Uyo and nanu misconception investigation (UNAMI) on sound-light waves materials in North Sulawesi.

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Abstract. Online learning amid the pandemic made students and teachers incapable to carry out face to face teaching and learning activities. This study aims to measure the state of the conception of students in Mongondow tribe with sound and light waves as material. The research method used descriptive quantitative method. The study was conducted on 67 students (22 male students called Uyo and 45 students who were usually called Nanu). Samples came from three Senior High School in Kotamobagu. The diagnosis of misconceptions was carried out using a four tiers diagnostic test instrument. The analysis in this study used the Rasch analysis. The results of the diagnosis appear that 16% of students in Senior High School in Kotamobagu have misconceptions on the material of sound and light waves especially on interference concept and characteristic sound wave, 39% of students who get it partially understand the concept, only 15% of students who understand it, and 24% of students who don’t understand the concept. Based on this research, it is known that the level of misconceptions and partial negative understand of students is low and medium category.

1. Introduction
Misconceptions in physics education apply only to the physics items. These reflect students’ incorrect preconceived ideas approximately a physics concept, ordinarily based on their experiences or perceptions of physics phenomena in daily life [1].

Physics misconceptions (counting those related to gravity) held by students of varying ages have been studied broadly. Past research has included investigations of primary, secondary, and college students [2][3], as well as pre-service teachers[4].

Many researchers found that misconception in physics phenomena inferred from extensive personal experience that students may create before they indeed enter the classroom [5]. Many of those convictions are misconceptions conflicting with logical clarifications. Moreover, they are difficult to beat and may inhibit students from understanding and applying more advanced physics concepts just in case not addressed early. Few diagnostic tests have been developed to measure the misconception of physics material, for example development multiple-choice items to track student misconceptions relating to “common sense beliefs” [6], development 1 tier, 2 tiers, 3 tiers, 4 tiers, and multitier instrument tests [7][8]. There are many studies related to misconceptions of physics. One of them is the misconception on different physics concepts.

A few of the physics concepts that are carried out by misconceptions are: simple electric circuit [9], refraction[10], and light wave concept [8]. Light waves are a material that has the same basic competence as sound wave material in Indonesia curriculum. Sound and light waves are in the same basic competency but different subject matter.
The sound waves produced by a vibrating object are compression waves. Sound waves can only travel through matter. Sound waves are longitudinal waves which vibrate in the same direction as the direction of propagation [11]. Speed of Longitudinal wave is:

$$v = \sqrt{\frac{\text{elastic fore factor}}{\text{inertial factor}}}$$  

Light is an electromagnetic wave. Electromagnetic waves are waves that can propagate by moving through matter or pure space, light travels through matter, interacts with atoms and particles in matter and slows down. Some of the properties of light are reflection, refraction, and dispersion [12][13]. In light wave material students also have misconception with the concept.

Many things are being done to help remediate misconceptions. Such as: development of learning models, instructional media, conceptual change text, and conceptual change labs[13][14][15]. In any case, before giving remediation of misconceptions in the form of good deeds, to begin with, check the level of misconceptions of students. So that it can be used as a benchmark for improvement after being given treatment or teaching materials to remediation the misconception. This research aims to measure the state of the conception of students (Uyo and Nanu) in Kotamobagu amid online learning during the pandemic with sound and light waves as material. This research special for Mongondow tribe in North Sulawesi, since each region or tribe can have different characteristics and research about misconceptions in this tribe are still lacking. Below is the framework that used in this research.

![Figure 1. How to Measure Misconception on Mongondow Tribe](image)

2. Method

2.1. Participant

The subjects are students who have studied about light and wave material. These samples came from three senior high school in Kotamobagu, North Sulawesi. The study was conducted on 67 students, 22 male students called Uyo and 45 female students called Nanu’, from Mongondow tribe. The Mongondow tribe in question could be a tribe within the Kotamobagu area, which is 207 km from Manado. Figure 2 could be a map showing the distance between Manado-Kotamobagu, in the main region of the Mongondow tribe in North Sulawesi, Indonesia.
Figure 2. Map of the Kotamobagu-Manado, inside the Mongondow Tribal Region
(Source: https://www.google.com/maps/dir/kotamobagu/manado)

2.2. Research Design

This research used descriptive quantitative method that aims to measure the state of the conception of students in Kotamobagu amid online learning during the pandemic with sound and light waves as material. The subunits in this study were students in grade 11th or 12th with a case focus of misconception. Student’s misconception is measured using four tiers diagnostic test instrument. The analysis in this study used the Rasch analysis. The results obtained were then analyzed to see the extent to which students’ understand and which students’ misconception in sound and light wave material.

2.3. Instrument

The instruments are six number used four tiers test. The instrument used has been analyzed using Rasch analysis with Cronbach alpha is .79 high category. Person Reliability is .60, Item Reliability is .94. Figure 3 is an example of a four-tier sound-light wave instrument utilized in this research.

| Figure 3. Example of Four Tiers Sound-Light Wave Instrument | Figure 3. Example of Four Tiers Sound-Light Wave Instrument |
|-------------------------------------------------------------|-------------------------------------------------------------|
| Below are the possible mediums for sound propagation         | Below are the possible mediums for sound propagation         |
| 1. Solids                                                   | 1. Solids                                                   |
| 2. Vacuum Space                                             | 2. Vacuum Space                                             |
| 3. Gas                                                     | 3. Gas                                                     |
| 4. Plasma                                                   | 4. Plasma                                                   |
| 5. Liquid                                                   | 5. Liquid                                                   |
| 1.1 Through what medium can sound propagate ...             | 1.1 Through what medium can sound propagate ...             |
| A. 1, 2, and 3                                             | A. 1, 2, and 3                                             |
| B. 1, 3, and 4                                             | B. 1, 3, and 4                                             |
| C. 2, 3 and 5                                              | C. 2, 3 and 5                                              |
| 1.2 Are you sure for the answer question to 1.1?           | 1.2 Are you sure for the answer question to 1.1?           |
| a. Sure                                                    | a. Sure                                                    |
| b. Not Sure                                                | b. Not Sure                                                |
| 1.3 Your reason for answering the question 1.1 is...        | 1.3 Your reason for answering the question 1.1 is...        |
| A. Since sound waves propagate within the form of compression and rarefaction | A. Since sound waves propagate within the form of compression and rarefaction |
| B. Because sound waves propagate within the frame of compression without rarefaction | B. Because sound waves propagate within the frame of compression without rarefaction |
| C. Since sound waves are included within the type of transverse waves | C. Since sound waves are included within the type of transverse waves |
| D. Since sound waves are included within the type of electromagnetic wave | D. Since sound waves are included within the type of electromagnetic wave |
| E. Since sound waves have a vibrating direction that’s perpendicular to the direction of propagation | E. Since sound waves have a vibrating direction that’s perpendicular to the direction of propagation |
| 1.4 Are you sure of the answer to question 1.3?             | 1.4 Are you sure of the answer to question 1.3?             |
| A. Sure                                                    | A. Sure                                                    |
| B. Not Sure                                                | B. Not Sure                                                |
2.4. Data Analysis

The data investigation was conducted in two phases. The main phase is the investigation of information by processing student according to the category of conception. The second phase is an investigation of information about conceptions, misconceptions, and levels of belief, and a comparison the three (conceptions, misconception and levels of believe) using the Rasch investigation [8].

First Stage, analyse student answers. Students’ answers are grouped into six types, specifically Misconceptions (MC), Sound Understanding (SU), Partial Positive (PP), Partial Negative (PN), No Understanding (NU), and No Coding (NC). This category of conception was developed by Aminudin et al [9]. The utilize of this category is to make scoring easier before analyzed using the Rasch model. There are two tables, Rating Category on Table 1 and Table 2 for the Score of Conceptions and Misconception. The first step is get the score from Table 1 and interpret using Table 2.

Table 1. Rating Category from MOLWI Instrument.

| Category | Coding | Description |
|----------|--------|-------------|
| Understanding Scores (US) | Only Tier 1 (USOT1) | Score 1 if the student's answer is accurately in tier 1, and the other score is 0 |
| | Only Tier 3 (USOT3) | Score 1 if the student's answer is accurately in tier 3, and the other score is 0. |
| | Only Tier 1 & 3 (USOT1&3) | Score 1 if the student's answer accurately in tier 1 and 3 and the other score is 0. |
| | All Tier 1 – 4 (USAT1-4) | Score 1 if the student's answer accurately in tier 1 and 3, and the other score is 0. Beyond any doubt for tier 2 and 4, and the other score is 0. |
| | Only Tier 1 (MSOT1) | Score 1 if the student's answer misconception in tier 1, and the other score is 0. |
| Misconception Scores (MS) | Only Tier 3 (MSOT3) | Score 1 if the student's answer misconception in tier 3, and the other score is 0. |
| | Only Tier 1 & 3 (MSOT1&3) | Score 1 if the student's answer misconception in tier 1 and 3, and the other score 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, and the other score is 0. |

Table 2. Conception and Misconception Scores

| Categories | Conception | Misconception |
|------------|------------|---------------|
| SU Sound Understanding | 4 | 0 |
| PP Partial Positive | 3 | 0 |
| PN Partial Negative | 1 | 1 |
| NU No Understanding | 0 | 3 |
| MC Misconception | 0 | 4 |
| NC No Coding | (empty) | (empty) |

An empty score within the No Coding (NC) category is intentioned made to identify the possible score that can be accomplished when using Rasch analysis.

Equation (2) was occupied to analyse the students answer.

$$PJ = \frac{n_j}{n_i} \times 100\%$$  \hspace{1cm} (2)
where \( PJ \) is the answers \% on each concept; \( n_x \) is the number of students grouped as SU, PP, PN, NU, MC, NC, while \( n_s \) is the total number of participants (67).

Second stage, the data from the score of conception and misconception were entered in the program of MINISTEP 4.8.2 to be analysed utilizing the Rasch analysis. The output tables utilize in this investigation are Summary Statistics and Variable (Wright) maps. The information utilized in statistic summary output is conception data, to obtain person reliability, item reliability, and Cronbach alpha (KR-20). Person reliability can be seen from the consistency of student’s answers. Item reliability appears in the quality of the test items. While the information utilized within the output of variable (Wright) maps are conception information and misconceptions [9].

3. Result and Discussion

3.1. Percentage of Conception Categories

Figure 3 is the representation of the result of percentage conception category of UNOMI.

![Figure 3. Percentage of Conception Category](image)

The result is Misconception in Highest category in number 6 (43\%) and the lowest is number 3 (1\%). The Sound Understanding (SU) category highest in number 3 (28\%) and the lowest on this category is number 6 (3\%). Another category is partial positive understanding. The highest score on Partial Positive Understanding (PP) is number 1 (12\%) and the lowest is number 6 (0\%). The fourth category is partial negative understanding. Number 3 (57\%) is the highest score on Partial Negative Understanding (PN) and the lowest is on number 4 (27\%). The fifth category is No Understanding (NU), on this category the highest score is number 2 and 4 (36\%) and the lowest is number 1 (12\%). And the last category is no coding, the highest score in this category is number 4 (3\%) and the lowest is number 5 (0\%). The investigation uses conceptions and misconceptions scores. Previously, the conception information score was used to identify Person Reliability, Item Reliability, and Cronbach alpha of this instrument.

3.2. Score of Conception and Misconception

Figure 4 shown the highest score in the conception category was achieved by 19 U (Uyo or male students) whereas the lowest scores in this category were obtained by 10 U and 20 U. In the conception category both the highest and lowest scores were obtained by male students (Uyo). 19 U students can answer all questions with the right and confident conception. He can answer from the easiest questions to the most difficult questions. While 10 U and 20 U their abilities are below from the question.
In addition to analyzing students' conceptions, the data obtained can also be used to analyze students that potential have misconceptions. Figure 5 The Result Misconception Score Using Rasch Analysis. Based information on the Figure 5, 20 U (Uyo/male student) has the highest score and the highest potential for misconception for all questions while the lowest score of misconception have achieved from 19U and 8 N (Nanu/female student). Student of 19 U, 8N, 35 N, 5N, 7N, 43 N has the potential for understanding the concept well, because their position is below questions Q6. Q6 has good qualities in terms of misconceptions. Many students answered misconceptions in their questions, with the exception of some students 6 Nanu (8N, 35 N, 5N, 7N, 43 N) and 1 Uyo (19 U). Questions 3 (Q3) answered at least with misconceptions, except for four students (20 U, 10 N, 11 N, 34 N) who answered with a misconception.

This research shows that from six numbers, students have category misconception in every number. There are two material, sound wave and light wave. In light wave, the highest alternative conception is number 6 around 43%. The question was about light wave especially interference concept. Most of the students answer with wrong answers but they are sure of the answers given and therefore fall into the MC category. Students are caught up in the concept that light travels in a straight line, most students choose that the light is blocked by wires so that the screen produces a wire-like image. This research relevant with Adam et al and Cotzee & Imenda [9]

Meanwhile in sound wave, most of student have highest alternative conception on number 2 around 16%. Question 2 ask about characteristic of sound wave. Most of students choose polarization is one of the characteristics of sound wave, and it's a wrong answer, but they choose sure at confidence tier.

The results show the need for innovations learning to improve conceptual understanding and decrease misconceptions about sound and light wave material that occurred during the learning process, especially in Kotamobagu, North Sulawesi.

4. Conclusion
This finding shows the measurement of conception condition in every category. The highest alternative conception in this research is on number 6 about interference concept around 43% and the lowest alternative conception is on number 3 about physics quantities in sound wave around 1 %. This research has a relation with tribe, because each region or tribe can have different characteristics.

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