Characteristics of Instruments and Profile of Creative Thinking Ability of Students on Work and Energy Material

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Abstract

Physics learning in secondary schools requires students to achieve learning objectives in developing conceptual skills and creative thinking by studying every problem that occurs in life using the concept of physics. However, the fact is that the physics material taught rarely relates the content of the lesson to everyday life, the lesson is mostly filled with convergent so that creative thinking skills cannot be measured. This study aims to apply the developed instrument and obtain empirical data on the validity of the instrument as well as a profile picture of students' creative thinking abilities. This study uses the ADDIE model with 5 stages, namely analysis, design, develop, implement, and evaluate. The test subjects in this study were 34 students of class X UMIPA 2 at MAN 1 Bojonegoro. The results of the development obtained 10 items of instruments that have been validated by 3 lecturers of physicists. Empirical validity was analyzed using Microsoft Excel software. Based on the data from the validity test results that have been analyzed, it shows that the instrument that has been developed is theoretically valid with an average V Aiken value in the material, construction and language domains, respectively 0.91; 0.91; and 0.87. The results of instrument validation are also declared empirically valid by having values: (a) Empirical validation of items with an $r_{xy}$ value range of 0.34 to 0.64; (b) The reliability of the instrument obtained an $r_{11}$ value of 0.564 with a sufficient category, (c) The difficulty level of the instrument questions was 30% of the questions in the medium category and 70% of the questions in the easy category, (d) The discriminatory power of the instrument had 10% good questions, 40% enough questions, and 50% of the questions are not good. Creative thinking skills in students have a medium to very high category.

Keywords: Creative thinking ability, Instruments, Validation


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INTRODUCTION

It was recorded that since the end of 2021, Indonesia has human resources (HR) of 273 million people (Kemendagri, 2022). Indonesia is also one of the countries that has abundant natural wealth. This is believed to be the main support for the Indonesian nation to become a developed country in the future. To be able to process Indonesia's natural resources, intelligent, character, and creative thinking people are needed. Juan Hauarte, a Spanish philosopher, stated that the highest level of intelligence possessed by a human being is True Creativity (in Aziz, 2014). Therefore, every student who takes education is required to play an active role and think creatively in improving the quality of education in Indonesia. As educators who are expected to be able to build ideas/creativity in students, they should be aware that life's problems are increasingly complex, especially in this modern era which is always changing and developing rapidly. Various products of scientific and technological innovation are very close to human life. To face the challenges of modern life which is dynamic and full of uncertainty, it is necessary to develop creative thinking skills in learning...
Like a tit for tat, the Government of the Republic of Indonesia has also issued policies to regulate and manage the education system of its citizens. Through Government Regulation No. 57 of 2021 concerning National Education Standards (SNP) it is emphasized that the implementation of learning is carried out in an interactive, inspiring learning atmosphere, playing an active, creative, and independent role (Kemdikbud, 2022). Thus, the creative thinking ability of students becomes one of the learning outcomes that all education actors need to pay attention to.

Creative thinking (CT) is a skill to generate new ideas (Amelia, 2021). In detail, Arnyana (2019) defines creative thinking skills as the ability to create new ideas or ideas that are different from those that existed before. While creative thinking is divergent, productive, creative ways of thinking laterally and heuristic thinking that can be taught explicitly in learning (Zubaidah, 2017). Basically, CT is a skill that emerges because it often solves problems using different methods (Kiryak and Calik, 2017). CT according to Batlolona JR (2019) is the ability to produce new works in the form of products that combine data, information, and elements that can form new jobs or ideas. Based on the opinions of these experts, it can be drawn an understanding of creative thinking skills, namely the ability to develop and produce new ideas that are different from a problem and have several ways of solving that are divergent. According to psychologist JP Guildford, divergent can be trained so that creative thinking can be improved (in Wulandari 2021).

According to Mundar (2012), to see the creative thinking ability of students, it can be measured directly using several indicators which include: (1) fluency, namely the ability to provide several solutions, (2) originality, namely the individual’s ability to seek specific answers, and create new ideas, (3) detailed thinking (elaborate), which describes the ability to allow deep reasoning behind answers, and (4) flexibility of thinking (flexibility), namely the ability to change the flow of thought when facing a dead end.

Basically every human being created, has his own mind and creativity in each. Every creative individual will be able to easily come up with ideas/creativity from existing problems. As for individuals who are less/not creative, it is clear that it will be difficult to pursue scientific and technological innovation. This is very crucial because it can become a permanent obstacle and threaten their survival. Yulius (2021) reveals that a person's creative potential can show the results of actions, performances/works, both in the form of goods and ideas in a meaningful and quality manner. For this reason, it is very necessary to monitor and measure the creative abilities of students on a regular basis, so that the level of creative abilities is recognized and assisted in developing or improving these abilities. Thus, instruments to measure creative thinking skills need to be prepared immediately in order to meet learning outcomes.

Based on the results of the preliminary study of science learning, it was revealed that Indonesian students have very low creative thinking skills. Fuad, et al. (2015) reported the results of the creative thinking test with a score range of 0–100, that the average achievement score for each creative thinking indicator was only 18.03. Each indicator of creative thinking has a very low achievement value, namely: fluency 15.90; elaborate 16.28; originality 12.05; and flexibility 18.7. In line with that, the Trend International Mathematics and Science Study (TIMMS) shows that the results of measuring the level of creative thinking skills of students in Indonesia are still relatively low, only 2% of Indonesian students are able to solve problems that require creative thinking skills in solving them (Muliss in Ismara, 2017).

Nasution's research (2018) also strengthens existing findings, that the creativity and creative thinking of high school students are still low, because there are several causes that hinder the creative thinking process of students, including the limited understanding of students on concepts and explanations of the material listed in textbooks. So that most students have not been trained to do the stages of creative thinking.

In learning physics in secondary schools, students are expected to work hard to achieve their learning objectives, namely developing conceptual skills and creative thinking skills as
much as possible. The effort in question is to study every problem that occurs in life using and applying physics concepts consistently (Collins, 2014). Creative thinking can be used as a learning innovation by educators, so educators must be able to carry out the mandate to constantly develop students' creative thinking skills. Wheeler, Bromfield, and Waite (2002) state that the task of educators is to provide the best conditions for students to acquire relevant thinking skills. However, Lestari (2021) provides an affirmation related to physics learning that has occurred so far, that the material taught rarely relates the content of lessons to everyday life, and lessons are mostly filled with tasks or practice questions that are convergent.

Based on the Google Scolar and a search on Google, several researches on the development of creative thinking instruments in the field of physics studies were recorded, including the research of Irmaya, FP and Sunarti, T. (2020) has developed a creative thinking instrument on dynamic fluid materials, Awalis Sholekhah (2020) developing instruments for materials of magnitude and measurement. Edi Istiyono, et al. (2018) developed 2 packages of creative thinking instruments for materials of elasticity and Hooke's law, static fluids, temperature and heat, as well as optical instruments. Marwiyah (2015) developed instruments on atomic, ion, and molecular materials. Nasution, IRY (2021) developing a creative thinking instrument on direct current electricity.

With the various considerations above, a creative thinking instrument was developed on the Business and Energy material in a format in the form of essay questions, in order to facilitate and give students freedom in giving divergent. This article will report on the preparation of instruments and describe the characteristics of creative thinking instruments that have been successfully developed by researchers.

To develop the intended instrument, the first step is to find information on the use of creative thinking skills in schools. Field observations were carried out at Madrasah Aliyah Negeri (MAN) 1 Bojonegoro. The results of interviews with students and school teachers obtained the fact that class X students had never taken measurements of creative thinking abilities, especially in the physics subject, while learning the material for work and energy, students only got knowledge of the concept of s as well as the principles of the material, have not yet reached activities that involve students directly such as conveying responses to phenomena, identifying and formulating problems to solving a problem. This is in stark contrast to the learning objectives where students must be able to master thinking skills and problem-solving skills they face (Apriani, 2019). Work and energy materials are closely related to everyday life, so this material needs in-depth understanding so that students' creative thinking abilities can be developed. This condition triggers researchers to apply the developed instrument and obtain empirical data on the validity of the instrument as well as a profile picture of students' creative thinking abilities. This activity also provides real experiences for the school and students to achieve learning goals and improve the quality of their education.

**METHOD**

This study uses the ADDIE model which consists of 5 stages, namely *analysis, design, develop, implement, and evaluate* (Branch, 2015). The creative thinking ability instrument was developed and tested on 34 students who had studied the business and energy materials. At the analysis stage, observations are made to meet development needs, determine goals, determine basic competencies that are adapted to the latest curriculum, and determine the material to be tested. Curriculum analysis is carried out by examining the KD physics 3.9 and 4.9 on the work and energy materials. Material analysis is carried out by reviewing various literature on work and energy materials from textbook (Serway, 2014; Mikrajuddin, 2017) as well as previous research studies discussing work and energy materials (Lestari, 2021).

After making observations, the next step is to design a grid of instrument questions. The preparation of the grid is done by reviewing some of the literature on work and energy
materials in order to obtain a draft of a creative thinking instrument in the form of essay test questions. In the third stage, the researcher develops the content draft instrument consultation discussions with the supervisor regarding the suitability of the content of the questions with the indicators, the fulfillment of the questions in terms of language and logic of thinking, as well as the depth and correctness of the concepts applied in the questions. The final draft of the instrument obtained 10 items which were then gradually carried out by the process of theoretical validation and empirical validation. The theoretical validation process involved 3 lecturers from the Department of Physics at Unesa who studied and assessed the content of physics material, the construction of the questions made, and the linguistic aspects of the questions. After going through the theoretical validation process, the instrument was improved according to the suggestions and input of the validator. The revised instrument draft was then tested on the students of MAN 1 Bojonegoro to obtain data on the empirical validity of an instrument. In addition to the validity of the instrument data, the test results are also equipped with checking the differentiating power and the level of difficulty of the items in order to obtain the characteristics of the instrument as a whole.

### Subject

This study involved 34 students of class X UMIPA 2 MAN 1 Bojonegoro in the even semester of the 2021/2022 academic year. The participants were on average 16 years old and consisted of 27 women and 7 men. Data collection was carried out on the 4th week of April 2022.

### Instrument, Procedure and Analysis

Data analysis techniques to obtain the theoretical validity of the instrument from the assessment of all validators, using Aiken's V test statistics by applying equation 1.

\[ V = \frac{\sum S}{n(c - 1)} \]  

Keterangan:
- \( V \) = Aiken V Index
- \( l_0 \) = Lowest Validation Value
- \( c \) = Highest Validation Value
- \( r \) = Value given by validator
- \( n \) = Number of Validation
- \( s = r - l_0 \)

Items can be declared valid if they have a V-Aiken index in the range 0.37 to 1.0 (Kowsalya, 2012: 702). According to the classification in Table 1.

<table>
<thead>
<tr>
<th>V Aiken</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00 &lt; V ≤ 0.20</td>
<td>Very Low</td>
</tr>
<tr>
<td>0.20 &lt; V ≤ 0.40</td>
<td>Low</td>
</tr>
<tr>
<td>0.40 &lt; V ≤ 0.60</td>
<td>Enough</td>
</tr>
<tr>
<td>0.60 &lt; V ≤ 0.80</td>
<td>High</td>
</tr>
<tr>
<td>0.80 &lt; V ≤ 1.00</td>
<td>Very High</td>
</tr>
</tbody>
</table>

To obtain the empirical validity of the instrument, data analysis was carried out from the results of the instrument test, by applying the product moment as stated in equation 2.

\[ r_{xy} = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{n(\sum x^2) - (\sum x)^2}(n(\sum y^2) - (\sum y)^2)} \]  

... (2)
Description:

\( r_{xy} = \) Correlation coefficient
\( xy = \) The product of the variables X and Y
\( \sum x^2 = \) Total squared value X
\( \sum y^2 = \) Total squared value Y
\( (x)^2 = \) Total X value squared
\( (y)^2 = \) Total Y value squared

To determine the validity of the instrument, the calculated correlation coefficient value was juxtaposed with the correlation coefficient value in the statistical data table. Instruments can be declared empirically valid if the value of \( r_{xy} \) is greater than \( r_{table} \). The criteria for the validity of the instrument can be determined according to the grouping of the correlation coefficient values calculated in Table 2.

<table>
<thead>
<tr>
<th>Value V</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00 - 0.20</td>
<td>Very Low</td>
</tr>
<tr>
<td>0.20 - 0.40</td>
<td>Low</td>
</tr>
<tr>
<td>0.40 - 0.60</td>
<td>Medium</td>
</tr>
<tr>
<td>0.60 - 0.80</td>
<td>High</td>
</tr>
<tr>
<td>0.80 - 1.00</td>
<td>Very High</td>
</tr>
</tbody>
</table>

(Source: Sugiyono, 2012)

To obtain the reliability of the questions on the instrument, Cronbach's Alpha as stated in equation 3. Meanwhile, to determine the reliability criteria of the instrument, the correlation value of Cronbach's Alpha can be matched with the grouping of values from the criteria in Table 3.

\[ r_{11} = \frac{k}{(k - 1)} \left( 1 - \frac{\sum s_i^2}{s_t^2} \right) \quad \ldots (3) \]

Description:

\( k = \) total of all items
\( \sum s_i^2 = \) total variance of scores
\( s_t^2 = \) varians question
\( r_{11} = \) alfa cronbanch coefficient

<table>
<thead>
<tr>
<th>R Value</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 0.8</td>
<td>Very Reliabel</td>
</tr>
<tr>
<td>0.6 – 0.8</td>
<td>Reliabel</td>
</tr>
<tr>
<td>0.4 – 0.6</td>
<td>Fairly Reliabel</td>
</tr>
<tr>
<td>0.2 – 0.4</td>
<td>Less Reliabel</td>
</tr>
<tr>
<td>&lt; 0.2</td>
<td>Not Reliabel</td>
</tr>
</tbody>
</table>

(Source: Sugiyono, 2012)

The determination of the distinguishing power and level of difficulty of each item is calculated by using equation 4 and equation 5

\[ D = P_A - P_B \quad \ldots (4) \]

Descriptions:
D = Discrimination index

\( P_A = \) Difficulty level for the upper group

\( P_B = \) Difficulty level for the lower group

\[ P = \frac{N_P}{N} \]  ...(5)

Descriptions :

\( P = \) Difficulty index (proportion)

\( N_P = \) Number of participants who answered the question correctly

\( N = \) Total participant answered the question wrong

The criteria for distinguishing power and the level of difficulty are determined according to Table 4 and Table 5.

<table>
<thead>
<tr>
<th>Table 4. Criteria of Discrimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>D Value</td>
</tr>
<tr>
<td>( D \leq 0 )</td>
</tr>
<tr>
<td>( 0 &lt; D \leq 0,2 )</td>
</tr>
<tr>
<td>( 0,2 &lt; D \leq 0,4 )</td>
</tr>
<tr>
<td>( 0,4 &lt; D \leq 0,7 )</td>
</tr>
<tr>
<td>( 0,7 &lt; D \leq 1 )</td>
</tr>
</tbody>
</table>

(Source: Bagiyono, 2017)

<table>
<thead>
<tr>
<th>Table 5. Criteria of Difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td>P Value</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>( 0 &lt; P \leq 0,3 )</td>
</tr>
<tr>
<td>( 0,3 &lt; P \leq 0,7 )</td>
</tr>
<tr>
<td>( 0,7 &lt; P &lt; 1 )</td>
</tr>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

(Sumber: Bagiyono, 2017)

RESULTS AND DISCUSSION

The creative thinking assessment instrument was developed based on the CT indicators according to Munandar (2012) which consists of fluency, originality, elaborate, and flexibility. The results of the recapitulation of the instrument are in Table 6.

<table>
<thead>
<tr>
<th>Table 6. Representation of the number test questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
</tr>
<tr>
<td>----</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Based on the results of the recapitulation of the instruments that have been carried out at the develop, it has been obtained that 10 items of the description test were tested on students in order to determine the empirical validity of the questions and also their reliability. One example of an instrument and assessment attribute that was successfully developed by researchers on one aspect of the CT indicator, namely flexibility in Table 7.
Table 7. Examples of Instruments Creative Thinking

<table>
<thead>
<tr>
<th>CT Indicator</th>
<th>Question</th>
<th>Answer</th>
<th>Students Response</th>
<th>Score</th>
</tr>
</thead>
</table>
| Flexibility  | Hasyim conducted a physics experiment as follows. In the first experiment, he pulled an object with a force $F$ on a smooth flat surface, thereby accelerating the object from rest to a speed of $v$. In the second experiment, he accelerated with the same force so that he concluded that the ratio of the work in the first and second experiments was 1:3. What speed must Hashim accelerate from speed $v$ in the second experiment? Explain! | **Method I:**

**Known:**
- Gaya tarik = $F$
- $W_1 : W_2 = 1 : 3$

**Asked:** $v_2$

**Answer:**
- $W = \Delta EK$
- $F_S = \frac{1}{2} m(v_1^2 - v_2^2)$

**First Experiment:**
- $W_1 = \frac{1}{2} m(v_1^2 - 0^2)$
- $W_1 = \frac{1}{2} m v_1^2$

**Second experiment:**
- $W_2 = \frac{1}{2} m(v_1^2 - v_2^2)$

It can be conclude that:

$$\frac{W_1}{W_2} = \frac{1}{3}$$

$$\frac{1}{2} m v_1^2 = \frac{1}{3}$$

$$v_1^2 = \frac{1}{3}$$

$$v_2^2 - v_1^2 = \frac{3}{3}$$

$$3v_1^2 = v_2^2 - v_1^2$$

$$4v_1^2 = v_2^2$$

$$2v_1 = v_2$$

**Method II:**

**Known:**
- $W_1 : W_2 = F_2 x S_2 / F_2 x S_1$
- $1 : 3 = F_1 / S_1 / F_2 / S_2$
- $1 : 3 = S_1 = S_2$
- $V_1 = v$
- $V_2 = 2v$

**Answer:**

**First experiment**
- $vt^2 = v0^2 + 2as$
- $v^2 = 2as$
- $s = v^2/2a .. (eq 1)$

**Second experiment**
- $vt^2 = v0^2 + 2as$
- $vt^2 = v0^2 + 2a.3s$
- $vt^2 = v0^2 + 6as$
- $vt^2 = vo^2 + 3v^2 .. (eq 2)$

**Substitution eq 2**
- $vt^2 = v0^2 + 3v^2$
- $(2v)^2 = v^2 + 3v^2$
- $4v^2 = 4v^2$

No Answer

Solve questions or problems with one wrong answer.

Solve questions or problems with two wrong answers.

Solve questions or problems with one correct answer.

Solve questions or problems with two correct answers.

0

3

5

7

10
\[ v = 2 \]

So, in the second experiment
Hasyim did it by accelerating
the object's speed to 2 times
the initial speed

It can be seen in Table 7 that the problem contains 2 different ways to solve the requested problem with a single answer. Students are expected to be able to answer more than one way to get the right results. From these questions, students can be trained to think creatively to find or change the flow of thought when facing a dead end in the process of working on the problem. So that the ability of students in flexibility can be measured.

**Result of Theoretical Validity**

Instruments that have been developed at the develop stage are validated by three validators to obtain theoretical validity covering the realm of material, construction, and language. The preparation of the assessment rubric is carried out based on the suitability of each domain with the curriculum, research objectives, cognitive level of students, delivery of information both in terms of language and representation and communication techniques used. The assessment is given using a scoring system in the range of 1 to 4 which refers to the poor to very good category.

a. Theoretical validation of the material

The assessment of the realm of the instrument material is designed based on the content of the learning material asked in the instrument questions. The assessment aspect is viewed from the degree of conformity between the content of the questions developed and the material being taught, with the CT indicators, and with the cognitive level of students. The theoretical validity of the material domain includes lesson content that is in accordance with the curriculum to measure certain goals (Putra, 2013). The results of the theoretical validity of the material domain are presented in Figure 2.

**Figure 1. Achievement of Theoretical Validity of the Material**

Based on the data in Figure 2, it can be seen that the instrument developed can be declared valid in the material realm because it has an average V Aiken value of 0.91 (Kowsalya, 2012: 702). All questions have met the business and energy material indicators, met the KBK indicators, and met the cognitive abilities of students who will receive the instrument, with an average achievement of above 3 (good). Only the third aspect, namely conformity to the cognitive level of students who get an average score
below 3, is given by the first validator. However, this aspect still meets the valid criteria in the good category.

b. Theoretical validity of the construction

The assessment of the theoretical validity of the construction realm is designed based on the structure/composition of information in the question sentence, the question framework and the question writing technique. Farida (2017) states that an assessment instrument that meets construction validity describes the instrument's ability to build research by measuring aspects of thinking. The results of the theoretical validity of the construction domain are shown in Figure 3.

![Figure 2](image)

**Figure 2. Achievement of Theoretical Validity of the Realm Construction**

Based on the data in Figure 3, it can be seen that all of the instrument questions have met all four aspects of the construction domain assessment with assessment achievements in the score range above 3, in the good to very good category. The V Aiken index value for all aspects of the assessment reached an average value of 0.91. It can be concluded that the developed instrument can be declared valid in the construction domain because the average V-Aiken index value has exceeded 0.37 (Kowsalya, 2012: 702).

c. Theoretical validity of the language

The assessment of the theoretical validity of the language domain is designed based on the provisions of the Big Indonesian Language Dictionary (KBBI) both in terms of word meaning, sentence writing and the use of punctuation properly and correctly. The results of the theoretical validity of the language domain can be seen in Figure 4:

![Figure 3](image)

**Figure 3. Achievement of Theoretical Validity of the Language**
Based on the graph in Figure 4 above, it can be seen that all of the instrument questions developed have met the four aspects of the language domain assessment with the average score of each aspect being above 3, in the good category. Meanwhile, the achievement of the V-Aiken index scored 0.87. Thus the instrument can be declared valid in the language domain because it has a V-Aiken index of more than 0.37 (Kowsalya, 2012: 702).

Based on the analysis of the results of each theoretical validation domain above, the creative thinking instrument developed has met the assessment requirements of all validators. The creative thinking instrument was declared valid in the material realm, valid in the construction realm, and valid in the language realm. So it can be concluded that theoretically the creative thinking instrument is valid. In line with Irmaya's research (2020) which states that the instrument can be said to be theoretically valid if the three aspects of the material, construction, and language domains have good category validity results from all validators.

**Result of Empirical Validity**

After the instrument is declared valid by the validator, improvements are made according to the validator's suggestions. Then the instrument was tested on students at MAN 1 Bojonegoro in order to obtain data on empirical validity, reliability, discriminating power and the level of difficulty of the instrument items. The results of item analysis to determine empirical validity, reliability, item difficulty, and discriminatory power are presented in Table 8, Figure 4, and Figure 5, respectively:

<table>
<thead>
<tr>
<th>Number of Questions</th>
<th>( r_{xy} )</th>
<th>( r_{table} )</th>
<th>Validity</th>
<th>( r_{11} )</th>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.434</td>
<td></td>
<td>Valid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.359</td>
<td></td>
<td>Valid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.519</td>
<td></td>
<td>Valid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.393</td>
<td>0.339</td>
<td>Valid</td>
<td>0.564</td>
<td>Reliabel</td>
</tr>
<tr>
<td>5</td>
<td>0.377</td>
<td></td>
<td>Valid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0.470</td>
<td></td>
<td>Valid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>0.646</td>
<td></td>
<td>Valid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>0.549</td>
<td></td>
<td>Valid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>0.339</td>
<td></td>
<td>Valid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>0.386</td>
<td></td>
<td>Valid</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The results of the overall empirical validity of the questions (Table 8) have a value of \( r_{xy} \) an average of 0.44, the calculation of empirical validity using *Microsoft Excel software*. After calculating the whole question is declared valid with a value of \( r_{xy} \) is greater than the \( r_{table} \) determined from the number of students as many as 34 people so that it is worth 0.339 with a significant level of 5%. All questions that are asked are valid in the low to high category, this can mean that the instrument questions can be used to measure students' creative thinking abilities (Harni, 2021). As for the reliability of the instrument has a value of \( r_{11} \) of 0.564. So that the entire instrument that has been developed can be declared reliable with a fairly reliable category. A reliable value that has a sufficient category is caused by a small number of samples. This is in line with Irmaya's research (2020) which states that the reliability of an instrument is influenced by 4 factors, namely: 1) the length of the question (the longer the question, the higher the reliability value and vice versa), 2) the quality of the item (clear questions, directives), the desired answer must be good, 3) the number of trial samples (the more samples will determine the size of the reliability of an instrument), and 4) test administration (such as supervision, test sites, and a supportive environment).
instrument with a reliability value of 0.564 indicates that the question of creative thinking skills can be trusted because it tends to give consistent results when given to different subjects (Son, 2019).

The level of difficulty of the items is obtained from the ability of students to complete the items, not from the point of view of teaching in conducting analysis during the preparation of the questions (bagiyono, 2017). The level of difficulty of the instrument that has been developed by the researcher can be seen in Figure 4a, which is as many as 30% of the questions have a moderate level of difficulty and as many as 70% of the questions have an easy level of difficulty. The questions that have a low level of difficulty are caused because more than half of the students in class X UMIPA 2 MAN 1 Bojonegoro can answer the questions correctly. This is reinforced by Suharsimi's statement which states that questions with easy criteria can be done perfectly by almost all students (in Irmaya, 2020).

The instrument that has been developed by researchers with a moderate level of difficulty can then be used by educators to measure students' creative thinking skills and can be stored in a collection of questions. This is in line with Susanto's research (2015) which states that questions that fall into the medium criteria should be immediately recorded in a question bank book, while instruments that have easy categories need to be followed up to be better than before. However, under certain conditions, instrument questions with easy criteria can provide benefits for students to pass the selection test.

The discriminatory power of an item is the ability of an item to distinguish groups in terms of aspects that are measured according to the differences that exist in that group (bagiyono, 2017). It can be seen in Figure 4b that the discriminatory power of the instrument in this study, as many as 10% of the instrument questions had good discriminating power, 40% of the questions had sufficient discriminating power, and 50% of the questions had poor discriminating power. The overall discriminatory index of the questions has a value of 0.11 to 0.50. On questions that have a low index value, because upper and lower class students have the ability to answer questions that are almost the same. Questions that have low discriminatory power are 50%, because the number of subjects used in this study is only 34 students, so it is difficult to know the distinguishing power of each question.

Profile Creative Thinking Ability

<table>
<thead>
<tr>
<th>Grade Interval</th>
<th>Category</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20</td>
<td>Very Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>21-40</td>
<td>Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>41-60</td>
<td>Medium</td>
<td>4</td>
<td>11.7%</td>
</tr>
<tr>
<td>61-80</td>
<td>High</td>
<td>20</td>
<td>58.8%</td>
</tr>
<tr>
<td>81-100</td>
<td>Very High</td>
<td>10</td>
<td>29.5%</td>
</tr>
</tbody>
</table>
The results of the percentage of creative thinking ability tests owned by students of class X UMIPA 2 at MAN 1 Bojonegoro can be seen in Table 9, that students who have creative thinking skills in the medium category are 4 people with a percentage of 11.7%. Then students who have the ability to think creatively in the high category are 11 people with a percentage of 58.8%. While students who have creative thinking skills in the very high category are 10 people with a percentage of 29.5%. Of the 34 students who had the highest score of 92.5 and the lowest of 57.5. So it can be seen that there are no students who have a value of 0 this is because there is no human being whose intelligence is zero (Treffinger in Supriadi, 1994). Likewise with creative thinking, it means that there are no students who do not have the ability to think creatively (Armandita, 2017).

Figure 5 shows that the highest indicator of students' creative thinking abilities is flexibility (flexible thinking) by 30% with an average value of 3.60 and the lowest is fluency (thinking fluently) by 22% with an average value of 2.70. This is in contrast to Fajrina's research (2018) which reveals that the CT indicator that has the highest average value is fluency while the lowest is flexibility and elaborate. In a study conducted by Vendiktama (2016) the CT indicator that has the highest average value is originality and the lowest is flexibility. Meanwhile, research conducted by Nurhakiki (2020) states that the highest CT indicator is fluency and the lowest is originality. So in this case it can be seen that the students of class X UMIPA 2 at MAN Bojonegoro are still lacking in fluency, such as formulating a problem and providing many solutions in problem solving, so they need to be retrained in their fluent thinking skills.

CONCLUSION

Based on the discussion and analysis of research data, it can be concluded that 10 items of creative thinking skills instrument questions on work and energy materials are declared theoretically valid with V Aiken values in the material, construction, and language domains of 0.91 each; 0.91; and 0.85 in the very high valid category. All instruments are also declared empirically valid by having values: (a) Empirical validation of items with a range of values of \( r_{xy} \) by 0.34 to 0.64; (b) Instrument reliability is obtained by the value of \( r_{11} \) of 0.564 in the sufficient category, (c) The level of difficulty of the instrument questions as much as 30% of the questions are in the medium category and 70% of the questions have the easy category, (d) the distinguishing power of the instrument has 10% good questions, 40% sufficient questions, and 50% less questions. good. So that the assessment instrument that has been developed can be declared valid theoretically and empirically.

The students of class X UMIPA 2 at MAN 1 Bojonegoro have the percentage of creative thinking ability in the medium category, high category, and very high category
respectively 11.7%; 58.8%; and 29.5%. Then the indicator of creative thinking ability that has the highest value is flexibility and the lowest is fluency of 3.60 and 2.70, respectively.

RECOMMENDATION
In future research, it is hoped that researchers can develop instruments using more trial samples in order to get better empirical validity results.

REFERENCES


