Radiasi: Jurnal Berkala Pendidikan Fisika
Vol. 14 No. 1 (2021) pp. 51-61
http://jurnal.umpwr.ac.id/index.php/radiasi/index
p-ISSN: 2302-6111 e-ISSN: 2549-0826

Rasch Analysis of Creative Thinking Skill on Optical Instrument (CTSOI) 11th Grade Students Sundanese Tribe: a Case Study

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Abstract

This study aims to determine the creative thinking skills at optic instrument of Sundanese tribe 11th grade students. This research is a case study research conducted at a high school in Majalengka district, West Java. Totaling 32 students consisting of 12 male students, namely "Aa", 20 female students, namely "Teteh", and 18 Sundanese, the rest are immigrants. The instrument used is the Test for Creative Thinking-optical instrument (TCT-OI) which has existed validated by experts. The data found were investigates with Rasch Analysis Model (RAM). Based on the results of the analysis using the Rasch Analysis, it was found that the creative thinking ability of students stayed static low can be shown by value of Person reliability which is 0.21 included in the weak category. There are variances in the level of creative thinking skills of students from the Sundanese and non-Sundanese tribes. As a result, it is necessary to develop creative thinking skill on optical instrument, 11th grade students sundanese tribe.

Keyword: *Rasch analysis, Creative thinking skill, Optic instrument*

Article Info:
Recieved:
31/03/2021
Revised:
26/04/2021
Accepted:
27/04/2021

Abstrak

Penelitian ini bertujuan untuk mengetahui keterampilan berpikir kreatif materi alat-alat optik pada siswa kelas XI Suku Sunda. Penelitian ini merupakan penelitian studi kasus yang dilakukan di salah satu Sekolah Menengah Atas di Kabupaten Majalengka, Jawa Barat. Sebanyak 32 siswa terdiri dari 12 siswa laki-laki yaitu "Aa", 20 siswa perempuan yaitu "Teteh", dan 18 orang Sunda, sisanya adalah pendatang. Instrumen yang digunakan adalah Tes Alat-alat Optik Berpikir Kreatif (TCT-OI) yang telah divalidasi oleh ahli. Data yang diperoleh kemudian dianalisis dengan Rasch Analysis Model (RAM). Berdasarkan hasil analisis menggunakan Analisis Rasch diketahui bahwa keterampilan berpikir kreatif siswa masih rendah dapat ditunjukkan dengan nilai Reliabilitas siswa sebesar 0,21 termasuk dalam kategori lemah. Terdapat perbedaan tingkat keterampilan berpikir kreatif siswa yang berasal dari suku Sunda dan non-Sunda. Untuk itu perlu dikembangkan keterampilan berpikir kreatif pada materi alat-alat optik siswa kelas XI suku sunda.

Kata kunci: *Analisis Rasch, Keterampilan berpikir kreatif, Alat-alat optik*

1. Introduction

Rasch analysis is one of the statistical methods to test the ability of each individual and the interaction and difficulty of the instrument items used in most of the research, especially in the fields of social education and science [1], [2], [3], [4], [5], [6], [7]. Rasch analysis can be utilized by all teachers in various fields of education to develop test instruments and to identify relevant information regarding student assessment [3]. Various studies in various fields of education use Rasch analysis such as techniques [8], [9], [10], mathematics [11], [12], chemistry [13], [14], physics [15], [16]. So to find out the ability of creative thinking in each student the researchers used the Rasch analysis model.

The 21st century is an era of globalization, there have been changes in all aspects of life in the fields of economy, social, politics, and science and technology. Facing this era of globalization, it is necessary to develop quality human beings who are creative, innovative, intelligent and able to compete globally to keep up with these rapid changes [17]. A student needs to have the ability to think creatively. Students as future generations need to be equipped with high-level abilities, such as creative thinking, as stated in the 21st Century Educational Framework [18] [19] [20], creative thinking will make a person think comprehensively, fundamentally and can choose which answers are correct in physics problems [21] [22]. Creative thinking considers problems from different perspectives, has its personal way, and finds many ways to solve a problem [23]. Creative thinking is not the same as intelligence, but the ability to think creatively can be improved by being trained, arising because it is often trained in solving problems using different ways [24] [25]. Students need to be trained in their creative thinking skills through science learning [26].

Optical instrument is one of the physics material in grade 11 high school, optical instrument discuss the instrument that use optical geometry in life. We found many physical phenomena of optical instrument in everyday life. From the phenomena raised, it is hoped that students will be able to think about the completion of their physical material. The phenomena of optical instruent shows at Figure 1 and Hypermetropic image formation presented by Figure 2.

Figure 1. The phenomenon of optical instruent in everyday life (*Source: alodokter.com*)

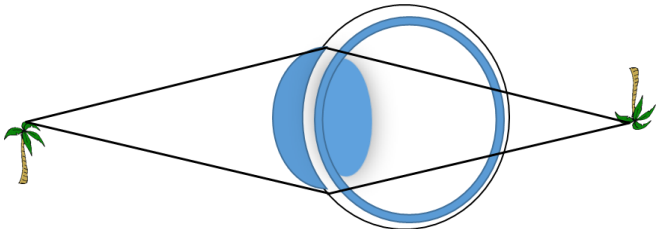

Figure 2. Hypermetropic image formation

Figure 1 is one of the phenomena of a grandfather wearing glasses so he can clearly see the reading material in the book, in this phenomenon there are physical quantities such as the strength of the lenses on the glasses, while Figure 2 is the process of forming object images in people with farsightedness (hypermetropy).To have the ability to think creatively in optical instrument material, students can be stimulated through the phenomena that are around them, especially in Indonesia which is known to have various tribes and cultures belonging to the 15 largest ethnic groups in Indonesia [27] of the fifteen largest tribes originating from Java, one of them is the Sundanese, the second-largest tribe after Java. Some characteristics in Sundanese are calls for adult men with "Aa" and adult women with "Teteh". In addition to the various ethnic and Indonesian cultures known by various kinds of religious differences so with these many differences most Indonesian citizens are easily influenced by negative assumptions that impact their education [28]. However, the Sundanese apply good principles, among which, one must learn as early as possible and the interaction between the teacher and students must be able to educate [29]. This principle is expected so that the Sundanese people become very good students, one of them is in science. Thus, the actual content of knowledge can be developed based on the original knowledge possessed by the community. For example, students are capable of making optical instruments such as periscopes, binoculars by utilizing the materials around them [30]. The demands in the 21st century are expected that students have creative thinking skills, so it is necessary to analyze students' creative thinking skills on the material of optical instruments with rasch analysis so that students can be given appropriate treatment.

2. Method

2.1 Research Design

The method used in this research is a case study. This design is not limited to one type of analysis, such as quantitative or qualitative, but allows a variety of methods that can be functional in sub-units [31]. This research was conducted by taking data through a one-time test of creative thinking skills on optical instrument material. Then the results are processed using Rasch analysis

2.2 Participant

Participants involved in this study are 11th grade students aged around 16-17 years old, most students have a good financial background, and have mobile phones that can help access information about subjects from the internet. There are 32 students (20 female students, "Teteh", 12 male, "Aa" and 18 of them are Sundanese, the rest are not Sundanese).

2.3 Instrument and Data Analysis

The instrument used in this study was TCT-OI (Test for Creative Thinking Skill-Optical Instrument) with good validity. It was developed referring to Torrance, involving aspects of fluency, flexibility, originality, elaboration. This instrument consists of 5 questions, each question included in the indicator of creative thinking skills to measure students' creative thinking abilities towards optical instrument material. The distribution of questions for the creative thinking skills test is shown in Table 1.

Tabel 1. The questions' distribution for the creative thinking skill test

No	Indicator	Description of Creative Thinking Skill
1	Elaboration	Able to enrich and develop an idea or product
2	Fluency	Ask lots of questions and find out the facts of the problem
3	Originality	Being able to produce new and unique phrases
4	Flexibility 1	Can generate a variety of ideas, answers, or questions
5	Flexibility 2	Being able to guess the cause and effect of a problem through image illustrations

2.4 Data Analysis

Data were obtained from the results of students' creative thinking skills tests then data were collected and analyzed using the Rasch Analysis Model. The software used is Ministep 4.5.2. To identify the creative thinking skills of Sundanese students, the first stage of analyzing the reliability of test instruments and respondents was obtained from table 3.1 in the 4.5.2 ministep stage two analyzes the Item Bias and stage three analyzes the level of creative thinking ability for each indicator obtained from table 1 in the ministep 4.5.2

3. Result and Discussion

3.1 Reliability

The results of creative thinking skills in optical instrument (CTSOI) were analyzed using the Rasch model. In the analysis of the Rasch model there are three types of reliability values, namely overall reliability (Cronbach's alpha), student reliability (person-reliability), and item reliability (item reliability). Obtained from table 3.1 on ministep 4.5.2 shown in the Figure 3.

	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	10.3	4.7	-1.32	.83	.98	-.11	1.02	-.03
SEM	.4	.1	.19	.02	.13	.21	.13	.20
P.SD	2.3	.7	1.07	.08	.71	1.14	.74	1.13
S.SD	2.3	.7	1.08	.09	.72	1.16	.75	1.15
MAX.	14.0	5.0	.75	1.16	2.85	1.96	2.85	2.10
MIN.	4.0	2.0	-3.64	.77	.14	-2.05	.14	-1.94

REAL RMSE	.95	TRUE SD	.49	SEPARATION	.51	Person RELIABILITY	.21
MODEL RMSE	.83	TRUE SD	.67	SEPARATION	.80	Person RELIABILITY	.39
S.E. OF Person MEAN = .19							

Person RAW SCORE-TO-MEASURE CORRELATION = .88

CRONBACH ALPHA (KR-20) Person RAW SCORE "TEST" RELIABILITY = .73 SEM = 1.19

SUMMARY OF 5 MEASURED Item

	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	66.2	30.2	.00	.32	.99	-.12	.99	-.08
SEM	5.8	.6	.55	.00	.12	.51	.12	.45
P.SD	11.7	1.2	1.11	.01	.25	1.01	.24	.90
S.SD	13.0	1.3	1.24	.01	.28	1.13	.26	1.01
MAX.	82.0	32.0	1.55	.34	1.31	1.15	1.35	1.19
MIN.	52.0	29.0	-1.34	.31	.73	-1.21	.76	-1.05

REAL RMSE	.34	TRUE SD	1.05	SEPARATION	3.07	Item RELIABILITY	.90
MODEL RMSE	.32	TRUE SD	1.06	SEPARATION	3.27	Item RELIABILITY	.91
S.E. OF Item MEAN = .55							

Figure 3. Reliability Tes

Based on the Figure 3. Cronbach alpha value (overall reliability) which is 0.73 included in the category good, the value of Person reliability (student reliability) which is 0.21 included in the weak category and the value of item reliability (test item reliability) which is 0.90 included in the very good category . Meanwhile, the person size of -1.32 shows the average ability of students is lower than the level of difficulty of the item (set by default at 0.0). The average value of logit more than 0.0 shows the tendency of respondents to answer more correctly on various items [32]. This means that here the ability of students is still low. These results are similar to findings from previous research results [33], [34] other findings confirm creative thinking skills get the lowest score when compared with other skills [35], [36].

Another important part of evaluating question items or instruments is unidimensionality. The unidimensionality instrument is an important measure to find out whether the developed instrument is able to measure what must be measured, namely the students' creative thinking abilities. As shown in the Figure 4.

Table of STANDARDIZED RESIDUAL variance in Eigenvalue units = Item information units

	Eigenvalue	Observed		Expected
Total raw variance in observations =	8.9565	100.0%		100.0%
Raw variance explained by measures =	3.9565	41.2%		40.7%
Raw variance explained by persons =	1.4694	16.4%		15.9%
Raw variance explained by items =	2.4871	27.8%		26.9%
Raw unexplained variance (total) =	5.0000	15.8%	100.0%	57.3%
Unexplned variance in 1st contrast =	2.0192	2.5%	40.4%	
Unexplned variance in 2nd contrast =	1.4621	6.3%	29.2%	
Unexplned variance in 3rd contrast =	.8934	1.0%	17.9%	
Unexplned variance in 4th contrast =	.6183	6.9%	12.4%	
Unexplned variance in 5th contrast =	.0054	.1%	.1%	

Figure 4. Unidimensionality of creative thinking skills instrument

Based on Figure 4, we can see that the raw variance measurement results are 41.2%. The value is not much different when compared to the expected value, which is 40.7%. This shows that the unidimensionality requirement of 20% can be fulfilled. Besides, the unidimensional limit in the Rasch model of 40% was also fulfilled. Another thing that also supports is that the variances that cannot be explained by the instrument are all below 10%. This shows that the level of independence of the items in the instrument included in either category

3.2 Item Identification Bias

In this research, the measurement of bias items is based on two variables, namely gender and ethnicity. The analysis of the Rasch model shows the biased detection of items in Differential Item Functioning or DIF obtained from table 30.4 on the 4.5.2 ministep. Item bias can be determined based on the probability value of items that are under 5%. shown in the Figure 5 and 6.

Person CLASSES	SUMMARY DIF CHI-SQUARED	D.F.	PROB.	BETWEEN-CLASS/GROUP Item UNWTD MNSQ	ZSTD	Number	Name
2	1.6002	1	.2059	1.7499	.91	1	S1
2	.1934	1	.6601	.2026	-.40	2	S2
2	.0360	1	.8496	.0364	-.95	3	S3
2	.6660	1	.4144	.7116	.24	4	S4
2	.4158	1	.5190	.4372	-.04	5	S5

Figure 5. Bias Detection Based on Gender

Person CLASSES	SUMMARY DIF CHI-SQUARED	D.F.	PROB.	BETWEEN-CLASS/GROUP Item UNWTD MNSQ	ZSTD	Number	Name
2	2.0835	1	.1489	2.2535	1.13	1	S1
2	.0000	1	1.0000	.0013	-1.42	2	S2
2	.2212	1	.6381	.2329	-.34	3	S3
2	1.8893	1	.1693	2.0459	1.04	4	S4
2	.1620	1	.6873	.1670	-.48	5	S5

Figure 6. Bias Detection Based on ethnicity

Based on Figure 5, bias detection based on gender, the results of the DIF analysis are the probability value between 0.2059 - 0.8496 (p> 0.05) as well as Figure 6 for bias detection based on ethnicity, the probability value is between 0.1489 - 1.0000 (p> 0, 0 5). The results of this analysis did not find any items that contain bias, it can be believed that the items are perceived the same by respondents of different gender or respondents of different ethnicities.

3.3 Identify students' creative thinking skills

The level of difficulty of the questions according to the pattern of creative thinking skills can be seen in Figure 7.

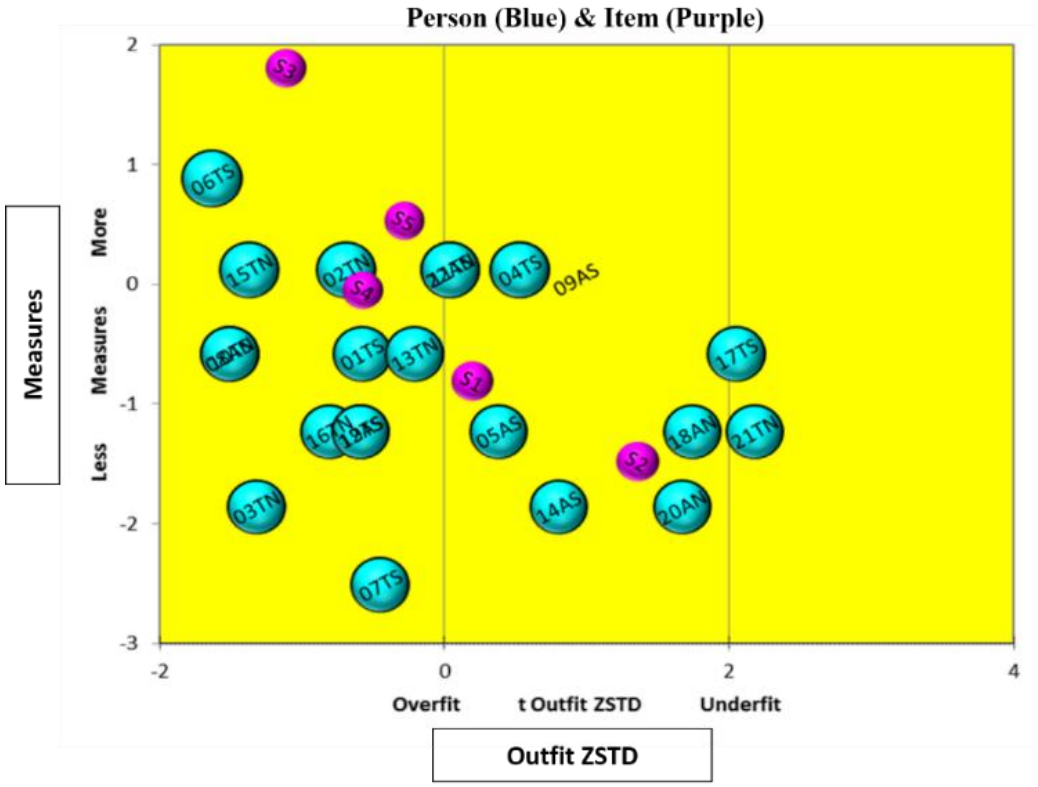

Figure 7. The Wright map shows the distribution of students' creative thinking skill and the level of difficulty of test item

Based on the Figure 7 there is the S code (questions) followed by the serial number and there is the serial number of students followed by code **A** (Aa or Male), **T** code (Teteh or Female), **S** code (Sundanese tribe) and **N** code (Not Sundanese or newcomer tribes). And the top and bottom shows the highest level of ability to the lowest. Students who have the highest level of creative thinking ability are 06TS (female students from Sundanese number 6) and students who have the lowest level of

creative thinking ability are 07TS (female students from Sundanese number 7). The level of difficulty is shown by the problem with the code S3 (originality) because it is in the top position and there are no students who have the potential to answer it. While the easiest problem is a question with a code S1 (fluency) because it is in the lowest position and can be answered by many students.

Originality shows the most difficult indicators that can happen because students are not accustomed to producing new and unique phrases. based on previous research that the improvement in the aspect of originality has the smallest increase compared to other aspects caused by conventional learning [37], [38] but other findings suggest that the aspect of originality increases in the high category after the learning model is applied PBL [39] such learning facilitates students to learn better independently or together when compared to conventional learning [40] Fluency shows the easiest indicators that can occur because students are accustomed to asking and issuing their opinions [41], [42], [43]. Incorrect identification of respondents or outliers can be seen from the Outfit Z-Standard (ZSTD) values received: -2.0 <ZSTD <+2.0 [24].

In the results of this study respondents included in the nonconformity were 21TN and 20AN. It can also be seen from the schalogram in Figure 8.

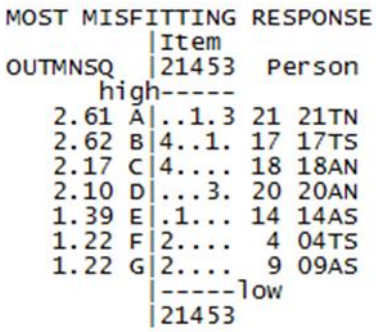

Figure 8. Respondents who misfit

Based on the Figure 8 that 21TN students (female students number 21 and Not Sundanese) get higher scores for the most difficult questions but the scores are lower for the easier questions beforehand. Likewise with respondents 20AN (student number 20 male and Not Sundanese). For more clearly can be seen in the Figure 9.

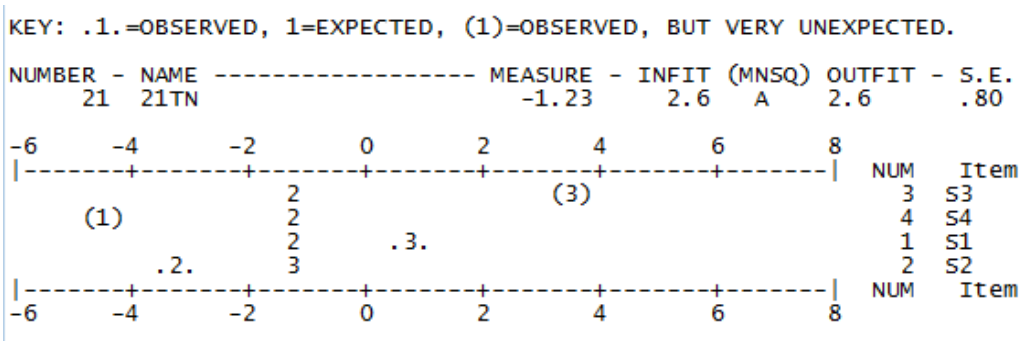

Figure 9. Respondents should

Based on Figure 9, 21TN students in the most difficult questions (S3) get a score of 3, easy questions (S4) get a score of 1 and the easiest questions (S2) get a score of 2. Ideally, these students have more abilities like getting a score of 3 on the easiest questions and the student has the same ability as getting a score of 2 on the easiest and most difficult questions. Overall the level of creative thinking skills of Sundanese and non-Sundanese students on each indicator can be seen in Figure 10.

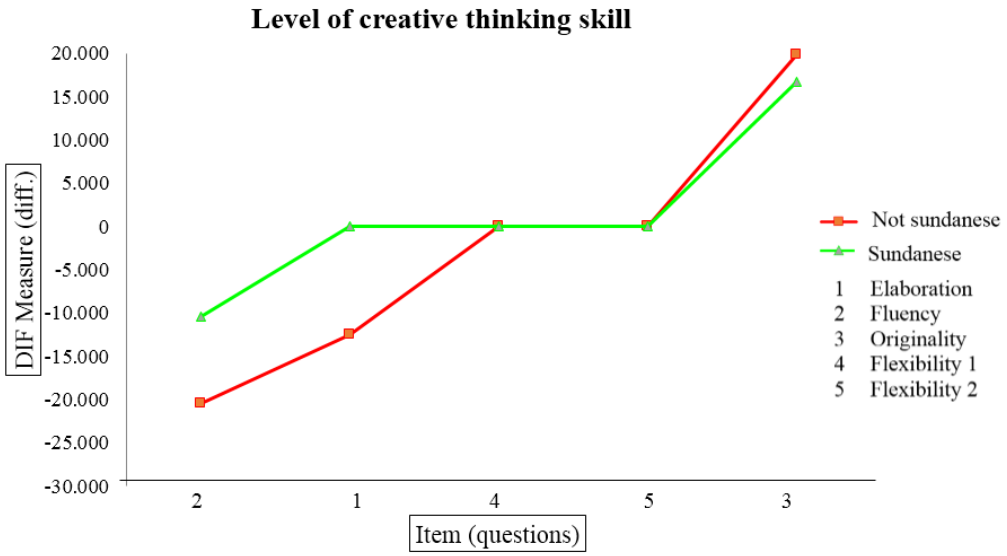

Figure 10. Sundanese and non-sundanese students' creative thinking skills

Based on the Figure 10 obtained information that there are differences in the level of creative thinking ability of Sundanese and non-Sundanese students on the indicators of fluency, elaboration, and originality. In the Elaboration and fluency indicators Sundanese students are higher than non-Sundanese students while in the originality indicators Sundanese students are more low than non-Sundanese students. However, there is no ethnic gap in the creative thinking skills of the optical instrument material.

4. Conclusion

The creative thinking skills test instrument tested on 11th grade students resulted in validity and reliability in the Good category. The tendency of the respondent's ability to solve the problem is smaller than the difficulty level of the question so that it can be stated that the students' creative thinking ability is still low. There are differences in the level of creative thinking skills of Sundanese and non-Sundanese students on indicators of fluency, elaboration, and originality.

Acknowledgement

Thank you to the 11th grade students at a high school in the district Majalengka, West Java, Indonesia for being willing to be respondents in this study and to the principal who has given permission for research.

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