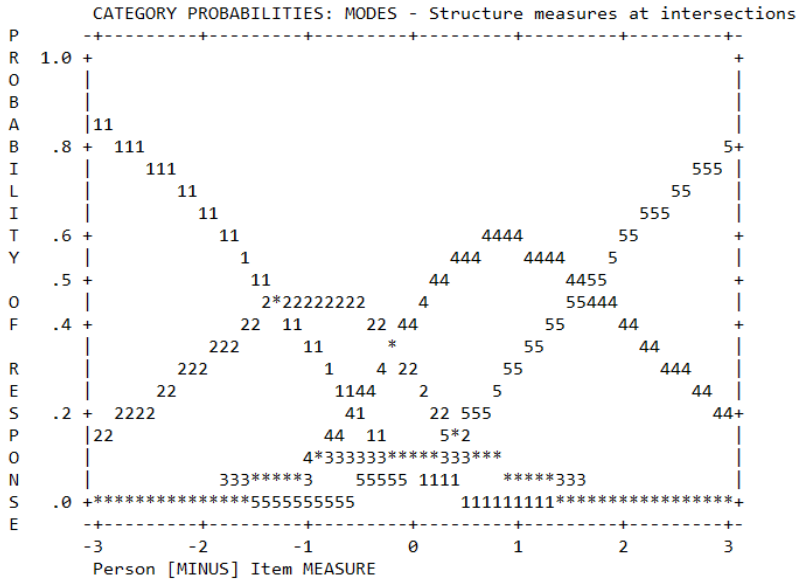

Figure 4. Probability Category Curve of The Green Character Instrument

Differential Item Functioning (DIF) Analysis

DIF analysis was conducted to determine whether different subgroups, in this case gender, responded to items differently (Iseppi et al., 2021). The results of the DIF analysis are shown in Figure 5.

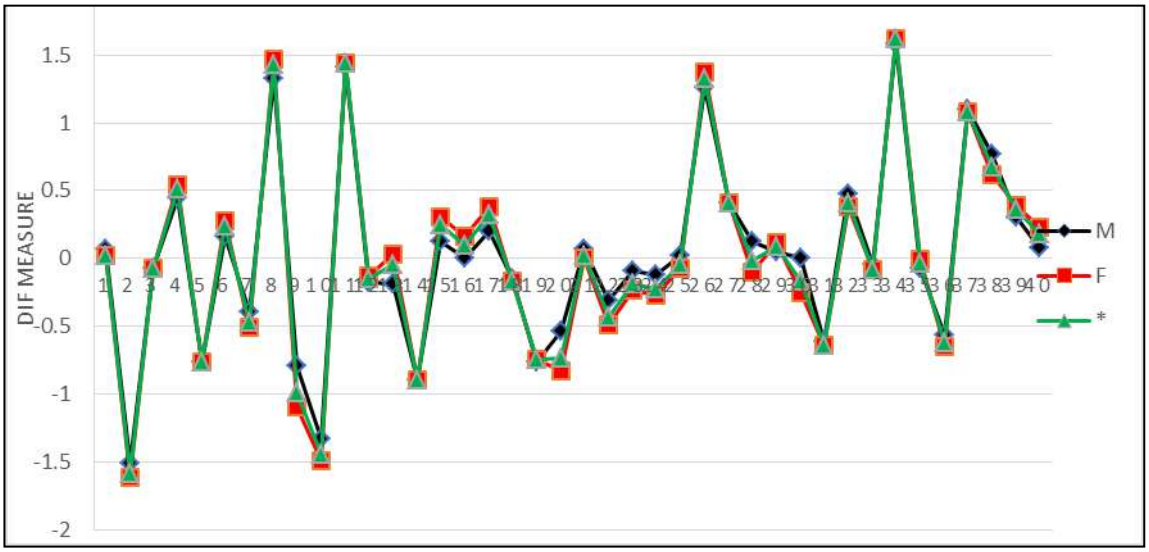

Figure 5. Graph of Person DIF of The Green Character Instrument

Discussion

This study will test the green character instrument consisting of 40 items which are coded from A1 to A40. The first step to test the relationship between variables in the instrument is performing factor analysis. EFA analysis results on Table 3 shows that the Eigenvalue is more than 1 (range from 1.54 to 4.77). Eigenvalue is a measure used to determine the number of factors being formed (Larsen & Warne, 2010). Based on the Eigenvalue, the 5 formed constructs are fit. This is in accordance with Yong and Pearce (2013) opinion which say that the Eigenvalue value of more than 1 indicates that the factor has met the assumption of the fit criteria. Table 3 also shows the value of the variance formed on each factor (ranging from 3.80 to 11.90) with a cumulative variance of 38.10%. The cumulative variance value is relatively small as usually the cumulative variance for humanities research ranges from 50-60% (Pett et al., 2011). However, the resulting variance value is still acceptable as the other criteria have been met in the EFA analysis. The low

value of this variance is thought to be caused by the maximum likelihood extraction method used. According to Costello and Osborne (2005), the principal component analysis (PCA) method in extraction produces a greater variance than the maximum likelihood (ML) method. This happens because PCA does not divide the unique variance from communalities so it sets all item communalities at 1.0, whereas ML estimates the level of shared variance for the items, which ranged from 0.39 to 0.70.

The range of the average interitem correlation values in the factors is 0.31 to 0.6 (Table 3). This indicates that there is a strong relationship between each item in the same factor. According to Tabachnick and Fidell (2014), the interitem correlation value that exceeds 0.3 meets good factorability in the EFA. Table 3 also shows that the average value of interfactor correlation is smaller than the average value of interitem correlation in factors that range from 0.02 to 0.07. This proves that the instrument has good specificity. The intended specificity is the instrument's ability to distinguish the specificity of each factor based on its correlation value (Trumpower et al., 2010). The results of Cronbach's alpha analysis in Table 3 reveal that the reliability value ranges from 0.74 to 0.85. This shows that the instrument has good reliability. The reliability value above 0.7 proves that the instrument is reliable and acceptable (Yu & Richardson, 2015).

To test the consistency of the formed factors, a confirmatory factor analysis was performed (Tomé-Fernández et al., 2020). CFA was conducted on 5 factors and 36 items. They are Environmental Behavior (EnB), Environmental Knowledge (EnK), Environmental Value (EnV), Environmental Attitude (EnA), and Environmental Habits (EnH) factors. The fit model criteria are based on the Root mean square error of approximation (RMSEA), Goodness of fit index (GFI), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and X2/df (Sun, 2005). The results of the CFA analysis in Table 4 show that all fit criteria have been met by the model. The obtained RMSEA value is 0.036, CFI = 0.952, TLI = 0.948, GFI = 0.957, and x2/df = 2.802. All of these values have met the model fit criteria (Hidayat et al., 2018; Nye & Drasgow, 2011; Prudon, 2014). The results of this final measurement are then used for the validity and reliability of items using the RASCH model (Susongko, 2016). The analysis using the RASCH model includes (1) instrument reliability, (2) instrument item quality, (3) level of difficulty of the items, (4) evaluate the clarity of items, and (5) items bias.

Instrument reliability was performed on five constructs, namely environmental behavior, knowledge, values, attitudes, and habits. The reliability analysis results showed that the item reliability values for each domain ranged from 0.99-1.00 with the item separation values ranging from 9.63 to 24.44. A reliability value above 0.9 indicates that the instrument's reliability is in the good category (Saefi et al., 2020), while the separation index value of > 2.0 indicates that the measurement using RASCH can distinguish the instrument into several different groups or domains (Ismail et al., 2020). In addition, the results of the person reliability analysis ranged from 0.65 to 0.83 which include in the pretty good category (Sumintono & Widhiarso, 2015) with a separation index value ranging from 1 and above 2. These results indicate that the instrument has the capability to distinguish respondents' abilities, respondents with high and low performance (Ismail et al., 2020).

The fit index value indicates the quality of the items in the instrument which reveals how accurately the data fits the model (Scoulas et al., 2021). The fit model reference used in this study is the MNSQ infit/outfit value, and PTMEA, while the ZSTD infit/outfit value is ignored because the sample used in this research is > 500 (Sumintono & Widhiarso, 2015). The MNSQ value is used as an indicator of item discrepancy in the RASCH model (Ismail et al., 2020), while the PTMEA is performed to determine whether the instrument can distinguish respondents according to their response level (Saefi et al., 2020).

The results of the item fit analysis in Table 6 show that there are two items which do not meet the fit index criteria. One item on the environmental attitude construct is EnA5 and on the environmental habits construct is EnH2. The MNSQ and PTMEA infit/outfit values for each of these items are outside the predetermined index value (Bond & Fox, 2007; Linacre, 2018). In this study, the criteria for item acceptance were determined by three criteria, namely infit MNSQ, outfit, MNSQ, and PTMEA. If the item meets one of the predetermined fit index criteria, then the item in the instrument can be accepted (Sumintono & Widhiarso, 2015). This result is different from the result of factor analysis and confirmatory factor. Based on these results, the loading factor values for EnA5 and EnH2 items are 0.464 and 0.721, respectively (Table 2). The loading factor value is quite large and acceptable (Prasetyo et al., 2019), but based on the results of item fit analysis using RASCH, both items do not meet the criteria and are declared as invalid items. This study found that there was a discrepancy between the results of the CFA analysis and the RASCH model. According to Scoulas et al. (2021), the RASCH model can detect potential measurement problems such as item bias or local item dependencies that may arise when measuring using classical validation methods such as factor analysis. Based on this assumption, researchers tend to eliminate both items which are considered as invalid items.

The analysis of the items difficulty level through the wright map in Figure 3 showed that only 4 items namely EnB9, EnV7, EnV1 and EnH2 are considered difficult by respondents in understanding green character instruments. There were no items that were categorized as difficult to be understood by the respondents in the environmental knowledge component. Overall, the questions on the instrument can be easily understood by the respondent. This shows that the green character instrument has met the criteria for a good item difficulty level.

The rating scale visualization shown in Figure 4 shows the probability of the response category in the green character instrument according to the recommended pattern. Each category has a distinct peak at some point along the scale as expected (Scoulas et al., 2021). Thus, it can be concluded that the green character instrument response series is functioning properly (Saefi et al., 2020). The final stage of testing items used the DIF test to determine the instrument items bias. DIF analysis was specifically used to reveal the ability to answer between male and female students to find out whether there was a bias from the items given. Question items that have a bias are indicated by differences in the ability to answer between male and female students. To overcome the bias in the items, Iseppi et al. (2021) suggested to make two separate items, one item for men and another for women. The results of the DIF analysis of the green character instrument shown in Figure 5 show that there is no bias as evidenced by the graph of male and female responses approaching the normal line (green). This proves that the items in the instrument are free from bias and can be used to reveal green character for both male and female respondents.

The final result of the green character instrument found in five constructs with a total of 34 items (4 items were eliminated after EFA and CFA, and 2 items were eliminated after RASCH). The five formed constructs, namely Environmental Behavior (EnB), Environmental Knowledge (EnK), Environmental Value (EnV), Environmental Attitude (EnA), and Environmental Habits (EnH) were confirmed through the CFA and met the criteria for the Goodness of fit index (Table 4). These results indicate that the construct validity of the instrument has been met. This finding is in line with the theory that underlies this research such as the theories that have been tested by Stern (2000) regarding Environmental Behavior, environmental knowledge (Raymond et al., 2010), environmental values (Thompson & Barton, 1994), and attitudes towards the environment (Dunlap et al., 2000). Based on the results of the content validity analysis, which includes the fit item test, person-item map, and diagnostic rating scale, and the consequential validity which includes the DIF analysis, the green character instrument is declared eligible and has met the standard criteria that have been determined. However, this study revealed that one of the constructs, the Environmental Habits (EnH), experienced an item reduction to leave only one statement item. Based on these findings, the researcher believes that there is a lack of research caused by the lack of items used in this instrument. However, empirically, based on the results of the EFA, CFA and RASCH this questionnaire has met the standards in instrument development, so it can be used to measure the students' green character.

Conclusion

This study showed that the green character instrument series had met the criteria for item validity and reliability using the EFA, CFA and RASCH models. The EFA showed the loading factor was approximately on 0.314-0.772 with the initial eigenvalues in the interval of 1.54-4.77. It had a good goodness of fit index with X^2/df, RMSEA, GFI, CFI and TLI in the category of good after confirmed through CFA. The EFA and CFA analysis resulted 36 items after eliminating 4 unstandardised items. A further analysis using RASCH on 36 items remained 34, 2 out of 36 was deleted due to not reach the standard value of MNSQ and PTMEA infit/outfit. The final result of this measurement found that the 34 items reached a fit model of EFA, CFA, and RASCH. This instrument can reveal knowledge, behavior, values, attitudes and habits towards the environment. Although it was found that there were discrepancies in the results of measurements using factors and RASCH, these three types of validity measurements should be used simultaneously so that they can complement one another.

Recommendations

Further research can be conducted to test the precision of the instruments that have been produced in revealing the students' green character in various demographic conditions. In addition, to obtain more comprehensive results, further research can be carried out at lower levels of education such as elementary, junior high and high school. For teachers, the green character instrument can be applied through a modified instrument for suitable materials and topics.

Limitations

The environmental habits construct has too few items. This allows the occurrence of missing in the data. Therefore, further research can arrange more items so that they can represent constructs to get more valid and reliable results.

Acknowledgment

The researcher would like to thank the Kemendikbud-Ristek of Republic Indonesia for support this research.

Authorship Contribution Statement

Sukri: Conceptualization, data analysis, writing. Rizka: design and data analysis. Purwanti: data acquisition. Siti Ramdiah: reviewing, technical or material support. Lukitasari: Editing, supervision and final approval.

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