

INVESTIGATION OF PERSON ABILITY AND ITEM FIT INSTRUMENTS OF ECO CRITICAL THINKING SKILLS IN BASIC SCIENCE CONCEPT MATERIALS FOR ELEMENTARY PRE-SERVICE TEACHERS

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ABSTRACT

The study aims to investigate Person Ability and Item Fit instruments for critical thinking skills of the environment (Eco Critical Thinking Skill) in elementary pre-service teachers. Instrument investigations were carried out by describing item fit, separation of item and person, unidimensionality, and reliability of item and person. The research method was carried out quantitatively by collecting data through an open-answer essay test and an ecocritical thinking skill test. Participants in this study were Elementary School Teacher Education (ESTE) students from 3 universities in Surabaya of East Java, Surakarta of Central Java, and Manggarai of East Nusa Tenggara. The number of participants was 110 ESTE students. Data were analyzed with the Rasch Model WINSTEP software. The result of the study is that 36% of ESTE students have high Person Ability, 58% of them have average Person Ability, and the rest (6%) have low Person Ability. Students who have higher abilities are dominated by students from campus in Surabaya at 50%. Item fit Instrument with Mean Square (MnSq) 0.7 - 1.33. ZSTD -1.4 - 2.0 and Pt-measure Corr 0.49-0.6. The research concludes that an instrument of ecocritical thinking skills is a good fit instrument. The distribution of pre-service teacher qualifications from Surakarta and Manggarai is at a medium level, and students from Surabaya-East Java dominate high ability. Elementary pre-service teachers have the most dominant ability to explain and analyze a phenomenon or fact related to environmental damage.

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Keywords: personability; item fit; ecocritical thinking skills

INTRODUCTION

Environmental problems become local, national, and global problems because it poses a threat to human life (Turan & Altuntas, 2018; Roth, 2019; Yoon et al., 2020). One of the causes of an unbalanced relationship between humans and the environment is anthropocentric behavior, which prioritizes human desires without considering environmental sustainability. Ecology provides a scientific understanding through the education of ecosystems to maintain and preserve life on Earth, by fostering a sense of love and saving the Earth (Hecht & Crowley, 2019). Various efforts to foster a sense of love and save the Earth have been initiated through various aspects, one of them through education. Environmental education is given from early childhood to instill environmental care (Valderama et al., 2017; Santos et al., 2017; Purnami et al., 2019).

Various studies on environmental awareness have been carried out. The findings of various studies stated the lack of knowledge about environmental care among students in primary schools to senior high schools (Yustina et al., 2020; Choe et al., 2020). Meanwhile, the natural environment condition is increasingly damaged, especially in the last decade (Richardson & Mishra, 2018). Environmental problems have threatened the lives of living things and become problems worldwide (Turan & Altuntas, 2018). One cause of damage to environmental conditions is the lack of attention to ecological conditions in making every decision. The environmental problem is the basis of the problem in this study to foster environmental awareness. Concern for the environment can be fostered by understanding that the environment must be protected (Casalo & Escario, 2018). One effort to foster understanding, love, and care for the environment can be started from education in schools.

Education in schools to foster a sense of love and care for the environment for students needs to be prepared from pre-service teachers. Teachers have an essential role in the learning process to achieve learning objectives and deliver material that fosters curiosity (Wiens et al., 2020; Trang & Hansen, 2020). Research findings suggested that elementary school teacher education students positively respond to environmental awareness learning as sustainable learning (Sadik & Sadik, 2014). Learning about environmental awareness also has a significant influence on students. Therefore, it is essential to conduct further research on the Person Ability of pre-service teachers, who are elementary school education students in environmental learning.

Environmental learning is carried out by various methods, including open discussion and negotiation (Evans et al., 2012), interesting knowledge, experience, and media (Karahana & Roehrig, 2015; Chu et al., 2017). Pre-service teachers, besides being equipped with the knowledge, also have the ability and skill to make

a decision that is needed in solving problems (Otto & Pensini, 2017). That skill is one of the components of critical thinking skills.

Critical Thinking skill is one of the critical competencies needed by students to prepare for their personal and professional lives (Bezanilla et al., 2019). Critical thinking skills have been studied in various scientific fields such as education (Pérez et al., 2015; Smith et al., 2018; Jacob et al., 2019). However, there are only a few research on ecocritical thinking skill.

Ecocritical thinking skills are critical skills in an environment which are cognitive skills to identify problems, interpretation, inference, explain, analyze, and evaluate material related to the environment. Research on ecocritical thinking skills must be done using good fit instruments. Ecocritical thinking is also a critical competency in science, especially in ecology, to preserve the environment. Because critical thinking skills about the environment are also crucial in 21st-century learning, ongoing research is needed.

Critical Thinking Skills have attracted attention for research in educational research at the elementary school to university level (Niu et al., 2013; Franco et al., 2018; Smith et al., 2018). At the university level, critical thinking skills need to be developed to solve problems, are essential for excellent academic achievement, and become the main goal in education (Stupple et al., 2017; Wechsler et al., 2018; Larsson, 2017). Research about critical thinking skills in biology education still requires improving appropriate data analysis techniques (Susetyarini & Fauzi, 2020). In general, critical thinking skills focus on the ability to analyze, synthesize, evaluate various information to make decisions and actions to solve problems. Some stages of critical thinking skills include formulating problems, interpretations, inferences, explanations, evaluations, to self-regulation. Critical thinking skills in each individual can be developed because critical thinking can be learned and taught (Facione, 2010). This study aims to investigate the Person Ability and Item fit instruments of the Eco Critical Thinking Skill, which is critical thinking about environmental ecology. The study is limited to quantitative research of student abilities without examining the participant's qualitative background descriptively. Critical thinking skills can be applied to science learning (Santos, 2017). Basic science concept materials have product characteristics, processes, scientific attitudes, and applications. Learning science materials has a positive impact on environmental awareness (Susongko & Afrizal, 2018). Environmental sustainability needs to be one of the primary considerations in making every decision. One of the ecocentric views is an ecological view, where the harmony and balance in the relationship between humans and their environment must be maintained. Critical thinking skills about the environment (Ecocritical thinking

skills) in the elementary pre-service teacher are fundamental.

Elementary pre-service teachers equipped with ecocritical thinking skills in the basic science concept materials are expected to be the first capital in the working world to be transferred to students when they become teachers. The teacher has a vital role in encouraging students to have critical thinking skills, so it needs to be equipped with cognitive skills (Janssen et al., 2019). The ability (Person Ability) in elementary school teacher education students in critical thinking about the environment (ecocritical thinking skills) is expected to be distributed to students early on, at the elementary school level. Therefore, investigation of Person Ability and instrument quality to measure Eco critical Thinking Skills of elementary school teacher education students is essential to prepare students who care about the environment. The fit analysis evaluates data and monitors respondents about person ability and item fit. The fit analysis is a technique to control the quality of the validity of items on an instrument.

The importance of the analysis of the Person Ability of Ecocritical Thinking Skill and environmental conditions that have increasingly deteriorated in the last decade, which poses a threat to humans and the motherland (Richardson & Mishra, 2018), encouraged to research by preparing elementary pre-service teachers to think critically about the environment. This research is limited to the analysis of the Person Ability of elementary pre-service teachers. There are two research questions formulated in this study. First, does the instrument have high quality by measuring item fit/item suitability level, Differential Item functioning, reliability, and unidimensional? Second, how is the Person Ability of elementary school teacher education students on ecocritical thinking skills? This research is

limited to the ability of the ecocritical thinking skills of elementary pre-service teachers who take the basic science subjects about pollution.

METHODS

This study used a quantitative paradigm to find out Person Ability and Item Fit instruments for the ecocritical thinking skills analyzed by the Rasch model (Jacob et al., 2019; Fortus et al., 2019). Indicators of ecocritical thinking skills consist of problem identification, interpretation, inference, analysis, explanation, and evaluation. Person Ability in this study shows each person's ability in the test to work on item questions. The Item fit instrument describes the extent of the instrument validity based on the results of the statistical test items, the reliability of the person and the items, unidimensionality, and the Wright Map description. The example item fit instrument are provided in Rasch analysis: Item Outfit Mean Square (MNSQ), Item Outfit Z-Standard (ZSTD), and Point Measure Correlation. The analysis used the Rasch Model of Winstep software. Rasch model analysis is a modern theory that began to be used in education (Waugh, 2012; Fortus et al., 2019). It uses logit scale in its measurements so that it can see the test results more thoroughly and in detail, because it can analyze the ability of each person to do the questions and able to describe the distribution of the level of difficulty of each item to item in a range of scales, the linkages between items in their dimensions. Analysis using the Rasch model can measure the hidden ability of students/participants, such as critical thinking skills. The test was done using an essay test, with a rubric assessment following Taxonomy SOLO theory (Structural of Observed Learning Outcome).

Table 1. Score Rubric for the Eco Critical Thinking Skill Test Following the SOLO Taxonomy. Adopted from (Park & Liu, 2019)

SOLO Level	Score	Description
Prestructural	1	The answers do not match the question. Students cannot respond to questions correctly. The information provided is elementary, not appropriate, or related to the question item
Unistructural	2	The answer is correct and contains scientific studies. Students can respond to questions, but the responses given cannot be understood. Students only give one part of the idea related to the question item and state one concept.
Multi structural	3	The answer is correct and contains scientific studies Students give some ideas but not yet interrelated and comprehensive with the question items. Students demonstrate ability regardless of the relation of ideas.
Relational	4	The answer is correct, and following scientific studies. Students give some interrelated and integrated ideas Students' ideas can relate facts to the theory given, relevant and integrated according to the context presented.

Extended abstract 5

Students explain the causes and effects of relevant ideas. The answer is correct, following scientific studies, supplemented by more than one interrelated and integrated interpretation. Students can generalize existing concepts linked to outside concepts. It shows that students have mastered the material, understand questions, and realize it in existing concepts.

Participants in this study consisted of Elementary School Teacher Education (ESTE) students in three universities selected based on the environmental conditions of the city. This environmental condition is divided by the award of the Ministry of Environment and Forestry, consist of the cleanest city (the city got Adipura Kencana award), the clean city (the city had ever got Adipura award), and the city that never get the award. There are two reasons for the determination of the participants. The first is the ESTE students are pre-service teachers in elementary schools. It is expected that after learning to improve ecocritical thinking skills, the skills can later be transferred to the students. It will provide environmental care for students from an early age in elementary school. The second is the demographic division intended to get a picture of the Person Ability and instruments from all ESTE students in various city classifications. Students from the cleanest city (Adipura Kencana award) were students from UNESA Surabaya, students from the clean city (Adipura award) were students from UNS Surakarta, and students from cities that have never received an Adipura award (predicate KLHK 2019) were students from UNIKA St. Paul Ruteng Flores. The number of participants was 110 students, consisting of 90% women and 10% men. There were 33 participants from UNESA, 40 participants from UNS, and 37 participants from UNIKA. All participants were students who took courses in the basic concepts of science (according to their names) on environmental pollution.

The data was collected using open answer essay examination item tests, consist 12 number items (S1 until S12) because it is a form that measures ecocritical thinking skills consisting of several components: problem identification, interpretation, explanation, inference, analysis, and evaluation. Instruments validated by experts are also empirically validated. Data collection was carried out from the results of essay tests for each class taking a basic science concept or similar names, especially environmental pollution. The data collected is evaluated according to the assessment rubric. The raw data is entered into the Excel program and analyzed using WINSTEP software on the Rasch model.

The data collected was analyzed with the Rasch model because this analysis has advantages over classical theory, which is used in educational research (e.g., Großschedl et al., 2019; Park & Liu, 2019). After all, it can measure in detail the

difficulty level of each item and the Person Ability on a logit scale (Stone & Wright, 1999; Sumintono & Widhiarso, 2015). Data were analyzed to measure statistical items and find out the Mean Square ($0,5 < MNSQ < 1,5$), Z-Standard ($-0,2 < ZSTD < +2,0$), Pt-measure Correlation ($0,4 < Pt Measure Corr < 0,85$), the distribution of questions (separation), the reliability of the questions, the relationship between items (unidimensionality), Different Item functioning (DIF), reliability of the person. The Person Ability was analyzed by measuring the person measure and using Wright Map to describe the Person Ability with each item's level of difficulty per item on the same logit scale.

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RESULTS AND DISCUSSION

The results of the essay data analysis were evaluated based on the rubric of assessment according to SOLO (Structural of Observe Outcome Learning). Data were analyzed using the Rasch model as a modern theory. The analysis results described: (a) item fit, which is based on Mean Square, Z-Standard, and Point Measure Correlation (b) Unidimensionality (c) Item reliability (d) Person Reliability (e) Differential Item Functioning (f) Person Ability of respondents in the Wright Map on Elementary School Teacher Education (ESTE) students in ecocritical thinking skills. Statistical items that described Mean Square, Z-Standard and Point Measure Correlation results can be seen in Table 2.

Table 2. Statistical Item Reported: 110 Person 12 Item 6 Cats Winstep 3.73
Item Statistic: Misfit Order

Number Item	Measure	MNSQ	ZSTD	Pt-Measure Corr.
S12	1.00	1.33	2.0	.49
S7	.75	1.26	1.6	.42
S5	.13	1.03	.3	.66
S1	-.91	1.05	.5	.46
S9	.08	1.02	.2	.51
S3	-1.18	1.01	.1	.52
S6	.36	.88	-.8	.53
S4	-.50	.95	-.4	.56
S8	-.48	.90	-.7	.66
S11	.62	.88	-.8	.57
S2	-.61	.86	-1.0	.59
S10	.72	.79	-1.4	.60

Table 2 shows each item's measurements by presenting that Mean Square (MNSQ), Z-Standard (Z-STD), and Pt-Measure Corr are in the range that indicates Good Fit. The Item Fit limit in Table 2 shows the Mean Square score of $0.79 < \text{MNSQ} < 1.33$, indicating all items are within the acceptable range. The Mean Square value at 0.79 indicates 21% less variation from the model, while the value at 1.33 shows 33% more variation than the model expected. Because the tolerance limit for the model's suitability is 50%, this shows that the MNSQ measurement results in this study have an item fit with the model.

Table 2 shows that Z-Standard scores are in the range -1.4 to 2.0. in comparison, the accepted range for Z-Standard is $-0.2 < \text{ZSTD} < +2.0$. It

shows that all items based on ZSTD are Fit. The range received at Pt Measure Correlation is $0.4 < \text{Pt Measure Corr} < 0.85$ (Boone et al., 2014). Table 2 shows the score of Pt Measure Correlation at 0.42 to 0.6. It shows that all items meet the item compliance criteria. Item no. 12 has a Z-Standard score that is very close to the maximum limit. However, in item 12, MNSQ and Pt Measure Correlation fulfilled the criteria so that all items show items to fit that meet all the criteria. The item fit criteria in the problem are also illustrated in the ICC expected score chart, as shown in Figure 1.

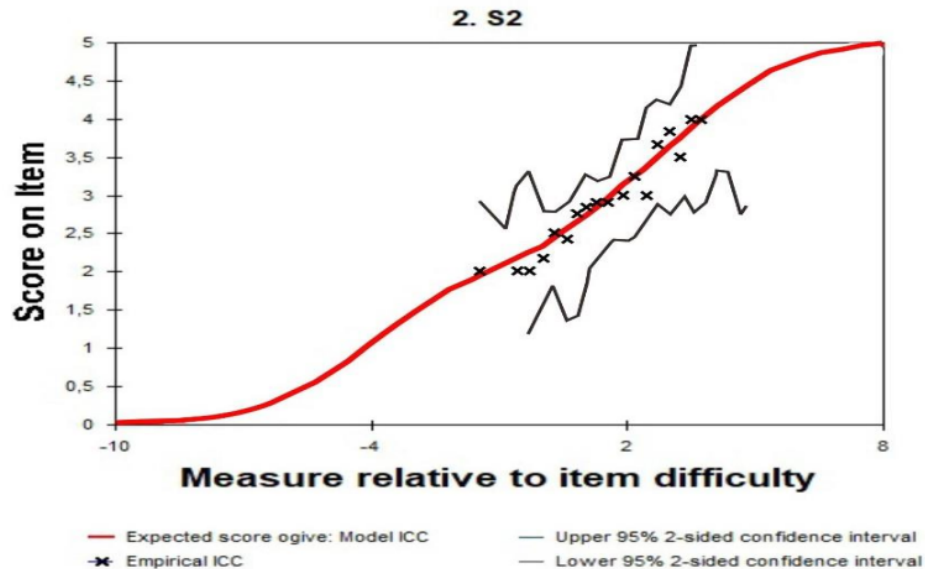


Figure 1. Expected Score Graph

Figure 1 shows a description of measurements made item by item for the entire instrument. The Expected Score graph shows that the ICC empirical questions about S2 are within the

confidence interval of outfit and infit. Figure 1 shows the empirical items approaching the model: the confidence interval of outfit and infit. Item-by-item description provides clear information on

each item used to carry out the measurement. Item quality is also based on item reliability score and item separation. Item reliability and separation scores can be seen in Table 3.

Table 3. Measure Items

	Total		Model		Infit		Outfit	
	Score	Count	measure	error	MNSQ	ZSTD	MNSQ	ZSTD
Mean	289.0	110.0	.00	.16	1.01	.0	1.00	.0
S.D	29.0	.0	.69	.01	.13	.9	.15	1.0
MAX	341.0	110.0	1.00	.17	1.29	1.8	1.33	2.0
MIN	249.0	110.0	-1.18	.14	.84	-1.1	.79	-1.4
Real RMSE			Separation		4.16	Reliability		.95
Mode RMSE			Separation		4.29	Reliability		.95

The reliability of the items in Table 3 shows the number 0.95 and separation at 4.16. It indicates that the items have very high stability and consistency, and the items are separated in the sample measurement along the linear interval scale. Reliability is expressed in numerical scores from -1.00 to +1.00, with high coefficients indicating high reliability. Reliability in Table 3, which shows the score at 0.95, provides information that the instrument used has a high consistency level. It provides information that the instrument can measure the object of research

consistently and can obtain the same measurement results at the time of repeated tests on the same object or object with the same characteristics. High reliability is associated with small measurement errors in obtaining measurement results. The higher the instrument reliability, the smaller the measurement error (Retnawati, 2015). Person reliability is a score that shows the consistency of students' answers and the interaction of items on responses. Person reliability on the ecocritical thinking skill instrument is presented in Table 4.

Table 4. Summary of 110 Measure Person

	Total		Model		Infit		Outfit	
	Score	Count	measure	error	MNSQ	ZSTD	MNSQ	ZSTD
Mean	31.5	12.0	.68	.47	.99	-.1	1.00	-.1
S.D	4.9	.0	1.06	.04	.55	1.2	.57	1.3
MAX	44.0	12.0	3.09	.55	3.02	2.9	3.04	2.9
MIN	21.0	12.0	-2.06	.42	.20	-2.3	.17	-2.4
Real RMSE			Separation		1.77	Reliability		.76
Mode RMSE			Separation		2.00	Reliability		.80

Table 4 shows the Person reliability at 0.76. It shows that the consistency of students' answers is high or good. Table 4 shows the interaction between Person and Item as a whole on Cronbach's alpha score at 0.79. Cronbach's alpha score is quite good. It shows that the interaction between the person and question items is very high, students have high consistency, and the question items can measure Person from low to high ability.

Unidimensionality is a measure that evaluates an instrument capable of measuring what should be

measured, for example, from the extent of diversity in the instrument. The diversity of instruments can be seen from the results of the raw variance. The unidimensionality score of an instrument shows the relationship between items on the instrument. The minimum raw variance explained is 24%, and the maximum is 15%. The unidimensionality score of the ecocritical thinking skill instrument can be seen in Table 5.

Table 5. Standardized Residual Variance

		empirical		modeled
Total raw variance in observations	29.5	100.0%	-	100.0%
Raw variance explained by measure	7.5	38.6%	-	38.6%
Raw variance explained by persons	3.1	15.9%	-	15.9%
Raw variance explained by item	4.4	22.7%	-	22.7%
Raw unexplained variance (total)	12.0	61.4%	100.0%	61.4%
Unexplen variance in 1 st contrast	1.9	9.6%	15.6%	
Unexplen variance in 2 st contrast	1.6	8.0%	13.1%	
Unexplen variance in 3 st contrast	1.4	7.2%	11.7%	
Unexplen variance in 4 st contrast	1.2	6.3%	10.2%	
Unexplen variance in 5 st contrast	1.2	6.1%	9.9%	

Table 5 shows the raw variance that exceeds the unidimensional requirements (24%), 38.6%. It shows that the instrument is unidimensional or there are interrelations between items. Unidimensionality in Table 5 shows that measuring instruments can measure the attributes that must be measured. An instrument that can measure what to be measured shows one indicator that the instrument is valid. The validity of the instrument is the extent to which the measurement instrument can measure the attributes that should be measured (Sumintono & Widhiarso, 2015). The

validity of the instrument is also based on the DIF (Differential Item Functional). DIF provides information about items in instruments favoring certain groups, for example, specific gender or demographic data. Probability scores become the standard DIF in an instrument, as can be seen in Table 6.

Table 6. Different Item Functioning (DIF)

Summary DIF CHI-SQUARE	D.F.	PROB	Number	Item Name
2.34	2	.3060	1	S1
.07	2	.9660	2	S2
.75	2	.6839	3	S3
.35	2	.8402	4	S4
4.79	2	.0894	5	S5
2.58	2	.2706	6	S6
.91	2	.6323	7	S7
1.19	2	.5472	8	S8
.72	2	.6944	9	S9
3.13	2	.2058	10	S10
3.35	2	.1841	11	S11
7.90	2	.0188	12	S12

The quality of items of an instrument can be seen from the detection of bias in the item. In the Rasch model, looking at the functioning of the DIF (Differential Item Functioning) score is done to detect item bias. DIF score is used to detect biased items. The items are biased because they favor certain groups, such as gender, origin, or other demographic characteristics. The minimum

standard for knowing bias items is based on the item's probability of more than 0.05. Table 6 shows all items have probabilities above 0.05 except for problem number 12, which is 0.01. The chart results of the DIF item are shown in Figure 2, which shows B = Surabaya city, M = Surakarta city, and K = Mangarai city.

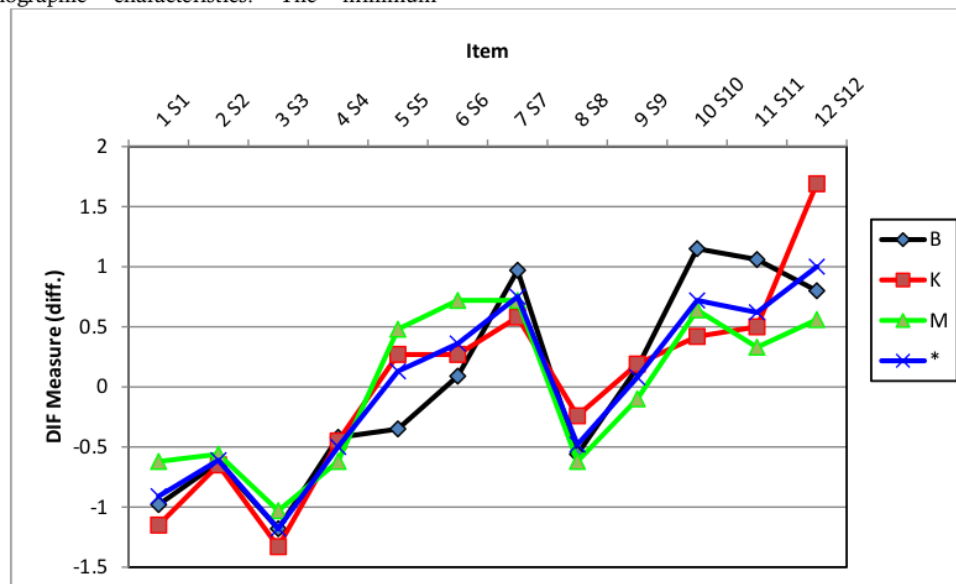


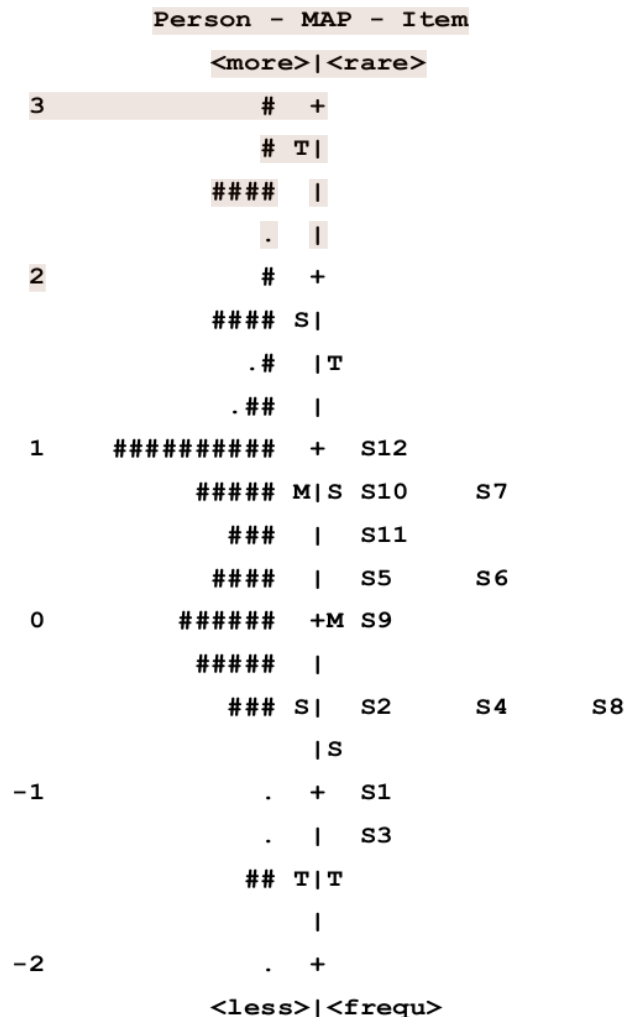
Figure 2. Differential Item Functioning Graph

The person or students' ability level to work on the problem and the difficulty level of the item can be

seen on the Wright map with the same scale. It shows the ability of each person/student to work

on each item. The level of personability is expressed on a logit scale. High logit scores indicate a high level of ability to solve problems. The level of personal ability can be seen from the person statistics results from the Winstep analysis on Rasch. It shows the level of individual ability (Person Measure) of 110 respondents, and the highest ability was in female student number 097 from campus in Surabaya. The lowest individual ability level was in female student number 058 from campus in Manggarai. The high ecocritical thinking skill was 36%, the medium ability was 58%, and the low ability was 6%.

The results of the analysis using the Rasch model have the features of the other analysis models because they can display a map between each item's difficulty level with each person's ability in the same logit scale. It gives a clear picture of each problem distribution according to the difficulty level per item and the ability of the person from low to high in one Wright map. The Wright map can also illustrate the distribution of students' abilities at the level of easy, medium, or high questions based on the standard deviations on the map. The wright map is seen in Figure 3.



Notes every “#” = 2 people “.” = 1 person

Figure 3. Wright Map of Distribution of Persons and Items on the Same Logit Scale

Figure 3 shows that students' ability and item fit difficulty are on the same logit scale. Person ability is distributed evenly from low, medium, and high based on the standard deviation. The items can be clearly described from each item of their level of distribution. Item is not grouped on a specific logit

scale but distributed from easy to difficult questions. The easiest question is S3, and the most difficult question is S12. Other questions were distributed evenly, from easy to difficult. It shows the pattern of students having low to high ability.

This research has investigated an instrument, the ecocritical thinking skill, analyzed using the Rasch model (Setiawan et al., 2018; Großschedl et al., 2019). The ecocritical thinking skill instrument analyzed has the suitability of the items following the expected model, based on the Mean Square (MNSQ), Z-Standard, and Pt Measure Correlation scores. The results of the analysis of unidimensionality and the reliability of the instrument's scores illustrate that all items in the ecocritical thinking skill instrument are related to each other. The items are reliable to be measured in Elementary School Teacher Education students in the cleanest city, clean city, and unawarded city in terms of the environment. The characteristics of the ecocritical thinking skill instrument measure the ability of identification, interpretation, analysis, explanation of environmental problems to the ability to decide on solutions to problems, following environmental components consisting of knowledge, attitudes, and behavior (Faize & Akhtar, 2020). The validity of this ecocritical thinking skill instrument still requires in-depth research studies because until now, the validity of measurement instruments is still being researched, like the validity of the New Ecological Paradigm (Harrison, 2020). Therefore, research on instruments related to ecological measurement or the person's ability on basic science concept is a topic that still being developed.

This study shows that Elementary School Teacher Education (ESTE) students have a distribution of ecocritical thinking skills ranging from low to high ability, but more than 50% of students are medium-level. Elementary pre-service teachers have the most dominant ability to explain and analyze a phenomenon or fact related to environmental damage. Elementary pre-service teachers can put forward their arguments based on evidence and concepts and identify ideas in analysis related to environmental damage because critical thinking skills have been applied in the classroom in some suitable courses (Cáceres et al., 2020). However, the dimensions of the ecocritical thinking skill instrument are equipped following the characteristics of environmental sustainability, namely knowledge, attitudes, and behavior under the existing context. Based on the study results, the ability of elementary pre-service teachers to interpret an environmental problem (S3) and identify an environmental problem (S1) is still low. Therefore, several methods to improve critical skills are carried out by developing analysis and interpretation in the classroom through case studies because they are still classified as low in interpreting facts (Ulusoy, 2020). Efforts to improve critical thinking skills on the basic concepts of science, especially in the pollution subject, can be integrated into every subject in the learning process (Cáceres et al., 2020).

There are several strategies in developing critical thinking skills in the classroom; one is authentic learning (Cáceres et al., 2020), which is integrated into the subject. Authentic learning is one of the

characteristics of basic science concepts. The basic science concepts also have characteristics in the form of products, processes, scientific attitudes, and applications. Characteristics of basic science concepts that are more contextual towards environmental and ecological conditions are appropriate materials to enhance ecocritical thinking skills. Therefore, to investigate person abilities and item fit instruments, the ecocritical thinking skill is applied to the basic science concepts.

Based on the Person Measure, high ability classification is dominated by students who come from the cleanest city (UNESA Surabaya). Things that could be considered because Surabaya received the award for the cleanest city in Indonesia (Adipura Kencana), of course, involved the community, academics, and related parties in fostering an attitude of caring for the environment. Students' high ecocritical thinking skills from universities in Surabaya is because the learning environment also significantly influences learning outcomes (Kwan & Wong, 2015). Ecocritical thinking skills in students in the cleanest city formed by several factors, one of them is tradition. The culture of protecting the environment is supported by regulations from local governments that support the developing environment. The students in Surabaya are more trained and skilled in thinking about the environment. The reason is that Surabaya has a large population and indeed produces large amounts of pollution and waste. People are trained to pay attention to the environment to live comfortably. The existence of many environmental problems encourages Surabaya students to be more skilled in ecocritical thinking skills.

Following Facione's theory, that critical thinking skills can be formed and learned. The ecocritical thinking skills for students from the cleanest city are formed through materials that have characteristics to improve critical thinking skills, such as basic science concepts. Hence, students are accustomed to identifying environmental problems, interpreting, concluding, and organizing themselves in making decisions to preserve the environment. It is this ecocritical thinking skill that causes students in the cleanest cities to have a higher ability because students have been trained to think critically through identifying to solving problems in daily life.

8 CONCLUSION

Ecocritical thinking skills in elementary school teacher education students are essential to be improved. Those students are pre-service teachers who are essential in preparing elementary school students to instill environmental awareness. The results of the investigation showed that the instrument of ecocritical thinking skill is a good fit model. The Person ability of elementary school teacher education students was not optimal. The

high ecocritical thinking skill was 36%, the medium ability was 58%, and the low ability was 6%. Students from Surabaya dominate high ability. Elementary pre-service teachers have the most dominant ability to explain and analyze a phenomenon or fact related to environmental damage. However, the ability of elementary pre-service teachers to interpret an environmental problem and identify an environmental problem is still low. This investigation used data analysis of the modern Rasch theory model, which is applied in measuring ecocritical thinking skills. These findings can be the basis for the importance of a curriculum on appropriate environmental materials and can improve ecocritical thinking skills.

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REFERENCES

- Bezanilla, M. J., Fernández-Nogueira, D., Poblete, M., & Galindo-Domínguez, H. (2019). Methodologies for teaching-learning critical thinking in higher education: The teacher's view. *Thinking Skills and Creativity*, 33(February), 100584.
- Boone, W., Staver, J., & Yale, M. (2014). *Rasch analysis in the human sciences*. Springer.
- Cáceres, M., Nussbaum, M., & Ortiz, J. (2020). Integrating critical thinking into the classroom: a teacher's perspective. *Thinking Skills and Creativity*, 100674.
- Casalo, L. V., & Escario, J. J. (2018). Heterogeneity in the association between environmental attitudes and pro-environmental behavior: A multilevel regression approach. *Journal of Cleaner Production*, 175, 155–163.
- Choe, J. H., Kim, C. H., & Ri, G. H. (2020). An investigation on the environmental knowledge and attitudes of senior middle school students in the Democratic People's Republic of Korea. *International Research in Geographical and Environmental Education*, 29(2), 146–162.
- Chu, S. L., Angello, G., Saenz, M., & Quek, F. (2017). Fun in Making: Understanding the experience of fun and learning through curriculum-based Making in the elementary school classroom. *Entertainment Computing*, 18, 31–40.
- Evans, N., Whitehouse, H., & Gooch, M. (2012). Barriers, successes and enabling practices of education for sustainability in far north Queensland schools: A case study. *Journal of Environmental Education*, 43(2), 121–138.
- Faize, F. A., & Akhtar, M. (2020). Addressing environmental knowledge and environmental attitude in undergraduate students through scientific argumentation. *Journal of Cleaner Production*, 252, 119928.
- Fortus, D., Kubsch, M., Bielik, T., Krajcik, J., Lehavi, Y., Neumann, K., Nordine, J., Opitz, S., & Touitou, I. (2019). Systems, transfer, and fields: Evaluating a new approach to energy instruction. *Journal of Research in Science Teaching*, 56(10), 1341–1361.
- Franco, A. R., Costa, P. S., & Almeida, S. (2018). Translation, adaptation, and validation of the Halpern Critical Thinking Assessment to Portugal: Effect of disciplinary area and academic level on critical thinking. *Anales de Psicología*, 34, 292–298.
- Großschedl, J., Welter, V., & Harms, U. (2019). A new instrument for measuring pre-service biology teachers' pedagogical content knowledge: The PCK-IBI. *Journal of Research in Science Teaching*, 56(4), 402–439.
- Harrison, G. M. (2020). Validity Evidence against the Children's New Ecological Paradigm Scale. *Journal of Environmental Education*, 51(1), 1–13.
- Hecht, M., & Crowley, K. (2019). Unpacking the Learning Ecosystems Framework: Lessons from the Adaptive Management of Biological Ecosystems. *Journal of the Learning Sciences*, 00(00), 1–21.
- Jacob, E. R., Duffield, C., & Jacob, A. M. (2019). Validation of data using RASCH analysis in a tool measuring changes in critical thinking in nursing students. *Nurse Education Today*, 76(November 2018), 196–199.
- Janssen, E. M., Mainhard, T., Buisman, R. S. M., Verkoeijen, P. P. J. L., Heijltjes, A. E. G., van Peppen, L. M., & van Gog, T. (2019). Training higher education teachers' critical thinking and attitudes towards teaching it. *Contemporary Educational Psychology*, 58(March), 310–322.
- Karahan, E., & Roehrig, G. (2015). Constructing Media Artifacts in a Social Constructivist Environment to Enhance Students' Environmental Awareness and Activism. *Journal of Science Education and Technology*, 24(1), 103–118.
- Kwan, Y. W., & Wong, A. F. L. (2015). Effects of the constructivist learning environment on students' critical thinking ability: Cognitive and motivational variables as mediators. *International Journal of Educational Research*, 70, 68–79.
- Larsson, K. (2017). Understanding and teaching critical thinking—A new approach. *International Journal of Educational Research*, 84(May), 32–42.
- Niu, L., Behar-horenstein, L. S., & Garvan, C. W. (2013). Do instructional interventions influence college students' critical thinking skills? A meta-analysis. *Educational Research Review*, 9, 114–128.

- Otto, S., & Pensini, P. (2017). Nature-based environmental education of children: Environmental knowledge and connectedness to nature, together, are related to ecological behaviour. *Global Environmental Change*, 47(September), 88–94.
- Park, M., & Liu, X. (2019). An Investigation of Item Difficulties in Energy Aspects Across Biology, Chemistry, Environmental Science, and Physics. *Research in Science Education*. y
- Purnami, W., Ashadi, Suranto, & Sarwanto. (2019). Item fit investigation on eco critical thinking skills instrument. *AIP Conference Proceedings*, 2194(December).
- Retnawati, H. (2015). *Analisis kuantitatif instrumen penelitian* (pertama). Parama publishing.
- Richardson, C., & Mishra, P. (2018). Learning environments that support student creativity: Developing the SCALE. *Thinking Skills and Creativity*, 27(February 2017), 45–54.
- Roth, S. (2019). Heal the world. A solution-focused systems therapy approach to environmental problems. *Journal of Cleaner Production*, 216, 504–510.
- Sadik, F., & Sadik, S. (2014). A Study on Environmental Knowledge and Attitudes of Teacher Candidates. *Procedia - Social and Behavioral Sciences*, 116, 2379–2385.
- Santos, C., Grili, N., Ghilardi-lobes, N. P., & Turra, A. (2017). A collaborative work process for the development of coastal environmental education activities in a public school in Sao Sebastiao (Sao Paulo State , Brazil). *Ocean & Coastal Management*, 1–9.
- Santos, L. F. (2017). The Role of Critical Thinking in Science Education. *Journal of Education and Practice*, 8(20), 160–173.
- Setiawan, B., Panduwangi, M., & Sumintono, B. (2018). A Rasch analysis of the community's preference for different attributes of Islamic banks in Indonesia. *International Journal of Social Economics*, 45(12), 1647–1662.
- Smith, T. E., Rama, P. S., & Helms, J. R. (2018). Teaching critical thinking in a GE class: A flipped model. *Thinking Skills and Creativity*, 28(February), 73–83.
- Stone, M., & Wright, B. D. (1999). *Measurement 2nd Edition* (2nd edition). Wide Range, INC.
- Stuppel, E. J. N., Maratos, F. A., Elander, J., Hunt, T. E., Cheung, K. Y. F., & Aubeeluck, A. V. (2017). Development of the Critical Thinking Toolkit (CriTT): A measure of student attitudes and beliefs about critical thinking. *Thinking Skills and Creativity*, 23, 91–100.
- Sumintono, B., & Widhiarso, W. (2015). *Aplikasi pemodelan rasch pada assessment pendidikan* (pertama). Trim komunikata.
- Susetyarini, E., & Fauzi, A. (2020). Trend of critical thinking skill researches in biology education journals across Indonesia: From research design to data analysis. *International Journal of Instruction*, 13(1), 535–550.
- Susongko, P., & Afrizal, T. (2018). The determinant factors analysis of Indonesian students' environmental awareness in pisa 2015. *Jurnal Pendidikan IPA Indonesia*, 7(4), 407–419.
- Trang, K. T., & Hansen, D. M. (2020). The Roles of Teacher Expectations and School Composition on Teacher–Child Relationship Quality. *Journal of Teacher Education*.
- Turan, S. L., & Altuntas, E. C. (2018). Awareness of secondary school students about renewable energy. *116*(116), 741–748.
- Ulusoy, F. (2020). Prospective teachers' skills of attending, interpreting and responding to content-specific characteristics of mathematics instruction in classroom videos. *Teaching and Teacher Education*, 94, 103103.
- Valderama, R., Hernandez, Alcantara, L., & Limon, D. (2017). The Complexity of Environmental Education: Teaching Ideas and Strategies from Teachers. *Procedia - Social and Behavioral Sciences*, 237(June 2016), 968–974.
- Waugh, R. (2012). Applications of rasch measurement in education. In *Applications of Rasch Measurement in Education*. Nova Science Publishers, Inc.
- Wechsler, S. M., Saiz, C., Rivas, S. F., Vendramini, C. M. M., Almeida, L. S., Mundim, M. C., & Franco, A. (2018). Creative and critical thinking: Independent or overlapping components? *Thinking Skills and Creativity*, 27(December 2017), 114–122.
- Wiens, P. D., LoCasale-Crouch, J., Cash, A. H., & Romo Escudero, F. (2020). Preservice Teachers' Skills to Identify Effective Teaching Interactions: Does It Relate to Their Ability to Implement Them? *Journal of Teacher Education*.
- Yoon, S., Song, D., Kim, J., Kim, J., Lim, H., & Koo, J. (2020). Identifying stack-driven indoor environmental problems and associated pressure difference in high-rise residential buildings: Airflow noise and draft. *Building and Environment*, 168(September 2019), 106483.
- Zuriguel Pérez, E., Lluch Canut, M. T., Falcó Peguerols, A., Puig Llobet, M., Moreno Arroyo, C., & Roldán Merino, J. (2015). Critical thinking in nursing: Scoping review of the literature. *International Journal of Nursing Practice*, 21(6), 820–830.

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