Analyze of conceptions and misconceptions on pre-service teacher about light

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Abstract. The purpose of this study is to define a description of the various conceptions and misconceptions of pre-service teacher about the concept of light in basic physics courses. This research was conducted on 96 students of basic physics teacher candidate in one of state universities (PTN) in Makassar. The mixed method was used in this study. Data collection in this research is through observation, test, analysis of test results, limited interviews, and analysis of data by quantitative and qualitative. The result of this research is found the misconception of physics pre-service teacher about the physics concepts, especially about the light concept. This shows that the low understanding of the concept of pre-service teacher to the basic concepts of physics, causing misconception. Therefore, that misconceptions are define an information to develop a continuous research that can contribute to improving the quality of teachers’ candidates, especially physics teachers who will give a positive impact on improving the quality of education, especially in Indonesia by developing a programming of basic physics course oriented conceptual change to eliminate a misconception on physics teacher candidates.

1. Introduction
1.1. Background
Until now, physics is still a material that is considered difficult and unpleasant to learn, both for students at the elementary, middle to university level [1-3]. The factor behind the students' difficulties in understanding physical material is the lack of understanding of the concept due to the poor quality of teaching and learning [4-8]. Lack of understanding of concepts supported by poor quality teaching and learning leads to misconceptions of the material being studied [9-11]. This is because each student already has a previous conception related to a particular material. Those responsible for the quality of teaching and learning are teachers. Teachers as educators are graduates from teacher training colleges who must have competence as professional teachers, one of which is pedagogic competence [12,13].

Pedagogic competence is the ability of a teacher's knowledge, including understanding of students, designing and implementing of learning, evaluating learning outcomes and developing students to actualize their various potentials. Pedagogic competence referred to in the Law of Teachers and Lecturers UU No.14 Tahun 2005 pasal 10 ayat 1, is the ability to manage student learning. The most important thing to create an effective teaching and learning process is that the teacher must have the correct understanding of the concept and of course must be in accordance with the scientific concept. However, in reality there are still physics teachers who have misconceptions about certain material. The
teacher’s misconception is most likely to occur when the teacher is still a student teacher candidate in college. Thus, it is very important to provide concept understanding to pre-service teacher to prepare professional teacher candidates especially for physics teachers. Understanding students as pre-service teachers in mastering the concepts of physics will influence the achievement of educational goals in the teaching and learning process. As a teacher, the understanding concepts is important and that are in accordance with scientific concepts. The basic concept that is very important for pre-service teacher is the concepts discussed in the basic physics course.

Basic Physics is one of the compulsory subjects for pre-service teacher at the LPTK and courses given in the first semester because these courses are a requirement for the next course [14] and basic material to be taught at junior high school and school level upper middle class. Basic physics courses also underlie the development of engineering, design, planning, technology and have an important role in various disciplines as well as developing human thinking power. The purpose of holding Basic Physics II lectures in the physics education study program curriculum at the physics education department at one of the LPTK in Makassar is to explain the basic concepts related to the subject matter, develop the concept of the concept as the basis for the next concept, and apply it in daily life. To achieve this goal, one of the competencies that must be developed in the basic physics lectures is understanding the concept (understanding concept). The National Research Council describes the implementation of the NSES (National Science Education Standards) which confirms the acquisition of scientific knowledge and the development of understanding. Scientific knowledge includes facts, concepts, principles, laws, theories, models and which can be obtained in many ways.

The understanding includes the ability to use knowledge, and understanding requires the ability to distinguish between those which include scientific ideas and those that are not scientific ideas. Developing understanding means that students can relate scientific ideas and experiences that are shared with the surrounding natural environment. It can be said that learning should move and focus on understanding concepts. However, in reality Basic Physics is one of the subjects that students find difficult. This is because in certain concepts on Basic Physics involves complicated mathematics [15,16]; too much material, depends on textbooks, abstracts and complexes; requires laboratory activities; and frequent misconceptions [17-19].

One material that is difficult to understand in basic physics is the concept of light. This is found in several studies conducted in science education that both students, pre-service teachers, and teachers have the wrong conception of the concept of light. According to the results of the preliminary research found the conceptions of physics pre-service teacher related to the light concept by using Three Tier Test found a lack of understanding of the physics concept on light topics as follows: the concept of a large angle of reflection equal to the angle of arrival; the concept of the procedure of using a comparison of shadows to the distance from the point of the light source; the concept of the procedure for using the angle of incidence ratio is the same as the angle of reflection of the beam; the concept of forming shadows on flat mirrors; the concept of the shadow properties of objects on a flat mirror [20,21]; the Law’s concept of reflection, as found in previous studies that most students have a hierarchy of knowledge that is wrong in the concept of reflection and dispersion of light [22]; determine the critical angle based on the total internal reflection characteristics using Snellius law; 8) the concept of light propagation in different mediums and refractive indices based on Snellius’s Law [23]; the concept of refraction [24]; critical angle; formation of shadows on the lens; and the properties of shadows on the lens.

In addition, teachers who teach optical materials are found to still use traditional models. Traditional learning processes are considered ineffective in learning physics concepts. Active learning that involves the active role of students in learning stimulates students’ ability to think in gaining knowledge compared to traditional learning [25] and to help cognitive processes during knowledge acquisition (especially learning the concepts of light and optics) required learning designs that effective learning that involves students directly in the learning process [26]. Thus, it is necessary to take preventive measures to overcome the lack of knowledge and understanding of concepts or improve the misconceptions of pre-service teachers, especially the concept of light before carrying out teaching. Based on the introduction that has been described, the problem in this study was what is the description of the pre-service teacher's
conception of the concept of light in the basic physics course. Objective of this research is to describe of the conceptions and misconceptions of the students of Pre-service teacher about light concept.

1.2. Literature review

1.2.1. Definition of misconception. Misconception by some experts is defined in different terms. Some use the term misunderstanding, misinterpretation of fact, and naïve believe [27]. There are also those who use the terms alternative concepts and native conception [28,29] and use the terms alternative frameworks, intuitive beliefs, and pre-conceptions. The number of terms used is due to the lack of definitions that can best represent in explaining related misconceptions. But there are at least a few points which are the meeting points of the differences in defining this term, namely that misconception is a natural phenomenon that occurs in almost every student where there are differences in students' ideas or understanding with the basic concepts of science.

In general, misconception is defined as a difference in a concept or idea that is built by students' own way of thinking with the ideas of teachers and scientists working in understanding scientific concepts [30,31]. In building their understanding of the concept of science, students sometimes only think simply while the concept of science that wants to be understood has far more complex characteristics. Misconception is also defined as an idea or understanding of a concept that is not based on basic understanding of science. Misconception in the form of ideas that are not easily removed. He is resistant and needs serious effort to change it [32,33].

Misconceptions have some of the same characteristics as the strength of misunderstandings embedded in students' cognitive structures, the concepts that are different from the concepts of experts. This misconception will affect how students understand natural phenomena and provide an explanation of the phenomenon, and the problem of misconceptions must be immediately overcome, avoided or eliminated to achieve an understanding of the concept that is appropriate or the same as understood by experts [34,35]. Misconception as a misunderstanding of concepts caused by students' cognitive construction errors is one of the factors causing low learning achievement [36]. But if explored further, misconceptions can be caused by many things, there are from a student; teachers; textbooks; context; and teaching methods.

1.2.2. Level of student conceptions pre-service physics teachers. Characteristics of the level developed by Küçükozer [37] about several categories that will be obtained through a coding system from several responses by classifying several categories and meanings at each level based on the students' physics teacher's reasoning displayed below: A- Scientifically Correct: Scientifically correct and complete explanations; B- Partially Correct: Responses contain / involve truth but the explanations are incomplete; C- Incorrect 1 (Error 1): Ideas contain partial truths and incorrect sentences / statements are still contained in them. In general, statements in this group are considered incorrect; D- Incorrect 2 (Errors 2): Ideas related to the concept under study and explanations are too minimal and the majority of answers are wrong; E-Incorrect 3: Ideas related to several concepts and parts of explanations of related concepts that are correlated; F- Uncodable: It is a difficult explanation to understand what is stated indirectly or the answer has no relation to the question; G-No Explanation (No explanation): Respondents who did not make some explanations about the questions and wrote the same responses / answers.

Based on a study developed by Ahmad (2012) on leveling conception that simplifies this leveling into four (4) levels of six (6) levels. The four levels are: 1) scientific conception (scientifically correct according to scientific conceptions), 2) parallel conceptions (Partially Correct) with some conceptual truths, 3) misconceptions (incorrect 1, 2, and 3), and 4) not understanding the concept (no explanation). In this study researchers refer to simplified leveling in detail in the following table.
Table 1. Criteria on leveling conception.

| Code | Criteria            | Explanation                                                                 |
|------|---------------------|-----------------------------------------------------------------------------|
| SC   | Scientifically      | Scientifically correct and complete explanations.                           |
|      | correct             |                                                                             |
| PC   | Partially Correct   | Responses contain truth but the explanations are incomplete.                |
| M    | Misconception       | Ideas related to concepts are explained too minimal and the majority of     |
|      |                     | answers are wrong, if the answers are correct then the explanation contains  |
|      |                     | partial truths and wrong sentences / statements.                             |
| NE   | No Explain          | Respondents who did not make an explanation                                 |
| U    | Uncodeable          | Explanation of respondents have no relation to the question.                |

2. Methods

This study used a quantitative-qualitative approach. The subject of research is students of pre-service physics teacher who a students of basic physics II courses at one of the University in Makassar City. Procedures of this study there are preliminary information was obtained, there were problems related to the conception and misconception of students in higher education. Based on the problems found in the field, test is carried out, the test results will be analyzed qualitatively with coding system consists of five categories including Scientific Correct (SC), Partially Correct (PC), Misconception (M), Uncodeable (U) and No Explain (NE) categories.

3. Results and Discussions

Based on the explanation of pre-service teacher responses, it can be identified that students tend to experience misconceptions on each sub subject of the concept of light. The sub-topics that experienced misconceptions include (1) The monochromatic nature of light in the phenomenon of two slit interference; (2) Application of the concept of light on the phenomenon of interference in everyday life; (3) The application of the concept of light on diffraction phenomenon in the color spectrum; (4) The characteristics of light in the application are concave mirrors; (5) Characteristics of monochromatic light; (6) The concept of phenomenon of interference in Young Experiments; (7) Light bending on the lattice and the sequence of the color spectrum in light; (8) Physical characteristics of light; (9) The characteristics of light as electromagnetic waves; (10) Characteristics of light as a wave; (11) Characteristics of monochromatic light on the concept of refraction; (12) The nature of light as a wave in its application to the concept of interference phenomenon; (13) Physical characteristics of light; (14) The characteristics of light in the concept of reflection; (15) Light characteristics that show the physical nature of light; (16) The characteristics of light in the application on a plane mirror; (17) The characteristics of light in the application on a convex mirror; (18) Application of a polychromatic concept of light on dispersion phenomenon; (19) The characteristics of light in its application to the concave lens; (20) Light characteristics in prisms; (21) Light characteristics in plan-parallel glass; (22) Light characteristics in refraction; (23) Color spectrum on the prism; (24) Light characteristics on the prism color spectrum; (25) Application of the concept of refraction. While the other five sub topics are a sub topic of the concept of light which is not misconception by all pre-service teacher who are respondents. There are (1) Light characteristics in the application of the reflection concept (2) Light characteristics on the concept of total internal reflection; (3) Characteristics of Light in optics; (4) Characteristics of reflected light; and (5) The concept of Snellius Law’s.
4. Conclusion
Based on the results and discussion that has been described, concluded that pre-service teachers still have misconceptions about the concept of light in almost all sub subjects about light.

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