Biogenerasi Vol 11, No 1, 2026

Biogenerasi

Jurnal Pendidikan Biologi

https://e-journal.my.id/biogenerasi

DEVELOPMENT OF *ECTA-T* AND *EMIS-T* WITH A COMBINATION OF THREE-TIER AND CERTAINTY RESPONSE INDEX METHODS IN ENVIRONMENTAL CONCEPT

Fitri Rizkiyah,

Universitas Tangerang Raya, Indonesia

*Corresponding author E-mail: fitririzkiyahpipit19@gmail.com

DOI : 10.30605/biogenerasi.v11i1.8139

Accepted :10 januari 2026 Approved : 13 februari 2026 Published : 14 februari 2026

Abstract

Environmental pollution is a problem that often occurs in the environment where we live, and requires the ability to think creatively to be able to solve it. The ability to think creatively in solving environmental problems is determined by their knowledge related to ecology. Therefore this study aims to create an instrument that can measure students' misconceptions (*EMis-T*) in ecological material and an instrument that can measure students' creative thinking skills (*ECTA-T*) in solving environmental problems. The research was conducted with reference to the Research and Development (R&D) method with the Borg & Gall (2003) development model which was modified into four development steps, including: (1) Preliminary study stage; (2) Development stage; (3) validation and trial stage; (4) Application Stage. The type of instrument developed is in the form of an essay type written test by combining the three tier test type and certainty response index. The objects that were used as targets for the development of this instrument were class X senior high school. Based on the results of the analysis it is known that the product that has been developed has valid criteria, medium high reliable value, no discriminating power which has a negative value, and questions that have an easy level of difficulty do not dominate, so this product can be used by educators to measure creative thinking skills and students' misconceptions about environmental material. The identified level of students' creative thinking ability was dominated by students in the high category. While the level of students' misconceptions that were identified were dominated by students in the low category.

Keywords: *Development research, Creative Thinking, Misconception, Ecology, Environmental problems*

INTRODUCTION

In the 21st century knowledge and technology are growing rapidly in life, so that everyone is required to have various skills in order to be able to compete with others (Suryadi, 2002). Some of these skills include creativity, critical thinking, collaboration, and communication (Bialik, 2015). Creativity is one of the four skills that are needed by a nation (Susanto, 2011). The Indonesian education system needs to make efforts to support the development of the skills of its citizens, especially the ability to think creatively. Efforts to develop creative thinking skills can be carried out if these skills can be identified (Talango, 2018). An evaluation instrument is needed that can measure the level of student development either before or after learning (Talango, 2018). The ability to think creatively can be measured using instruments specifically intended to measure the ability to think creatively by oriented to the aspects in it. Aspects of the ability to think creatively include generating a large number of ideas in response to open questions, changing the direction of one's thinking or changing one's point of view, generating new ideas that are unusual or statistically rare, and adding details or expanding ideas (Trefingger, 2012).

The ability to think creatively is included in the ability to think at a higher level, as well as critical thinking (Nofiana, et al., 2014). Kartimi has developed a critical thinking measuring instrument on thermochemical material in the form of multi-tier multiple choice questions where the results show that the measuring instrument is able to distinguish students' critical thinking skills (Kartimi, 2012). Referring to the development of the form of the instrument, an instrument was developed in the form of multi-tier questions to measure students' creative thinking abilities. Multi-tier questions were chosen because they can find out how students think in answering questions or solving problems (Rosyana, 2019).

Multi-tier test instruments have been developed such as the Two-Tier Test and the Three-Tier Test. Bayrak developed a Two-Tier Test to find out understanding of concepts and misconceptions in acid-base material (Bayrak, 2013). Eryilmaz and Pesman developed a Three-Tier Test to find out students' misconceptions (Pesman & Eryilmaz, 2010). The Three-Tier Test instrument developed into a test instrument that can be combined with the type of certainty response index (Ahmad & Indana, 2018), which is a question to find out the quality of the response given by students who are being detected (Ibrahim, 2019). Referring to some of these studies, a development of the *ECTA-T* (Electronic Creative Thinking Ability Test) was carried out with a combination of the Three-Tier method and the Certainty Response Index on environmental change material.

Based on the results of research conducted by Ahmad and Indana, the test instrument with a combination of the Three-Tier Test and the Certainty Response Index can be used to measure students' misconceptions about the animal kingdom material (Ahmad & Indana, 2018). Referring to this research, the *EMis-T* (Electronic Misconception Test) was also developed with a combination of the Three-tier method and the Certainty response index on other material, namely ecological material. Misconceptions can occur in various disciplines, one of which is in the field of science (Gurel et al., 2015). Ecology material is included in the field of science where misconceptions often occur during the learning process (Stamp, 2018). Several studies have shown that students do not understand the complexity of ecological material (D'Avanzo, 2003; Grumbine, 2012). Focusing research on the variable of misconceptions about ecological material is necessary because by understanding ecological material students can increase their resistance to addressing environmental problems (Stamp, 2018).

Environmental problems such as drought, floods, forest fires, pollution, a hole in the ozone layer, and a series of other environmental problems that are happening today need to find solutions to handle them (Munggoro & Armansyah, 2007). Solutions related to environmental problems can be obtained through authentic ideas resulting from creative thinking. This is in line with the opinion expressed by Meitiyani, Nadhiro, and Ali Syaban, that creative thinking is one of the abilities needed to produce various kinds of authentic and new ideas in overcoming environmental problems (Meitiyani, 2019).

METODE

This research was conducted referring to the Research and Development (R&D) method with the Borg & Gall (2003) development model which was modified into four development steps, including: (1) Preliminary study stage; (2) Development stage; (3) validation and trial stage; (4) Application Stage. Data collection techniques in this study were questionnaires and tests. The type of data consists of qualitative and quantitative data. Qualitative data were obtained from validity tests by experts, and quantitative data were obtained from item analysis in the form of reliability, discriminating power, and the level of difficulty of the questions, as well as an analysis of the level of misconceptions and creative thinking abilities of students in environmental material.

The validity test was carried out on 4 experts and then the scores obtained were calculated for the percentage and categorized according to the table of validity criteria proposed by Ratumanan & Laurens (2006) (Table 1).

$$P = \frac{f}{n} \; x \; 100\%$$

Explanation :
P = Product eligibility percentage
f = Total score of the average aspect of the assessment
n = Total maximum score of the assessment aspect

Table 1. Validation Category

Interval Category	*Criteria*
1,75 > x ≥ 1,00	Invalid
2,50 > x ≥ 1,75	Less Valid
3,25 > x ≥ 2,50	Valid
4,00 > x ≥ 3,25	Very Valid

Source: Ratumanan & Laurens (2006)

The trial was carried out on students were class XI senior high school. 30 students in the first trial, and 60 students in the second trial. The scores obtained by students on the *EMis-T* which were developed to identify misconceptions were categorized according to the table of criteria proposed by Arslan, et al. (2012), and scoring scores that refer to the criteria put forward by Firman (2015) (Table 2). Meanwhile, students' responses to the *ECTA-T* which was developed to measure creative thinking skills were given a score adjusted to the criteria table put forward by Treffinger (2002) and Hasan, et al. (1999) (Table 3).

Table 2. Possible student responses to the misconception instrument

First tier	**Second tier**	**Third tier**	**Categories**	**Score**
Correct	Correct	Certain	Scientific knowledge	1
Correct	Incorrect	Certain	Misconception	0
Incorrect	Correct	Certain	Misconception	0
Incorrect	Incorrect	Certain	Misconception	0
Correct	Correct	Uncertain	Lack of confidence	0
Correct	Incorrect	Uncertain	Lack of knowledge	0
Incorrect	Correct	Uncertain	Lack of knowledge	0
Incorrect	Incorrect	Uncertain	Lack of knowledge	0

Source :Arslan, dkk. (2012) & Firman (2015)

Table 3. Possible student responses to the creative thinking ability instrument

Score	Criteria
4	If the answers to questions on tier 1-2 contain all aspects of creative thinking (*fluency, flexibility, originality,* dan *elaboration*) and responses to tier 3 questions are included in the "Sure" category
3	If the answers to questions at tier 1-2 contain 3 aspects of creative thinking, and the responses to questions at tier 3 are in the "Sure" category
2	If the answers to questions at tier 1-2 contain 1 aspects of creative thinking, and the responses to questions at level 3 are in the "Sure" category
1	If the answers to questions at tier 1-2 contain 1 aspects of creative thinking, and the responses to questions at level 3 are in the "Sure" category
0	If you don't answer questions at tier 1-2 or the response at tier 3 is in the "Not Sure" category

Source : Treffinger (2002) & Hasan, dkk. (1999)

At tier 3 questions included in the question type CRI (Certainty of response index) were used to determine the category of students' beliefs in answering questions (Hasan et al., 1999) (Table 4).

Table 4. The category of student response confidence uses CRI

Score	Categori	Confidence
0	Definitely a guess	Not Sure
1	Almost guessed	Not Sure
2	Guessing but there are elements to consider	Not Sure
3	Answered with a lot of thought, but there is still an element of guesswork	Sure
4	Answer with confidence	Sure
5	Answer with absolute confidence	Sure

Source : Hasan, dkk. (1999)

After all students' answers were given a score, an analysis of the items was carried out which included tests of reliability, discriminating power, and level of difficulty. The *EMis-T* instrument was tested for reliability with *KR20* using the *Microsoft Excel program.*

$$KR-20 = \left(\frac{n}{n-1}\right)\left(\frac{S_t^2 - \Sigma pq}{S_t^2}\right)$$

Explanation :
n = Number of questions
p = The proportion of correct answers on a particular item
q = The proportion of wrong answers on a particular item
St^2 = Total score variance

Whereas the *ECTA-T* instrument was tested for Cronbach's alpha reliability using the SPSS version 22 program. The reliability test was carried out by referring to the category table proposed by Herlanti (2012) (Table 5).

Table 5. Instrument Reliability Criteria

Reliability Coefficient	Reliability Level
0,00 – 0,20	Very Low

0,21 – 0,40	Low
0,41 – 0,70	Medium
0,71 – 0,90	High
0,91 – 1,00	Very High

Source : Herlanti (2012)

Test the level of difficulty of each item is calculated using the following formula:

$$\text{Difficullty Level} = \frac{\text{Mean}}{\text{Score Max}}$$

Then the results of these calculations are interpreted using the criteria for the difficulty level of the items proposed by Sofyan, et al. (2006) (Table 6).

Table 6. Difficulty Level Criteria

Difficulty index	Interpretation
0,00 – 0,25	Hard
0,26 – 0,75	Medium
0,76 – 1,00	Easy

Source : Sofyan, dkk. (2006)

The discrimination test is known by calculating the difference between average of the upper group students and average of the lower group students, divided by the ideal maximum score.

$$\text{The Discrimination} = \frac{\overline{X_A} - \overline{X_B}}{SMI}$$

Explanation :
$\bar{x}_A$ = Average upper group students
$\bar{x}_B$ = Average lower group students
SMI = Ideal maximum score

The discrimination coefficient of the calculation is interpreted using the criteria put forward by Arikunto (2012) (Table 7).

Table 7. Criteria for Discriminating Power

Discrimination Value	Interpretation
0,00 – 0,20	Bad
0,21 – 0,40	Moderate
0,41 – 0,70	Good
0,71 – 1,00	Very Good
Negatif	Very Bad

Source : Arikunto (2012)

Furthermore, an analysis of the level of misconceptions and students' creative thinking abilities was carried out by first calculating the percentage of scores obtained and then categorizing them according to the criteria table adopted from Suharsimi Arikunto's book (2009) with modifications as necessary (Table 8).

$$P = \frac{f}{n} x\ 100\%$$

Explanation :
P = Percentage of students' creative thinking skills/misconceptions
f = Average score
n = Maximum Score

Table 8. Criteria for Level of Creative Thinking Ability/Student's Misconceptions

Answers Percentage	CTA Category	Misconception Category
81 – 100	Very High	Very Low
61 – 80	High	Low
41 – 60	Medium	Medium
21 – 40	Low	High
00 – 20	Very Low	Very High

Source : Arikunto (2009)

RESULT AND DISCUSSION

The purpose of this research and development is to produce a product in the form of an evaluation instrument by combining the three-tier method and certainty response index to measure students' creative thinking abilities and misconceptions about environmental material. The development of the test instrument is carried out through a series of stages starting from the preliminary study stage, the development stage, the validation and trial stages, and the application stage.

The preliminary study stage is the initial stage in the development activities carried out aiming to find out the problems that are happening in the field. Then narrowed it down to a particular area. Preliminary studies are carried out in two ways, namely literature studies and field studies. Based on the results of the literature study it is known that the ability to think creatively is the main skill needed by Indonesian people in this century and is very important for solving environmental problems. In addition, it is also known that misconceptions are the main component that needs to be considered in the learning process, especially in ecological material, because understanding ecological material can increase resistance to addressing environmental problems (Stamp, 2018). It is also known that multi-tier questions can find out how the thinking process of students is in answering questions or solving problems.

Based on the results of field studies, it is known that there are still many teachers who have not developed a special tiered evaluation instrument to determine the level of students' creative thinking abilities in learning. Multi-tier questions are often made only as a measuring tool to determine students' cognitive abilities in achieving basic knowledge competence mastery. In addition, efforts to find out misconceptions with special instruments have also received little attention.

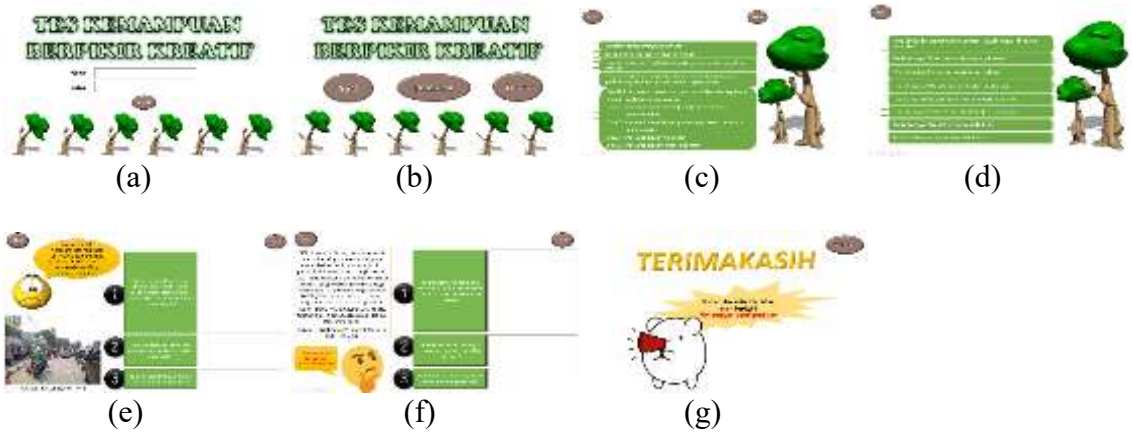
At this stage an analysis of environmental material is also carried out in accordance with the basic competencies determined by the Indonesian education curriculum for high school level. This analysis was carried out with the aim of being able to design problem indicators on the instrument by integrating indicators of creative thinking ability and indicators of measurement of misconceptions without leaving the material components set by the curriculum for the high school level.

The second stage is the development stage. At this stage it begins with compiling an initial draft, namely in the form of a grid arranged based on what competencies must be assessed. There are two types of instruments developed, namely the misconception instrument (Figure 1) and the instrument for creative thinking skills (Figure 2).

(a) (b) (c) (d)

(e) (f) (g)

Figure 1. (a), (b), (c), (d), (e), (f), (g) Appearance *EMis-T* (*Electronic Misconception Test*)



(a) (b) (c) (d)

(e) (f) (g)

Figure 2. (a), (b), (c), (d), (e), (f), (g) Appearance *ECTA-T* (*Electronic Creative Thinking Ability Test*)

The type of instrument developed is in the form of an essay type written test by combining the three tier test type and certainty response. The *E-Test* consists of 3 tier of questions, the first is the presentation of first-tier questions that require students to be able to identify the questions presented, then analyze and draw conclusions by choosing one of the answers that have been presented. Second, students are presented with second-tier questions which are a continuation of first-tier questions. In this second tier question students are asked to provide reasons for the answers given to the questions in the first tier. Third, students are presented with questions that ask them to determine their level of confidence in answering tier 1 and 2 questions according to the scale presented on the instrument sheet. Scale (1) means students answer by guessing; Scale (2) students answer by guessing but there are elements that are considered; scale (3) means students answer with a lot of consideration, but there is still an element of guessing; Scale (4) means that students answer confidently correctly; Scale (5) means that students answer very confidently correctly. The assessment indicators used in the instrument are not only based on the competency indicators of the material being taught, but are also linked to aspects of creative thinking ability.

Assessment instruments can be said to have good quality if they meet the requirements listed in Permendiknas Number 20 of 2007 concerning Assessment Standards. So to find out whether the assessment instrument meets the requirements or not, two events are carried out, namely the analysis of questions theoretically and empirically (Sukiman, 2012). The theoretical method is carried out through validity testing on several experts and the empirical method is carried out by means of trials on student. Based on the validation test in terms of material, it was found that the developed *ECTA-T* and *EMis-T* media were in the "valid" category with a value of 3.25 for *ECTA-T* media, and 2.87 for *EMis-T* media (Table 9).

Table 9. *ECTA-T* Validation Test Results by Media Experts

Assessment of instrument items	***ECTA-T***	***EMis-T***
Proportional layout of text and images	3,5	3

Selection of the appropriate background	3	3
Correct color proportions	4	4
Choose the appropriate font size	3	3
Backsound appropriate / not disturbing	3	3
Interesting pictures/animations	3	3
The images presented are in accordance with the material	4	3
Attractive navigator shape	3	3
Consistent navigator display	3	3
Ease of use of the program	3,5	3
Button reaction accuracy	3,5	3
Speed button function	2,5	2
Average	**3,2**	**3**

While the results of media validation that has been carried out show that the two media that have been developed are in the "valid" category with a value of 3.2 for *ECTA-T* media, and 3.01 for *EMis-T* media (Table 10). Based on the trials, it was found that the *ECTA-T* and *EMis-T* had medium-high reliability values, no discriminating power had a negative value, and questions with easy difficulty did not dominate (Table 11).

Table 10. *ECTA-T* Validation Test Results by Material Experts

Assessment of instrument items	*ECTA-T*	*EMis-T*
Components of questions in accordance with KD	3	3
The components of the questions correspond to the learning indicators	3	3
Instruments represent each learning indicator	3	3
Instrument items can measure misconception skills	3	3
The presentation of the items is written systematically	3	3
The instrument was made according to the conditions of high school students	3	3
Instruments are presented in a clear and easy to understand manner	3	3
The information presented in each item is very accurate	3	3
The use of language is in accordance with the level of maturity of students	4	2
Use of communicative language	3	3
Use of clear and understandable language	3	2
Use of the EYD (Enhanced Spelling) rule for each item	4	3
Average	3	3

Table 11. Analysis of Instrument Trial Results

Question Number			1	2	3	4	5	6
First Trial	*ECTA-T*	Difficulty level	0,72	0,77	0,72	0,77	0,67	0,75
			Medium	Easy	Medium	Easy	Medium	Medium
		Discriminating power	0,35	0,15	0,25	0,25	0,35	0,3
			Moderat	Bad	Moderat	Moderat	Moderat	Moderat
	EMis-T	Difficulty level	0,12	0,10	0,10	0,10	0,10	0,11
			Hard	Hard	Hard	Hard	Hard	Hard
		Discriminating power	0,25	0,20	0,20	0,20	0,20	0,22
			Bad	Bad	Bad	Bad	Bad	Moderate
Second Trial	*ECTA-T*	Difficulty level	0,60	0,60	0,61	0,64	0,54	0,66
			Medium	Medium	Medium	Medium	Medium	Medium
		Discriminating power	0,35	0,50	0,41	0,47	0,22	0,47
			Moderat	Good	Good	Good	Moderat	Good

EMis-T	Difficulty level	0,11	0,12	0,11	0,11	0,12	0,11
		Hard	Hard	Hard	Hard	Hard	Hard
	Discriminating power	0,22	0,25	0,22	0,22	0,25	0,22
		Moderat	Moderat	Moderat	Moderat	Moderat	Moderat

Then the last stage, namely the application stage. At this stage the instruments that have met the requirements listed in Permendiknas Number 20 of 2007 concerning Assessment Standards, include having valid criteria, medium-high reliable values, no discriminating power which has a negative value, questions that have an easy difficulty level do not dominate, then these questions can be used by educators to measure creative thinking skills and students' misconceptions about environmental material. Here I apply the instruments that have been developed to class X students senior high school.

Based on the measurement results, it is known that class have high creative thinking skills in solving various kinds of environmental problems (Figure 3), and it is also known that students' misconceptions in understanding ecological material are included in the low category (Figure 4). This proves that students' ability to think creatively in solving various kinds of environmental problems is inversely proportional to the level of misconceptions in understanding ecological material. The higher students' misconceptions in understanding ecological material, the lower students' creative thinking abilities. Vice versa, the lower students' misconceptions in understanding ecological material, the lower the level of students' creative thinking skills in solving various kinds of environmental problems.

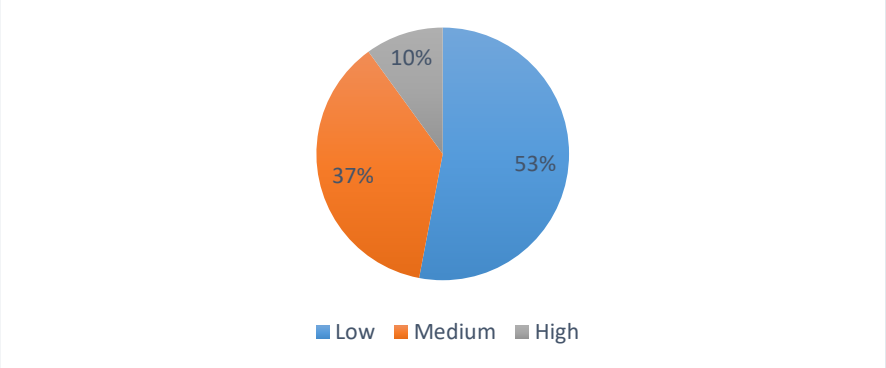


Figure 3. Creative Thinking Ability Percentase

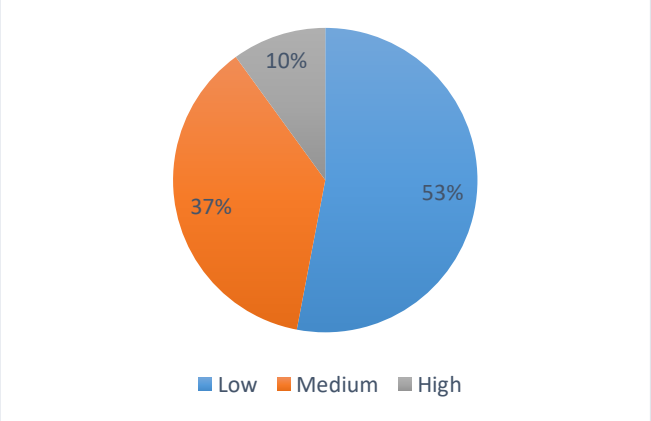


Figure 4. Misconception Percentase

The results of this study are in accordance with those presented by Lewinsohn et al. (2014) that one's understanding of ecology contributes to one's ability to solve

environmental problems. Sucia, A.H. et al. (2018) in his research entitled "The Influence of Learning and Ecoliteracy Models on Students' Environmental Problem Solving Ability", the researcher said that a person's knowledge related to ecology has an important role in improving environmental problem solving. The results of this study are also in accordance with those described by Lenny, P. et al. (2020) in his research journal entitled "Relationship between Ecological Literacy and the Ability to Solve Environmental Problems at the Adiwiyata School in Tangerang City", the researcher stated that ecological literacy contributes to the ability to solve environmental problems due to internal factors that exist within students such as their knowledge. Law Number 32 of 2009 concerning Environmental Protection and Management also explains that the concept of ecology in a subject can encourage students to increase awareness of environmental issues (Purnami, W., Utama, W.G., & Madu, F.J, 2016).

Environmental problems such as water, soil and air pollution, which often occur in the environment where students live, need to find a solution, and creative thinking is one of the skills needed to deal with this. Creative thinking is the ability to find original, aesthetic, and constructive ideas or results related to concepts where the emphasis is on aspects of intuitive and rational thinking, especially in using information and materials to bring up or explain them with the perspective of original thinkers (Putri, et al. al., 2017). Creativity is one of the abilities that can make a person able to face increasingly complex problems as changes occur from time to time (Munandar, 2012).

CONCLUSION

The development of the *ECTA-T (Electronic Creative Thinking Ability Test)* and *EMis-T (Electronic Misconception Test)* was carried out by referring to the Research and Development (R&D) method with the Borg & Gall (2003) development model which was modified according to conditions into four development steps, including namely: (1) Preliminary study stage; (2) Development stage; (3) validation and trial stage; (4) Application Stage. Based on the results of the analysis it is known that the product that has been developed has valid criteria, medium-high reliable value, no discriminating power which has a negative value, and questions that have an easy level of difficulty do not dominate, so this product can be used by educators to measure creative thinking skills and students' misconceptions about environmental material.

The level of students' creative thinking abilities identified by *ECTA-T* with a combination of the three-tier method and the certainty response index on environmental material is dominated by students in the high category. While the level of students' misconceptions identified by *EMis-T* with a combination of the three-tier method and certainty response index in environmental material is dominated by students in the low category. This proves that students with low misconceptions can have high creative thinking skills.

REFERENCES

Ahmad, M., & Indana, S. (2018). Development of Student Misconception Test Instrumen Using Combination of Three-Tier Test and Certainty of Response Index on Animalia Kingdom Grade X High School. *Bioedu Berkala Ilmiah Pendidikan Biologi, 7*(2), 119-128. Diakses dari https://ejournal.unesa.ac.id/index.php/bioedu

Arikunto, S. & Safruddin, C. (2009). *Evaluasi Program Pendidikan: Pedoman Teoritis Praktis Bagi Mahasiswa dan Praktisi Pendidikan.* Jakarta: Bumi Aksara.

Arikunto, S. (2012). *Dasar-Dasar Evaluasi Pendidikan (Edisi 2)*. Jakarta:Bumi Aksara.

Arslan, H. O., Cigdemoglu, C., & Moseley, C. A. (2012). Three-tier test to assess pre-service teacher's misconceptions about global warming, greenhouse effect, ozone layer depletion, and acid rain. *International Journal of Science Education, 34*(11), 1667-1686. Diakses dari http://dx.doi.org/10.1080/09500693.2012.680618

Bayrak, B. K. (2013). Using Two-Tier Test to Identify Primary Students' Conceptual Understanding and Alternative

Conceptions in Acid Base. *Mevlana International Journal of Education, 3*(2), 19-26. Diakses dari http://mije.mevlana.edu.tr/

Bialik, M., & Fadel, C. (2015). *Skills for the 21st Century: What Should Students Learn?*. Boston: Center for Curiculum Redesign.

Borg, W. R., & Gall, M. D. (2003). *Educational Research: An Introduction Seventh Edition*. Boston: Allyn and Bacon.

D'Avanzo, C. (2003). Application of research on learning to college teaching: ecological examples. *Bio-Science, 53,* 1121-1128. Diakses dari https://academic.oup.com/bioscience/

Grumbine, Richard. (2012). Can you build it? Using manipulatives to assess student understanding of food-web concepts. *American Biology Teacher, 74*(7), 518. DOI: 10.1525/abt.2012.74.7.16

Firman, F. (2016). *Pengembangan Three Tier Tests untuk Mengidentifikasi Miskonsepsi Siswa Kelas VII pada Materi Persamaan dan Pertidaksamaan Linear Satu Variabel.* (Skripsi). Diakses dari http://eprints.unm.ac.id/6662/1.

Gurel, D. K., Eryilmaz, A., dan Mc Dermott, L. C. (2015). A Review and Comparison of Diagnostic Instrumens to Identify Students' Misconceptions in Science. *Eurasia Journal of Mathematics, Science & Technology Education. 11* (5), 989-1008. DOI: 10.12973/Eurasia.2015.1369a

Hasan, S., Bagayoko, D., & Kelley, Ella L. (1999). Misconceptions and The Certainty of Response Index (CRI). *Physics Education*, *34*(5): 294-299. DOI:10.1088/0031-9120/34/5/304

Herlanti, Y. (2014). *Tanya Jawab Seputar Penelitian Pendidikan Sains: Jawaban atas pertanyaan-pertanyaan mahasiswa tingkat akhir yang sering muncul dalam penelitian pendidikan sains*. Jakarta: UIN Jakarta.

Ibrahim, M. (2019). *Model Pembelajaran P2OC2R untuk Mengubah Konsepsi IPA Siswa.* Sidoarjo: Zifatama Jawara.

Kartimi, & Liliasari. (2012). Pengembangan Alat Ukur Berpikir Kritis pada Konsep Termokimia untuk Siswa SMA Peringkat Atas dan Menengah. *Jurnal Pendidikan IPA (JPPI), 1*(1), 21-26. Diakses dari http://journal.ummes.ac.id/index.php/jpii

Lewinsohn, T. M., Attayde, J. L., Fonseca, C. R., Ganade, G., Jorge, L., R., Kollman, J., Overbenck, G. E., & Prado, I. P. (2014). Ecological literacy and beyond: problem-based learning for future professionals, *AMBIO*, 44, 154–162. DOI: 10.1007/s13280-014-0539-2

Meitiyani, N., & Syaban, Ali. (2019). Membangun Kemampuan Berpikir Kreatif untuk Mengatasi Masalah Lingkungan dengan Menggunakan Pembelajaran Otentik. *EDUSAINS, 11*(2), 297-302. Diakses dari http://journal.uinjkt.ac.id/index.php/edusains

Munandar, Utami. (2012). *Pengembangan Kreativitas Anak Berbakat, cet.Ke-3*. Jakarta: PT. Rineka Cipta.

Munggoro, D. W., & Armansyah, A. (2007). *Menjadi Enviromentalis itu Gampang!.* Jakarta: WALHI.

Nofiana, M., Sajidan, & Puguh. (2014). Pengembangan Instrumen Evaluasi Two-Tier Multiple Choice Question untuk Mengukur Keterampilan Berpikir Tingkat Tinggi. *Jurnal Inkuiri, 3*(II), 60-74. Diakses dari http://jurnal.fkip.uns.ac.id/index.php/sains

Pesman, H., & Eryilmaz, A. (2010). Development of a Three-Tier Test to Assess Misconceptions About Simple Electric Circuits. *The Journal of Educational Research, 103*(3), 208-222. DOI:10.1080/00220670903383002

Prastiwi, L., Sigit, D. V., & Ristanto, R.H. (2020). Hubungan Antara Literasi Ekologi dengan Kemampuan Memecahkan Masalah Lingkungan di Sekolah Adiwiyata Kota Tangerang. *Jurnal Pendidikan Matematika dan IPA, 11(1),* 47-61. Diakses dari http://jurnal.untan.ac.id/index.php/PMP

Purnami, W., Utama, W. G., & Madu, F. J. (2016). Internalisasi Kesadaran Ekologis Melalui Pengelolaan Sampah di Lingkungan Sekolah Dasar. *Seminar Nasional Pendidikan Sains,* 487–49. Diakses dari media.neliti.com/media/publications

Putri, I. W. S., dkk,. (2017). Kemampuan Berpikir Kreatif Dalam Menyelesaikan Masalah Kesebangunan di SMPN 11 Jember. *Jurnal Edukasi*, *IV*(3), 59. Diakses dari https://jurnal.unej.ac.id/index.php/JEUJ/article/view/6310

Ratumanan, T.G., dan Laurens, T. (2006). *Evaluasi Hasil Belajar yang Relevan dengan Kurikulum Berbasis Kompotensi.* Surabaya: Unesa University Press.

Rosyana, W., dkk. (2019). Pengembangan instrumen penilaian *Three-Tier Multiple Choice* (*Three*-TMC) untuk Mengukur Keterampilan Berpikir Kritis Siswa pada Materi Kimia Larutan Penyangga Kelas XI SMA. *Jurnal Pendidikan IPA*, *8*(1), 48-58. DOI: 10.20961/inkuiri.v8i1.31814

Sofyan, A., dkk. (2006). *Evaluasi Pembelajaran IPA Berbasis Kompetensi.* Jakarta: UIN Syarif Hidayatullah Jakarta.

Stamp, N. (2018). Ecological Misconception, Survey III: The Challenge of Identifying Sophisticated Understanding. *ESA Bulletin, 87*(2), 168-175. DOI:10.1890/0012-9623

Sucia, A. H., Purwanto, agung, & Sucahyanto. (2018). Pengaruh Model Pembelajaran dan Ekoliterasi terhadap kemampuan Pemecahan Masalahh Lingkungan Peserta Didik, *PLPB, XIX* (2), 39-49. DOI: 10.21009/PLPB

Sukiman. (2012). *Pengembangan Sistem Evaluasi.* Ypgyakarta: Insan Mandiri.

Suryadi, A. (2002). *Pendidikan, Investasi SDM, dan Pembangunan*. Jakarta: Balai Pusataka.

Susanto, A. (2011). *Perkembangan Anak Usia Dini: Pengantar dalam berbagai aspeknya.* Jakarta: Kencana Prenada Media Group.

Talango, S. R. & Pratiwi, W. (2018). Asesmen Perkembangan Anak (Studi Kasus Asesmen Perkembangan Anak Usia 2 Tahun). *Jurnal Manajemen Pendidikan Islam, 6*(2), 49-60. Diakses dari https://journal.iaingorontalo.ac.id/index.php/

Treffinger, D. J., Young, G. C., Selby, E. C., & Shepardson, C. (2002). *Assesing creativity: A Guide for Educators.* Florida: University of Connecticut.