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Research Article

Rasch Analysis of Multitier Open-ended Light-Wave Instrument (MOLWI): Developing and Assessing Second-Years Sundanese-Scholars Alternative Conceptions

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Abstract

The research aims to develop and to assess alternative conceptions of second year's Sundanese scholars on light wave with Multitier Open-ended Light Wave Instrument (MOLWI). The research method has been utilized by the 3D+1I model (Defining, Designing, Developing and Implementing). Participants who involved in this research are 26 of second year's scholars (11 male students, namely "*Ujang*" and 15 female students, namely "*Eneng*", the average age of them are about 17 years of Sundanese-tribe). The MOLWI consist of 15 questions which has been already analysed by Rasch analysis. Students' conceptions have ever been categorized regarding to the six categories, that are; Sound Understanding (SU), Partial Positive (PP), Partial Negative (PN), Misconception (MC), No Understanding (NU), and No Coding (NC). The research results show that the PN category has the highest percentage about 86 percent in the number six. The lowest category is the NC category about four percent in the number of 3, 5, 7 and 13. While Rasch analysis explains the Sundanese-scholars only answer confidently on easy questions and not misconceptions.

Keywords:

rasch analysis, Open-ended Light Wave Instrument (MOLWI), Sundanese-scholars, alternative conception

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Introduction

The Rasch analysis was originally made by Georg Rasch in 1960 to test construction in psychology with two types of parameters, a difficulty for each item and an ability for each person (Tesio, 2003; Masters, 1982; Rasch, 1960). Rasch analysis is a statistical method for describes the interaction of persons with test item that can be understood as a psychometric tool in social science and it has strong measurement properties (Planinic, Boone, Susac, & Ivanjek, 2019; Sumintono, 2018; Brandt, Moulton, & Duckor, 2015; Chan, Ismail, & Sumintono, 2014; Mui Lim, Rodger, & Brown, 2009; Joyce & Yates, 2007; Rasch, 1960) Furthermore, the various extensions of this relatively simple model have already been proposed since then and are regularly applied in assessments, such as in the field of health by Duncan, Bode, Lai, Perera, & Glycin (2003), in chemistry education by Herrmann-Abell, DeBoer, & Roseman (2009), in mathematics education by Long, Wendt, & Dunne (2011), and the emergence of Rasch measurement in language testing by McNamara & Knoch (2012). Rasch analysis is related to instrument analysis, thus it is appropriate to use in the field of education. Sumintono (2018) revealed Rasch model can be used by teachers and lecturers to develop test items as well as an essential tool that can serve relevant information regard to student assessment for learning. Precisely, Rasch analysis can be used to assess the measurement functioning of such instruments (Boone, 2016). In the physics education context, Rasch analysis has ever been carried out for several studies including research by Kauertz & Fischer (2006), Planinic, Ivanjek, & Susac (2010), Oon & Subramaniam. (2013), Susac, Planinic, Klemencic, & Sipus (2018), and Planinic, Boone, Susac, & Ivanjek, (2019). While Rasch analysis that has been used to analysis of misconceptions in the physics learning includes Wind & Gale (2015) about, "Diagnostic Opportunities Using Rasch Measurement in the Context of a Misconceptions-Based Physical Science Assessment". The instrument used is the MDDMC item from the National Assessment of Education Progress Questions and AAAS Bank Items developed by Project 2061. Herrmann-Abell & DeBoer (2016) researched about, "Using Rasch Modeling and Option Probability Curves to Diagnose Students' Misconceptions". The research presents an assessment of students' misconceptions on energy. Hereinafter, Fratiwi, Ramalis, & Samsudin (2019) conducted research on "The Three-tier Diagnostic Instrument: Using Rasch Analysis to Develop and Assess K-10 Students' Alternative Conceptions on Force Concept". Indirectly, Rasch analysis for multitier instruments in physics is still rarely found.

Multitier instruments are multiple choice with a tier of confidence. These instruments are usually used to measure conception, alternative conception, or student misconception. Research on the assessment of student conceptions has been carried out for several materials in physics. Through the document analysis method,

there are 273 articles about developed instruments to diagnose student conceptions since 1980 to 2019 (Kaltakci-Gurel, Eryılmaz & McDermott, 2015). Some instruments among them Force Concept Inventory (FCI) by Hestenes, Wells, & Swackhamer (1992), Electromagnetics Concept Inventory (EMCI) by Notaros (2002). Wave Diagnostic Instrument (WADI) by Caleon & Subramaniam (2010), Astronomy Concept Test (ACT) by Kanli (2015), Four-Tier Geometrical Optics Test (FTGOT) by Kaltakci-Gurel, Eryilmaz, & McDermott (2017), Three tier Force Concept Inventory (T-FCI) by Fratiwi, Ramalis, & Samsudin (2019), Momentum and Impulse Four-Tier Test (MIFT) by Amalia, Suhendi, Kaniawati, Samsudin, Fratiwi, Hidayat, Zulfikar, Sholihat, Jubaedah, Setyadin, Purwanto, Muhaimin, Bhakti, & Afif (2019). However, diagnostic instruments in light wave material are rarely found, because most of them focus on geometrical optics in addition to the discussion of light as waves. Then the development of instruments is needed to assess students' conceptions of light waves.

Multitier Open-ended Light Wave Instrument (MOLWI) is a multiple choices instrument with four-tiers as in general instrument for assessing alternative conceptions. Other studies have developed multiple-choice conception tests in various formats, such as the two-tier, the three-tier, and the four-tier test format (Kaniawati, Fratiwi, Danawan, Suyana, Samsudin, & Suhendi, 2019; Hermita et al., 2017; Samsudin, Suhandi, Rusdiana, Kaniawati, & Coştu, 2017; Afif, Nugraha., & Samsudin, 2017; Kaltakci-Gurel, Eryilmaz, & McDermott, 2017; Coştu, Ayas, & Niaz, 2012; Peşman & Eryılmaz, 2010; Coştu, 2008). The four-tier test instrument which is generally used has a composition with tier one and three are multiple choice, tier two and four are the level of confidence. While in the third tier of MOLWI, there was no choice for reasons, students had to fill in their own part of the reason. The aim is to obtain alternative conceptions from second-years Sundanese-scholars.

Indonesia is well-known to have various tribes and cultures. Ananta, Arifin, Hasbullah, Handayani, & Pramono (2013) classified 15 largest tribes in Indonesia such as Javanese, Sundanese, Malay, Batak, Madurese, Betawi, Minangkabau, Buginese, Bantenese, Banjarese, Balinese, Acehnese, Dayak, Sasak, and Chinese. Furthermore, they explained that five of the fifteen largest tribes originated from the Island of Java one of which was the Sundanese, the second largest tribe after the Javanese. Some characteristics in the Sundanese are the call for boys with "*Ujang*" and girls with "*Eneng*". Thus the discussion of the Sundanese is an interesting thing to discuss, especially in the field of education.

In education, Sundanese tribes apply the good principle, among them, "*Kudu guguru ti lelembut, diajar ti bubudak, geus gede kari makena*", and "*Silih asah, silih asih, silih asuh*" (Sudaryat, 2014). This principle has meaning, one must learn as early as possible and the interaction between teachers and students must be able to train, love, and educate. This principle is expected to make the Sundanese scholars become

excellent students, one of them in science. Meanwhile, the most important thing in science is conceptual understanding (Yumuşak, Maraş, & Şahin, 2015). Nuangchalerm & El Islami (2018) revealed that "Indonesian students understand in the concepts of physics higher than those Thai students". This is a motivation for Indonesian students including Sundanese to study science, one of which is physics. Studying physics will be easier if it is associated with a culture in everyday life. Thus, the science content can actually be developed based on original knowledge held by the community such as research by Parmin, Nuangchalerm, & El Islami, (2019). However, sometimes students' experiences related to phenomena in everyday life can lead to alternative conceptions of the explanation of a concept.

Alternative conception is the difference in understanding of students with scientific conceptions caused by many factors (Fratiwi, Ramalis, & Samsudin 2019; Ahmed, Opatola, Yahaya, & Sulaiman, 2018; Pujayanto et al., 2018; Kaltakci-Gurel, Eryilmaz, & McDermott; 2017). These factors include lack of knowledge about concepts, textbooks, confusion, environment, and the translation of inaccurate terms (Kocakulah & Kural, 2010, Oberoi, 2017). Alternative conceptions can be scuffle in the process of integrating information, hence alternative conceptions must be immediately identified, either by diagnosis or interview tests (Canu, Hosson, & Quque, 2016; Tortop, 2012). These problems have an impact on the objectives of this research.

The research aims to develop and to assess alternative conceptions of second year's Sundanese scholars on light wave with Multitier Open-ended Light Wave Instrument (MOLWI). The development of diagnostic instruments, such as MOLWI, is important because diagnostic tests on the concept of light waves are still difficult to find. The development was carried out on MOLWI in assessing alternative conceptions, starting with open-ended become close-ended instruments. The assessment is categorized based on predetermined criteria, and the results are analysed using Rasch analysis. Thus, the Sundanese-scholar conception of light waves and the comparison between conception, misconception, and the level of confidence they have can be detected.

Method

Reseach Model

The research method has been utilized by the 3D+1I model (Defining, Designing, Developing and Implementing). The defining stage has been done to literature studies about misconceptions on light waves. The designing stage is realized by designing content for each four-tier open-ended test. The developing stage is carried out to make the instrument from a four-tier open-ended test to four-tier close-ended. Finally, the implementing stage was used to test the four-tier open-ended instrument analysed using Rasch analysis.

Participants

Participants who involved in this research are 26 of second year's scholars (11 male students, namely "*Ujang*" and 15 female students, namely "*Eneng*", average age around 17 years of Sundanese tribe). The Sundanese tribe in question is the Ciamis area which is about 159 km from Bandung, the capital of West Java. Figure 1 shows a map distance Ciamis-Bandung in the main region of the Sundanese tribe of West Java and Banten, Indonesia.

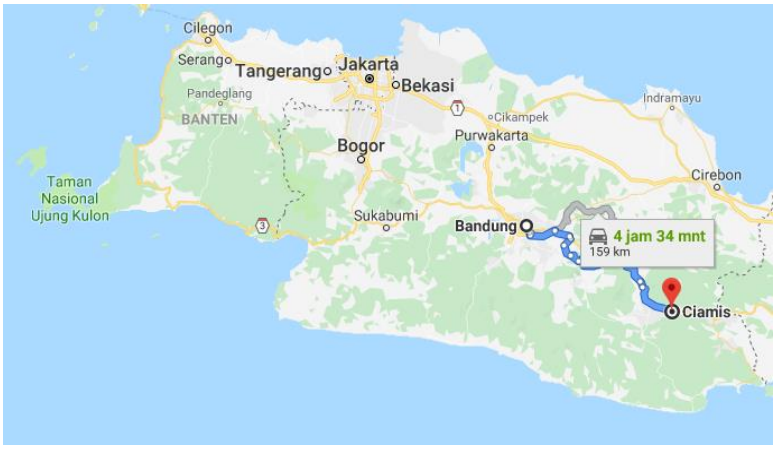

Figure 1

Map of the Ciamis-Bandung distance within the Sundanese Tribal Region (Source: https://www.google.com/maps/dir/bandung/ciamis)

Instrument

The instrument utilised in this research is Multitier Open-ended Light Wave Instrument (MOLWI) which consists of light wave material such as refraction, dispersion, diffraction, interference, and polarization. Whereas, the multitier in question is a multiple choice instrument with two levels of confidence in the second tier and fourth tier, and open-ended reason for the third tier.

Data Analysis

Data analysis was carried out in two stages. The first stage is the analysis of data by processing student answers based on the category of conception. The second stage is an analysis of data on conception, misconception, and level of trust, as well as a comparison of the three using Rasch analysis.

Analysis 1

Students' conceptions are categorized based on six categories of conceptions, Sound Understanding (SU), Partial Positive (PP), Partial Negative (PN), Misconception (MC), No Understanding (NU), and No Coding (NC). This category is a combination of the level of understanding by Coştu (2008), scoring by Kaltakci-

Gurel, Eryilmaz, & McDermott (2017), and concept category by Amalia et al. (2019). The level of understanding consists of Sound Understanding (SU), Partial Understanding (PU), Partial Understanding with Specific Misconception (PUSM), Specific Misconceptions (SM), and No Understanding (NU). We developed these categories in the Partial Understanding (PU) section into Partial Positive (PP) to show the correct answers in tier 1 and 3 but were not sure of either tier 2 or 4. Whereas we changed the Partial Understanding with Specific Misconception (PUSM) section become Partial Negative (PN) that shows the answer to the correct answer only in one tier 1 or 3, with varying levels of confidence. Then we added the No Coding (NC) section to indicate that the answers provided were incomplete. The categories of conception are shown in Table 1.

Table 1.

Categories of Conceptions

Tier	Category																
	SU	PP			PN								MC	NU			NC
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	C	C	C	C	C	C	C	C	I	I	I	I	I	I	I	I	IA
2	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	
3	C	C	C	C	I	I	I	I	C	C	C	C	I	I	I	I	
4	S	S	NS	NS	S	S	NS	NS	S	S	NS	NS	S	S	NS	NS	

*SU: Sound Understanding, PP: Partial Positive, PN: Partial Negative, MC: Misconception, NU: No Understanding, NC: No Coding, C: Correct, I: Incorrect, S: Sure, NS: Not Sure, IA: Incomplete Answer

Table 1 has been synchronized with assessments based on the research of Kaltakci-Gurel, Eryilmaz, & McDermott (2017). Then the data were processed through three assessments shown in Table 2, among them Understanding Scores (US), Misconception Scores (MS), and Confidence Scores (CS).

Table 2

Rating Category

Category	Coding	Description
Understanding Score	Only Tier 1 (USOT1)	Score 1 if the student's answer correctly in tier 1, and another the value is 0.

Category	Coding	Description
s (US)		
	Only Tier 3 (USOT3)	Score 1 if the student's answer correctly in tier 3, and another the value is 0.
	Only Tier 1 & 3 (USOT1&3)	Score 1 if the student's answer correctly in tier 1 and 3, another the value is 0.
	All Tier 1 – 4 (USAT1-4)	Score 1 if the student's answer correctly in tier 1 and 3, and sure for tier 2 and 4, another the value is 0.
Misconception Scores (MS)	Only Tier 1 (MSOT1)	Score 1 if the student's answer misconception in tier 1, and another the value is 0.
	Only Tier 3 (MSOT3)	Score 1 if the student's answer misconception in tier 3, and another the value is 0.
	Only Tier 1 & 3 (MSOT1&3)	Score 1 if the student's answer misconception in tier 1 and 3, and another the value is 0.
	All Tier 1 – 4 (MSAT1-4)	Score 1 if the student's answer misconception in tier 1 and 3, and sure for tier 2 and 4, another the value is 0.
Confidence Scores (CS)	Only Tier 1 (CSOT1)	Score 1 if the student's answer sure in tier 1, and another the value is 0.
	Only Tier 3 (CSOT3)	Score 1 if the student's answer sure in tier 3, and another the value is 0.
	Only Tier 1 & 3 (CSOT1&3)	Score 1 if the student's answer sure in tier 1 and 3, and another the value is 0.

The tier of trust is also adjusted to four categories, Confidence (C), Partial Confidence (PC), and No Coding Confidence (NC *), and No Coding. Table 3

shows the score of conceptions and misconception, and Table 4 shows the score of confidence.

Table 3.

The Score of Conceptions, Misconception, and Confidence

Categories	Score		
	Conception	**Misconception**	**Confidence**
Sound Understanding (SU)	4	0	-
Partial Positive (PP)	3	0	-
Partial Negative (PN)	1	1	-
No Understanding (NU)	0	3	-
Misconception (MC)	0	4	-
No Coding (NC)	(empty)	(empty)	(empty)
Confidence (C)	-	-	3
Partial Confidence (PC)	-	-	1
Not Confidence (NC*)	-	-	0

Empty scores in the No Coding (NC) category are intentionally made to identify score opportunities that can be achieved. This is the advantage of Rasch analysis. The Rasch analysis identifies the empty score, not as zero (0), but will be filled with scores from the average answers.

Analysis 2

In analysis 2, the data from the score of conception, misconception, and confidence were entered in the software of MINISTEP 4.3.1 to be analysed using Rasch analysis. The output tables used in this research is (Table 3.1) Summary Statistics and Tables (1) Variable (Wright) maps. The data used in Summary Statistics output is conception data. The aims to obtain person reliability, item reliability, and Cronbach alpha (KR-20). Person reliability shows the consistency of student answers. Likewise, item reliability shows the quality of the test items. While the data used in the output of Variable (Wright) maps are conception data, misconceptions, and levels of confidence. Then the results will be compared between the score of conception with the score of confidence, the score of misconception with the score of confidence, and finally the score of conception with the score of misconception.

Results

Instrument development is emphasized on alternative conceptions from student answers in MOLWI. Details on the stages of development by the 3D+1I model

(Defining, Designing, Developing and Implementing) and analysis will be discussed as follows.

Define

The instrument was initially tested during the Defining stage. The define stage is a literature study on misconceptions in light waves. This stage is used to find references from research. Once collected, we make instruments based on the references obtained and predictions that may occur later on light waves.

Design

This stage is an instrument design that will be used at MOLWI in assessing alternative conceptions, and the development design instrument from open-ended becomes close-ended. MOLWI is a four-tier open-ended instrument. The first tier is ordinary multiple choice, while the second tier, the choice is about confidence, with two choices "Sure" and "Not sure". The third tier in four-tier open-ended is the reason students must fill because they have no choice in this tier. While the fourth tier is the tier of confidence like the second tier. Whereas the four-tier close-ended instrument has a structure like four-tier open-ended, except that the third tier has a choice so the answer is closed. The designs four-tier open-ended and four-tier close-ended instrument shown in Figure 2.

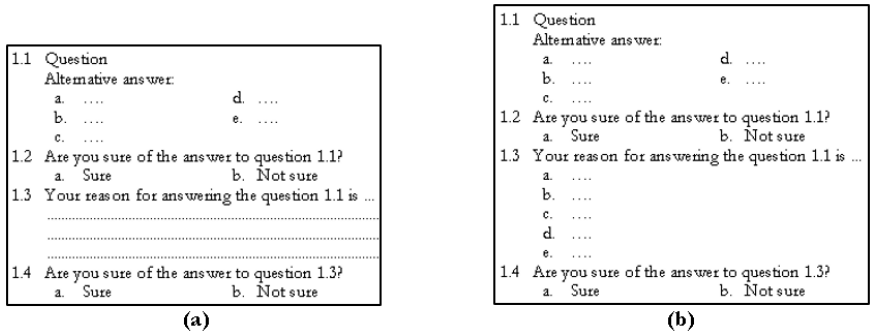

Figure 2

(a) The Design of Four-tier Open-ended Instrument, (b) The Design of Four-tier Close-ended instrument

Develop

At the Development stage, open-ended four-tier instruments will be converted into close-ended four-tier. The open-ended four-tier instruments contain 15 items of four-tier instruments were named the Multitier Open-ended Light Wave Instrument (MOLWI). This stage was carried out to explore alternative conceptions of students with open answers in the third tier. The example development of MOLWI shown in Figure 3. Furthermore, the alternative conception obtained will be an option on the third tier of the close-ended four-tier instrument.

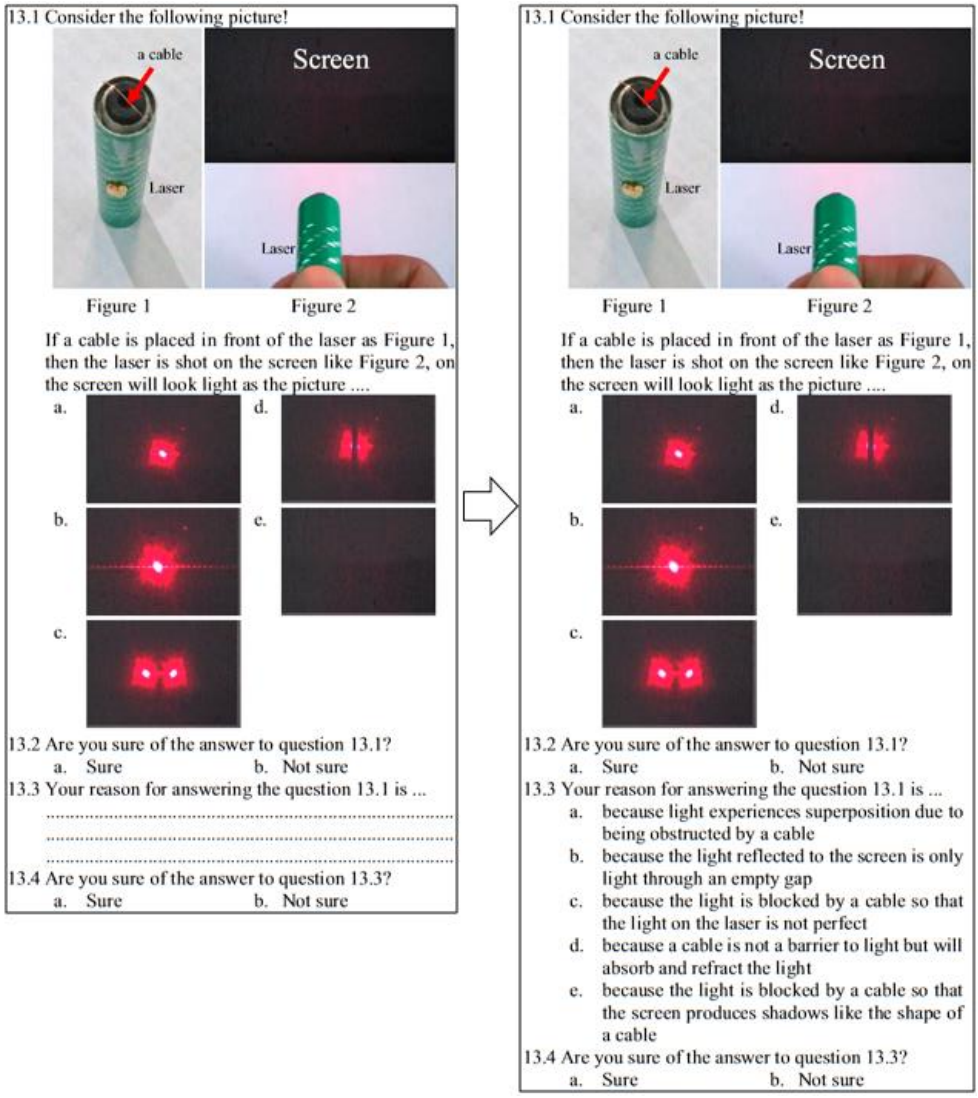

Figure 3.

The Example Development of Multitier Open-ended Light Wave Instrument (MOLWI) to Close-ended

Implementing

The implementing is a concrete stage to apply the instrument that has been made. The results are then analysed through two stages of analysis. The first analysis calculates the percentage of each conception category. Thus, students' conceptions can be distributed based on the categories that have been made. The second analysis is a description of conception, misconception, and level of confidence, as well as a comparison using Rasch analysis. The aim is to identify the level of confidence students have and their comparison with abilities and their potential for answers to

misconception on MOLWI. Figure 4 shows the percentage of conception categories for each MOLWI item.

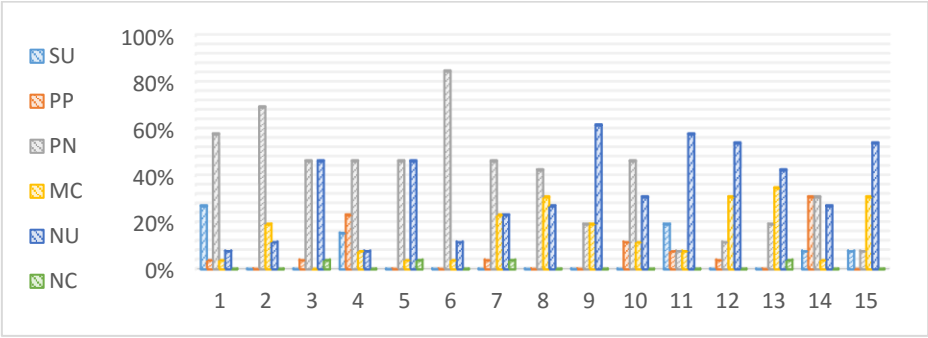

Figure 4.

Percentage Categories of Conceptions

The result is Sound Understanding (SU) category highest in number 1 (27%) and the lowest in numbers 2, 3, 5, 6, 7, 8, 9, 10, 12, and 13 (0%). The Partial Positive (PP) category highest in numbers 14 (31%) and the lowest in numbers 2, 5, 6, 8, 9, 13 and 15 (0%). The Partial Negative (PN) category highest in numbers 6 (85%) and the lowest in numbers 11 and 15 (8%). The Misconception (MC) category highest in number 13 (35%) and the lowest in number 3 (0%). The No Understanding (NU) category highest in number 9 (62%) the lowest in numbers 1 and 4 (8%). The last category No Coding (NC) highest in numbers 3, 5, 7 and 13 (4%) and the others (0%).

The analysis uses the score of conception, misconception, and confidence to determine the extent of students' beliefs in answering MOLWI. Previously the score of conception data was used to identify Person Reliability, Item Reliability, and Cronbach alpha of MOLWI instrument shown in Figure 5.

INPUT: 26 Person 15 Item REPORTED: 26 Person 15 Item 5 CATS MINISTEP 4.3.1

SUMMARY OF 26 MEASURED Person

	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	11.5	14.8	-1.34	.37	1.10	.22	1.07	.20
SEM	1.2	.1	.15	.03	.10	.16	.11	.19
P.SD	5.8	.5	.76	.16	.52	.80	.54	.93
S.SD	5.9	.5	.78	.16	.53	.81	.55	.95
MAX.	27.0	15.0	-.10	1.05	2.57	1.77	2.45	2.35
MIN.	1.0	13.0	-4.12	.24	.34	-1.28	.42	-1.24

REAL RMSE	.45	TRUE SD	.62	SEPARATION	1.38	Person	RELIABILITY	.66
MODEL RMSE	.40	TRUE SD	.65	SEPARATION	1.62	Person	RELIABILITY	.72
S.E. OF Person MEAN = .15								

Person RAW SCORE-TO-MEASURE CORRELATION = .89

CRONBACH ALPHA (KR-20) Person RAW SCORE "TEST" RELIABILITY = .66 SEM = 3.41

SUMMARY OF 15 MEASURED Item

	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	20.0	25.7	.00	.30	1.12	.14	1.07	.19
SEM	3.6	.1	.23	.03	.20	.41	.13	.30
P.SD	13.6	.4	.86	.11	.75	1.52	.49	1.14
S.SD	14.1	.5	.89	.12	.77	1.57	.50	1.18
MAX.	46.0	26.0	1.45	.50	3.33	3.07	1.97	1.97
MIN.	5.0	25.0	-1.24	.17	.26	-2.74	.33	-1.98

REAL RMSE	.37	TRUE SD	.77	SEPARATION	2.07	Item	RELIABILITY	.81
MODEL RMSE	.32	TRUE SD	.80	SEPARATION	2.50	Item	RELIABILITY	.86
S.E. OF Item MEAN = .23								

Figure 5.

Summary Statistics on Rasch Analysis

Figure 5 shows the value of person reliability .66 and .72, which the reliability for a person included in the sufficient category. While the value of item reliability .81 and .86, which the test item has reliability in a good category. Finally, the Cronbach alpha value of .66 included the sufficient category.

The other analysis relates to the score of conception shown in Figure 6.

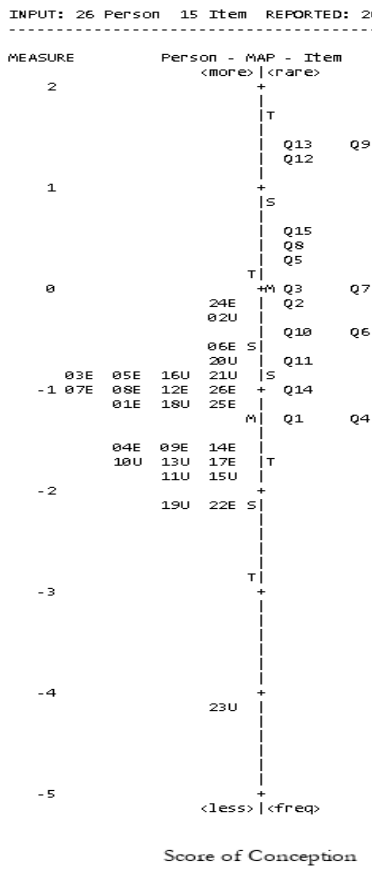

Figure 6.
Score of Conception

The score of conception shows the students of 24E (Eneng or Female) have the highest ability and the lowest ability is 23U (Ujang or Male). However, despite the highest ability of 24E below Q3 (Question 3), thus 24E answer questions from Q2 to the bottom. While 23U, their abilities under all questions. The questions with the lowest are Q1 and Q4, hence students with the ability below are certainly not able to answer all the questions. The other information provided is the hardest question for Q13 and Q9. In this case, there is actually no student who has the ability to answer it.

Analysis scores of misconception were conducted to determine the potential misconceptions students have to answer MOLWI questions, the result shown in Figure 7.

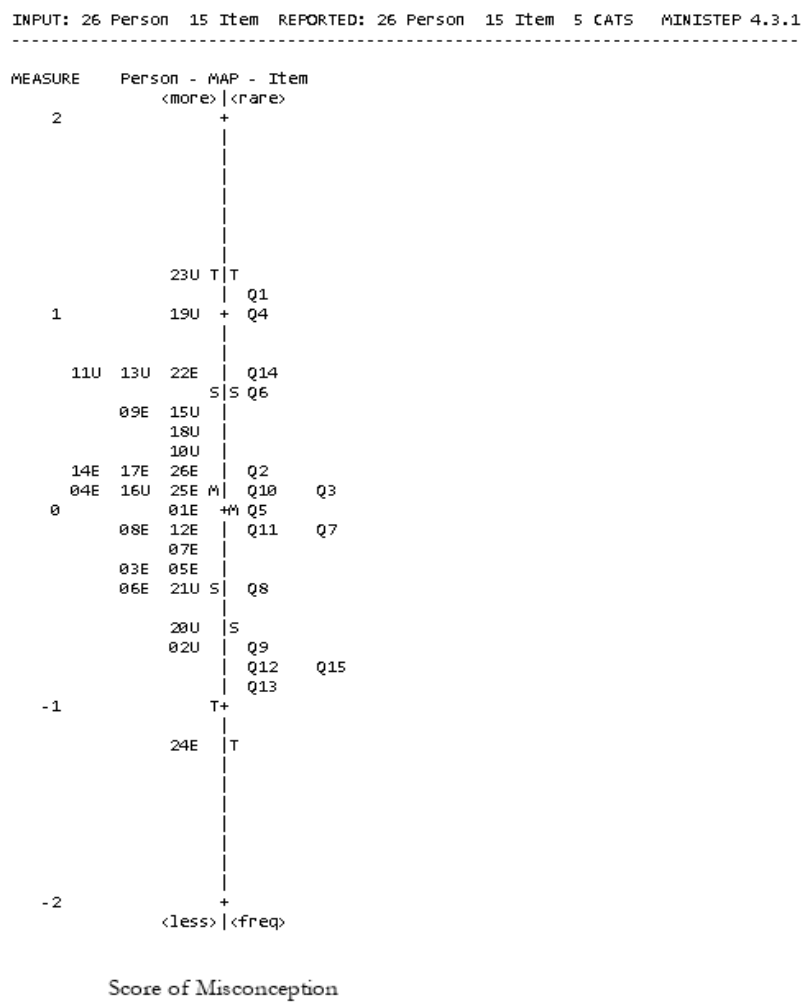

Figure 7.

Score of Misconception

Figure 7 shows 23U have the highest potential for misconception, while 24E at the bottom from potential misconception. Student of 23U has the potential misconception for all questions. Different from 24E because their position is below questions Q13. The question of Q13 have good quality in terms of misconceptions. Almost all students answer misconceptions in their question, except students 24E. Whereas Q1 questions are the least answered questions with misconceptions, except by 23U.

Analysis of score of confidence to see the extent to which students believe in their abilities. Students with high ability will see the level of confidence, likewise for the level of misconception. The analysis score of confidence shown in Figure 8.

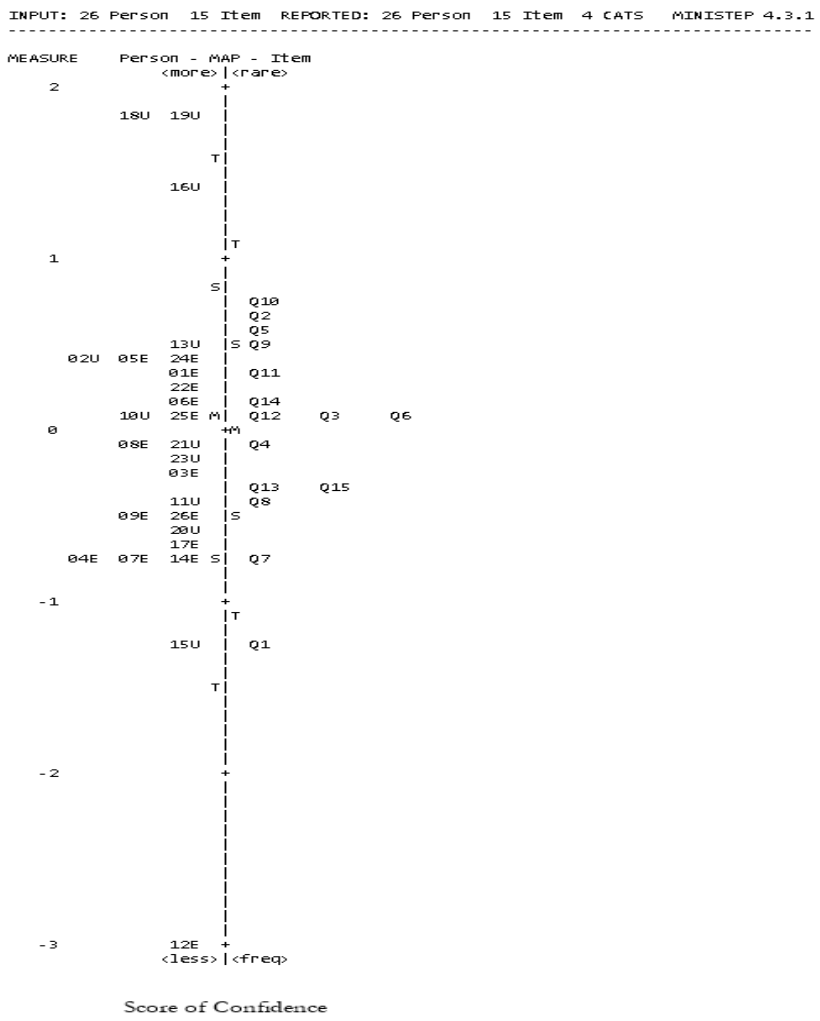

Figure 8.

Score of Confidence

Figure 8 shows the level of confidence. Students of 18U and 19U have a high score of confidence, while 12E has a low. Students of 18U and 19U have the ability to believe all the answers given to each MOLWI question. While 12E tends to be unsure of all the answers given. In terms of questions, the questions of Q10 have the least confidence level, except by 18U, 19U, and 16U. Whereas Q1 questions are the questions most believed by all students, except 12E.

Based on the information obtained, we found a comparison between students' conception with the level of confidence from the score of conception and score of confidence. Comparison between students' conception and the level of confidence shown in Figure 9.

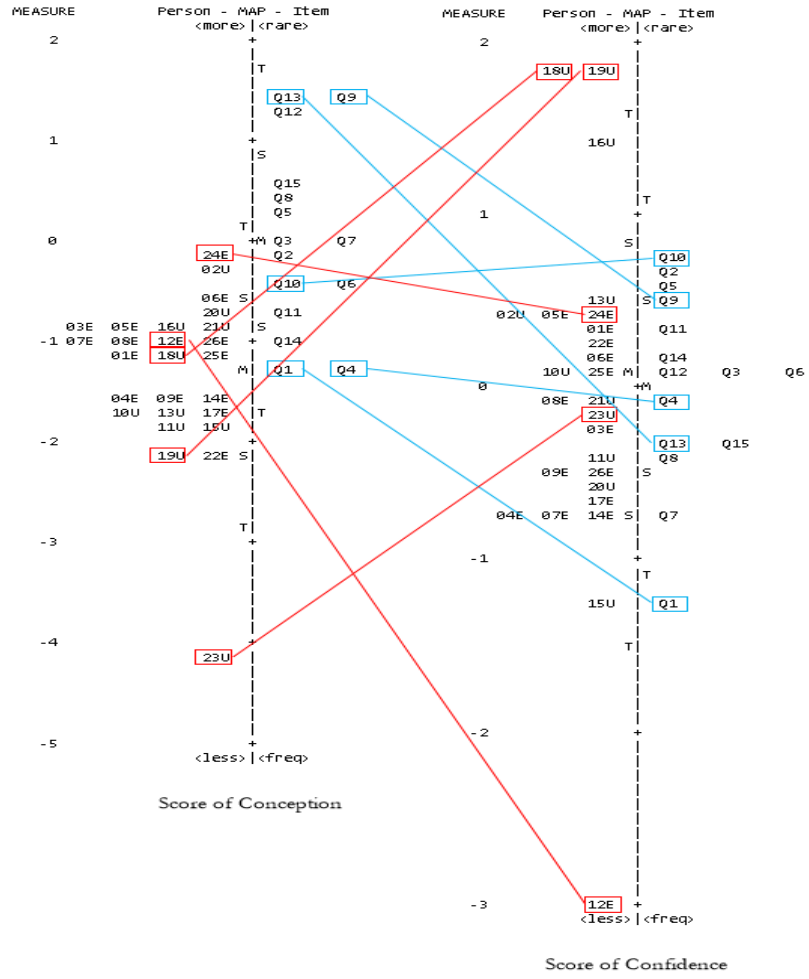

Figure 9.

Comparison Score of Conception and Score of Confidence

Figure 9 shows a comparison between the level of students' ability to answer MOLWI questions and their level of confidence. The red line shows the relationship between people, and the blue line shows the relationship between items. We find that 24E has the highest ability compared to others, but it is not proportional to the level of self-confidence. Student of 18U, which has a high level of confidence, its ability is below 24E. Especially 19U, with a high level of confidence but its ability is in the last two positions with 22E. Likewise, the level of ability 23U is low but the level of confidence in the middle position. While 12E has a low level of confidence, but its ability in the middle position.

In terms of questions, the question of Q13 has the highest level of difficulty but the level of student confidence in answering in the third position from the bottom. This means most students are sure of the answers they give. Whereas Q9 has a high

level of difficulty but almost all students are not sure of the answer. Q1 questions have the lowest difficulty level and all students are sure of the answer. Question Q4 with a low level of difficulty and only a few students are sure of the answer.

Another comparison is the comparison between students' misconception and the level of confidence from the score of misconception and the score of confidence shown in Figure 10.

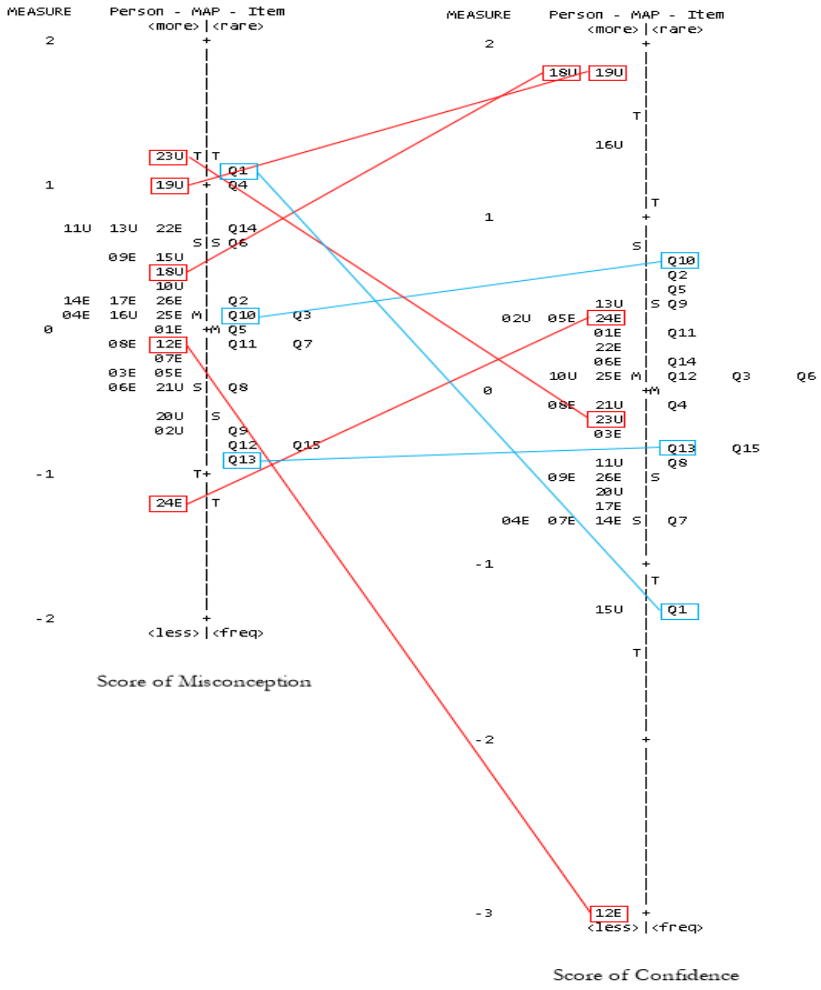

Figure 10.

Comparison Ccore of Misconception and Score of Confidence

Figure 10 shows a comparison between the score of misconception and a score of confidence when answering MOLWI. We find that 23U misconceptions are of the highest value compared to others, but not comparable to the level of confidence in the middle position. An interesting thing was pointed out by 19U, with a high

level of confidence but the answers are given were almost all misconceptions, below 23U. While 12E has a low level of confidence but the answer to misconception is in the middle position.

In terms of questions, the question of Q1 have rarely answered misconceptions and all students answered confidently except 12E. Whereas the Q13 question was answered by a misconception by all students except that 24E and answered with a confidence level in the middle position. The question answered no confidence is question Q10 with the position of misconception in the middle position.

Other comparisons between students' conception and the level of misconception from the score of conception and the score of misconception shown in Figure 11

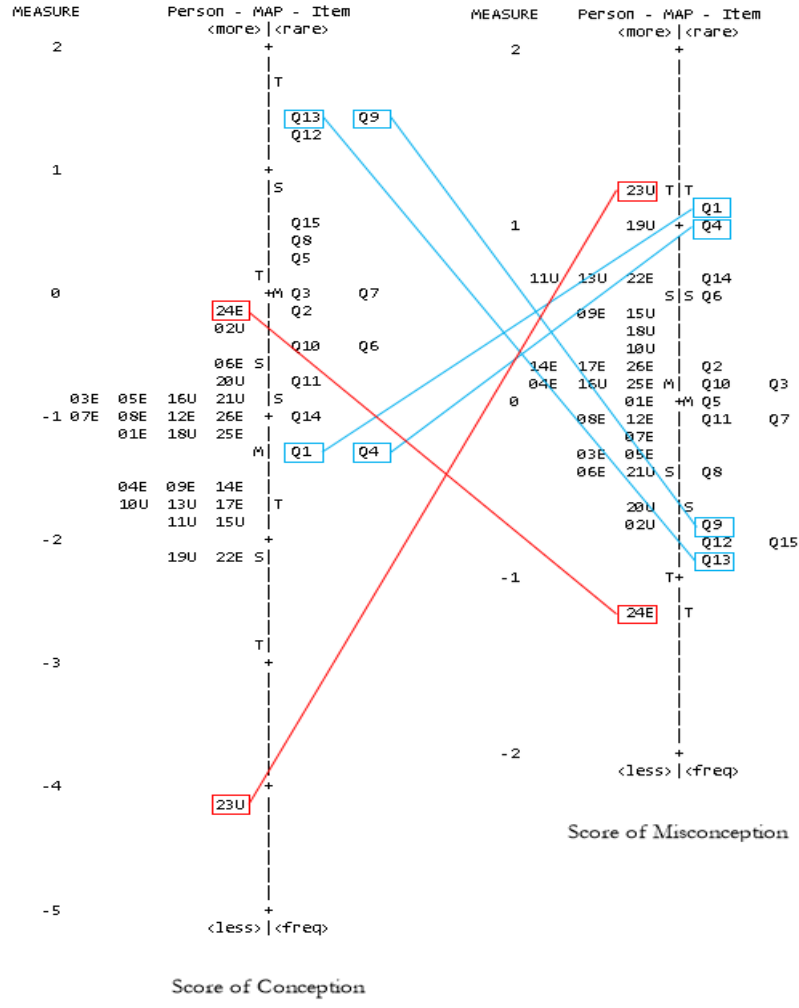

Figure 11.

Comparison Score of Conception and Score of Misconception

We find regularity that 24E has the highest value compared to others and the lowest level in terms of misconception. While 23U has a low level of ability and are at the highest level in terms of misconception.

In terms of questions, the questions of Q13 and Q9 have a high degree of difficulty and most students answer with misconceptions. Whereas questions Q1 and Q4 have a low level of difficulty, rarely answered with misconceptions except for 23U.

Comparison of three scores analysed by Rasch analysis (score of conception, misconception, and confidence) resulted in e*neng* having the highest ability and *ujang* having the lowest ability. But this ability is inversely proportional to the level of confidence. Students with high abilities are clearly in the middle level of confidence adjacent to students with the lowest ability. Whereas between misconceptions and self-confidence levels are directly proportional. *Ujang* with a high potential for misconception has a high level of confidence, and *eneng* with the potential for low misconception has a level of confidence in the middle position.

In terms of questions, questions that are difficult to answer with a lack of confidence and questions that are easily answered with confidence. Whereas the questions answered with misconceptions are just as sure as the answers, such as questions that haven't potential for misconception.

Discussion and Conclusion

Light is the most important physics concept that can be found in everyday life. Without understanding the concept of light and its characteristics, students should not understand many scientific domains in physics (Djanette, Fouad, & Djamel, 2013). Some characteristics of light include reflection, refraction, and dispersion. However, other characteristics such as diffraction, interference, and polarization are considered foreign terms because they are rarely used, although the phenomenon can be found in everyday life. Even light can be considered a wave because of these characteristics. Thus, students' potential to have various alternative conceptions if related to these terms.

This research shows that students have alternative conceptions with the highest percentage of 35% in question number 13, the question of interference when a laser is blocked by a cable. Most students answer with wrong answers but are sure of the answers given, thus entering the MC category. Students are stuck with the concept that light travels in a straight direction. Whereas when the light passes through a small obstacle (cable), the pattern that will be seen is not the shadow of the cable, but the light-dark pattern will appear due to interference. This research is relevant to Coetzee & Imenda (2012) that students have various alternative conceptions on the concept of interference. Likewise, the research of Djanette, Fouad, & Djamel (2013) which states that after nearly 30 years of researching on student

misconceptions about light and optical phenomena shows there are still misconceptions that can be detected. Furthermore, Rasch analysis is used to explain data about conception, misconception, and level of confidence.

Based on Rasch analysis, the values of Person Reliability and Item Reliability in sequence are .64 - .71 and .81 - .86. Whereas Cronbach alpha is .62. These results can be categorized sufficient for the measure of reliability. Person reliability and item reliability values from 0 to 1 and can be interpreted much like a Cronbach's alpha, meaning that values closer to 1 indicate a more consistent measure (Boone & Noltemeyer, 2017). Furthermore, Rasch analysis explains that the level of confidence of Sundanese-scholars is inversely proportional to their abilities and directly proportional to the level of misconception. These results are obtained from the output of Variable (Wright) maps in MINISTEP 4.3.1 software. Boone & Noltemeyer (2017) revealed the wright map supports researchers to measure the strengths and weaknesses of instruments, document the grading of item test, compare theory to the experimental data, and provide guidance to researchers. In terms of instruments, the difficulty level of the question is inversely proportional to the level of confidence. Questions that are difficult to answer with not confidence, while questions easily answered with confidence. For questions that have the potential for misconception answered doubtfully and questions that aren't misconceptions are answered with confidence. Thus the Sundanese-scholars simply answer confidently on easy questions and not misconceptions.

This finding is interesting because each region or tribe potential to have different characteristics. Culture has an impact on beliefs related to natural phenomena, but does not affect the making of concepts because alternative conceptions appear to be universal (Tortop, 2015; Kurnaz & Arslan, 2011; Thijs & Van Den Berg, 1995). Furthermore, Suprapto (2019) stated that Indonesian physics education researchers have great potential in conducting research because of the demographic location and local wisdom that have a positive impact in supporting research. This is a suggestion for further research relating to alternative conceptions in areas with different tribes or cultures. The assessment of alternative conceptions for several regions can be realized by developing similar instruments. Meanwhile, the instrument used in this research can be a recommendation to find out the students conceptions concerning light wave material.

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