Analysis of Understanding Science Concepts for Prospective Elementary School Teacher Candidates

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Abstract: Understanding the concept is one of the most important parts of realizing a teacher's professional competence. As elementary school teacher candidates, Elementary School Teacher Education students must have good conceptual understanding skills to realize the expected professional competence. This study aims to analyze elementary school teacher candidates' level of understanding of science concepts, specifically on temperature and heat, electricity, magnetic fields, and the solar system. This type of research is quantitative descriptive with research subjects of Elementary School Teacher Education Study Program students who program elementary science education courses. The total sample of 218 was selected by purposive sampling. Data on understanding the science concepts of elementary school teacher candidates were collected using a three-level test instrument equipped with a Certain Response Index (CRI). Results of data analysis showed that 46.27% understood the concept well, 9.04% understood the concept but were unsure, 30.90% had misconceptions and 13.67% did not know the concept. The data illustrates that the number of elementary school teacher candidates who experience misconceptions is still quite high. The causes of misconceptions among students in understanding science concepts include material that is abstract, complex, has many mathematical equations and contains many images that are difficult to explain physically. Based on the results of this study, it is necessary to provide positive feedback and improve learning to facilitate elementary school teacher candidates so that they can understand science concepts easily and correctly.

Keywords: Understanding of concepts; Science; Prospective Elementary Teachers

Introduction

The teacher profession has enormous duties and responsibilities in the field of education. In carrying out his profession a teacher is required to have professionalism. Quality education will not be realized if it is not supported by the presence of professional teachers (Adrian & Agustina, 2019). This is supported by the opinion (Rusman, 2012) which suggests that the professionalism of a teacher is one of the determining factors for the quality of education. Teachers can be categorized as professionals if they have four main competencies. The competence in question is the ability in terms of knowledge, scientific knowledge, skills, attitudes, and self-development that must be mastered and owned by the teacher in carrying out his duties (Linda, 2017). The main competencies that must be possessed by a teacher include professional competence, pedagogical competence, social competence, and personality competence (Nursalim, 2017).

The four competencies that have been described are inseparable units. Before becoming a teacher, a student teacher candidate is expected to have the main competencies from college. One of the competencies that can be formed in college is professional competence. Professional competence is the ability to master the fields of science, technology, arts, and culture (Adrian, 2017). This competence at least includes mastery of subject matter broadly and in-depth per the standard content of educational unit programs, subjects, and

subject groups to be taught, concepts and methods of scientific disciplines or mastery of scientific structure and methodology, relevant technology or art, which conceptually covers or is coherent with the educational unit program, subject, or group of subjects to be taught. This professional competence must be owned by teachers so that they do not experience obstacles in carrying out their duties at school.

One important part of professional competence is conceptual understanding. Understanding the concept is an abstract idea that allows one to classify an object into examples and non-examples, which are usually stated by definition (Yuliani & Saragih, 2015). A simpler understanding of the concept can be interpreted as an understanding of a material. A good teacher can manage the teaching and learning process in class well and can master the material to be taught. If the teacher can manage the class and master the material well, students will feel comfortable and enthusiastic about learning (Rusman, 2012). Based on this statement, a teacher may not be able to teach well if he does not master the material to be taught. Therefore the teacher must be able to master the material to be taught properly and in depth so as not to cause misconceptions in students when learning. To make this happen, education personnel in educational institutions as institutions that give birth to prospective teachers must provide and instill these competencies in prospective teacher students, including prospective elementary school teacher students. One of the first steps taken to prepare teachers who master their skills is to ensure that prospective teachers have a good grasp of the material they are studying (González-Gómez et al., 2022).

Many concepts must be understood by prospective elementary school teachers, one of which is the subject of Natural Sciences. Science is a body of knowledge formed by continuous inquiry and compassing the people who are engaged in the scientific enterprise. The characteristic difference between science and other sciences is that science is pursued through various empirical process findings using the scientific method (Fahmi et al., 2022). Natural Science has four characteristics which consist of product, process, attitude, and application (Sujana, 2014). Science as a product is a collection of knowledge and a collection of concepts, theories, facts, and laws. As a process is a solving procedure through the scientific method. As attitude is an attitude that is taken and developed by scientists to achieve the expected results. As an application, science theories will give birth to technology that can provide convenience for life.

Science does not only study natural phenomena through data and concepts but also discusses how they occur, and how to think and solve problems. According to (Syawaludin et al., 2019) Science is a lesson that can be used as a medium for students to learn about themselves and their surroundings. Although science lessons are contextual lessons with everyday life, this lesson has several limitations for students to learn, including the explanation that is less understandable because of its abstract nature and emphasizes memorization, so that science becomes a lesson that is less interpreted by students.

This problem does not only happen to students, even teachers and prospective teachers also experience the same thing. Research conducted by (Andayani et al., 2022) states that the understanding of teachers, prospective teachers, and students in elementary schools is almost not much different. This can happen partly because of the ineffectiveness of the learning process carried out in teaching science in the classroom so that the impact of science becomes a lesson that is more likely to be memorized. Based on observations, elementary school teachers' students often complain about the difficulty of understanding science concepts. The cause of the difficulty in understanding the concept of science is that science contains many abstract concepts, many mathematical equations, and contains many pictures that are difficult to explain physically. However, every prospective elementary school teacher must prepare himself to have a good understanding of concepts before becoming a teacher.

Understanding the concept is one of the most important parts of realizing a teacher's professional competence. As prospective elementary school teachers, elementary school teacher education students are required to have good conceptual understanding skills so that the expected professional competence can be realized (Al Mamun et al., 2022). The purpose of this study was to analyze the level of understanding of science concepts for elementary school teacher candidates, especially in the material of temperature and heat, simple electric circuits, magnetic fields, and the Solar System using a three-level multiple choice instrument equipped with Certain, Response, Index (CRI). Through this research, it is hoped that it will be able to find out the ability profile of prospective elementary school teachers in mastering science concepts. The results of this research are expected to be used as evaluation material in the process of science education lectures in tertiary institutions so that they can produce professional graduates in the field of education in the future.

Method

This study uses a quantitative descriptive approach. Descriptive quantitative research aims to describe a fact and a symptom that occurs at a certain time and location. In this study, researchers will

describe, identify and analyze the level of understanding of science concepts for prospective elementary school teaching students in the Elementary School Teacher Education Study Program, Faculty of Teacher Training and Education, University of Mataram. Scientific concepts are specifically measured on the matter of temperature and heat, electricity, magnetic fields, and the solar system. The subjects of this study were 2nd-semester students of the 2021/2022 academic year who were selected by purposive sampling and totaled 218 people. The instrument used was the form of a three-tier test instrument. The test was analyzed using the Certainty of Response Index technique modified by (Hakim et al., 2012). This technique can see the level of understanding of science concepts for elementary school teachers in 4 categories, namely understanding the concept correctly, understanding the concept but not being sure, misconception, and not knowing the concept. The criteria for the category understanding of the concept are following Table 1.

Table 1. Assessment Criteria based on CRI Technique

Answer	Reason	CRI Score	Concept understanding level
Correct	Correct	>2,5	Understand the concept properly
Correct	Correct	< 2,5	Understand the concept but not sure
Correct	Wrong	>2,5	Misconception
Correct	Wrong	< 2,5	Don't know the concept
Wrong	Correct	>2,5	Misconception
Wrong	Correct	< 2,5	Don't know the concept
Wrong	Wrong	>2,5	Misconception
Wrong	Wrong	< 2,5	Don't know the concept

(Hakim et al., 2012).

Then analyzed using the percentage formula for each category of concept understanding:

$P = f/N \times 100\%$ (Sudjana, 2013)

Information:

P = Percentage

f = Frequency

N = Number of respondents

Result and Discussion

Data on the level of understanding of science concepts for elementary school teacher candidates obtained through a three-level multiple choice test are categorized into four categories, namely: understanding the concept correctly (MB), understanding the concept but not sure (M), misconceptions (MSK) and not knowing the concept (TM). The distribution of the level of understanding of the concept is expressed in percent (%) as shown in Table 2.

Table 2. Distribution of the Levels of Understanding of Science Concepts for Prospective Elementary School Teachers (%)

Subject Material	Concept understanding level (%)			
	MB	M	MSK	TM
Temperature and Heat	47.03	8.62	30.08	14.12
Electricity	48.87	8.76	29.10	13.28
Magnetic field	43.79	8.76	33.05	13.56
Solar system	43.50	11.58	31.64	13.28
Average	46.27	9.04	30.90	13.67

Based on Table 2 above, it can be seen that the percentage of prospective elementary school teaching students who have correctly understood the concepts of science material is still below 50%. This indicates that their professional competence is still lacking to carry out their role as prospective teachers. Mastery of concepts is a very important part that must be owned by teachers and prospective teachers when studying science (Oktaviani et al., 2020). According to Rahmat, et al (2018), students are required to understand what is being taught, know what is being communicated and the contents can be utilized. Students are considered to understand a concept if they student can explain what has been heard and read in their sentence and can provide other examples of what has been exemplified. However, students often encounter obstacles in learning. This causes student learning outcomes to be less good.

When the content knowledge of prospective teachers is inadequate, this will result in learning not being able to achieve the expected goals, it will cause a lot of confusion and misconceptions to students in the future (Anam, 2022). Because in this process, the teacher plays an important role in conveying the material to be understood by the students during learning. The ability of teachers to carry out their duties is closely related to quality and professional qualifications (Durukan, 2015). Science competence is important to be mastered by prospective elementary school teachers because elementary school is the beginning of students gaining knowledge and scientific process skills that are formed through the practice of science competence, therefore prospective elementary school teachers must master science competence for student learning achievement (Asrial et al., 2018).

Students who experience misconceptions by 30.9%, this shows that there are still many students who are prospective elementary school teachers who experience misconceptions about elementary science concepts. According to Syuhendri (2017), misconceptions not only affect concept change but can also be an obstacle to achieving learning goals. Even misconceptions can last a long time and are difficult to correct during the learning

process. The occurrence of misconceptions can result in a decrease in the quality of education and this can lead to not achieving learning objectives. The understanding of student teacher candidates in mastering science learning concepts will affect the achievement of science learning objectives, especially elementary school science learning.
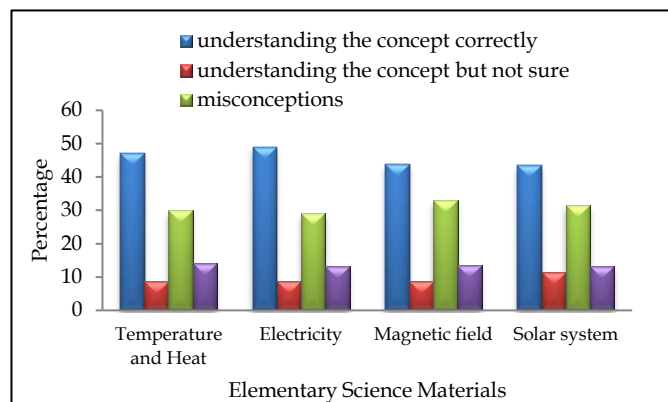

Figure 1. Percentage of Understanding Level of Science Concepts for Elementary Teacher Prospective Students

When viewed based on each material, the highest understanding of science concepts for prospective teacher students is in the Electricity material, namely 48.87%, who understand the concept well, and the lowest is in the Solar System material, which is 43.50% (Figure 1). As for the topics of magnetic fields and temperature & heat, the proportion of prospective teacher students who understand the concept is 43.79% and 47.03%. This means that the most mastered topic is material about electricity, while the most difficult material is about the solar system. Even though the category includes the most mastered material, the proportion of prospective teachers who master the concept of electricity is less than half (< 50% of prospective elementary school teacher students). This fact shows that most of the topics (temperature and heat, electricity, magnetic field, and the solar system) are still difficult for most elementary school teacher candidates at FKIP University of Mataram.

Factors that make it difficult for students to understand science concepts well include science material that is abstract, complex, has many mathematical equations, and contains many pictures that are difficult to explain physically. In addition to these factors, other factors influence, namely several external factors. The first is the low weight of the semester credit system (SKS) which equips elementary school teacher candidates to master science. During education, a total of only 3 credits were taken from the Elementary Science Education course (Designation Team, 2020).

The second factor is the implementation of distance learning during the pandemic caused by Covid-19. Distance learning, which is generally carried out online, has its drawbacks. Some of them are: (1) the cost of buying a quota is expensive, (2) the ICT literacy of some lecturers and students is still low, (3) good network conditions are not evenly distributed so that students are often thrown off when doing video conferences (Indrawati, 2020; Legowo). , 2020; Nainggolan et al., 2020). These weaknesses have caused prospective elementary school teaching students to respond poorly to online learning and want learning to be carried out face-to-face (Rahmatih & Fauzi, 2020; Widodo et al., 2020). This is because students feel freer to ask questions or express their opinions if they meet directly with their lecturers. They are also more active in seeking various sources/references to increase their knowledge.

The third factor that causes low mastery of science concepts is low science process skills. Why science process skills? This is because science process skills are fundamental competencies needed to facilitate mastery of science concepts (Prayitno et al., 2015) and have a positive correlation (Artayasa et al., 2017). Based on the results of previous studies, the science process skills of prospective teacher students are in a low category (Syazali, Rahmatih, et al., 2021). This is indicated by the average (mean) score of prospective elementary school teachers is 37.88 in the first assessment and 34.46 in the second assessment. Based on the Academic Guidelines of the University of Mataram (Preparing Team, 2019), the quantitative value is in the grade E grade and the interpretation is very poor. From the distribution aspect, none of the students got a score with a very good interpretation. The proportion with good and sufficient interpretation is only a small part (11.43%). The rest are values with poor and very poor interpretation.

The existence of facts related to the low understanding of the concept of elementary school teacher candidates shows that an effective solution is needed. An effective solution needs to refer to the root cause of the problem. For the reason for the low weight of SKS in Science Education courses, the solution is to increase the weight of SKS from courses that equip students to master science. This is the hope of the science lecturer team at the FKIP Mataram of the University Elementary School Teacher Education Study Program. This year is an opportunity/opportunity because the current curriculum, namely the Merdeka Learning Campus Merdeka curriculum which is effective starting in 2020, will be reconstructed. This new curriculum will be developed based on local, national, and global needs. In the science aspect, the curriculum must be developed so that it becomes a solution to problems related to the low scientific literacy of students in Indonesia, including in NTB (Schleicher, 2019). As prospective elementary

school teachers, elementary school teacher education students must of course be equipped with scientific competence to facilitate their students well and be able to provide scientific competence as needed, to be able to solve various problems, both at the local, national, and global levels.

The solution to the problem of low understanding of scientific concepts caused by the implementation of distance learning during the Covid-19 pandemic is to utilize the right combination of tools and strategies. It is based on the implementation of distance learning which is generally done online. The combination of learning tools and strategies that can be implemented is what is recommended by (Utomo et al., 2020). This recommendation combines 3 online learning tools/media which are theoretically effective and relatively inexpensive (Figure 2a) because they can reduce expensive costs which have been one of the problems experienced by students. The three tools/media are Google Classroom, WhatsApp, and Zoom social media. Google Classroom is used for assignments, quizzes, and exams (Middle Semester and Final Semester Exams. Whatsapp social media is used to carry out activities such as discussion forums and deliver announcements related to the lecture process through chat media. Zoom is used for face-to-face learning activities through video conferences The combination of tools/media as a science learning strategy that can also be a solution is a recommendation (Syazali & Ilhamdi, 2022). In this recommendation, Google Classroom is replaced with the E-learning Mataram of the University, and Zoom is replaced with Google Meet (Figure 2b).

The solution to the third factor causing the low mastery of science concepts is to apply learning facilities that can improve or develop science process skills. Empirically, learning facilities that have been proven to be able to improve and develop science process skills consist of 7 types, namely strategies, approaches, models, methods, media, and other learning facilities (Syazali, et al., 2021). This last type is a type of learning facility that cannot be grouped into 6 existing learning facilities. Of these 7 types, there are 106 variants of learning facilities. Of all these variants, there are 7 variants of strategies and approaches, 34 variants of the model, 11 variants of the method, 5 other variants, and 15 variants of learning media. From these variants, there are 7 variants of learning facilities that are recommended to be implemented in order to improve students' science process skills. The seven learning facilities are inquiry learning models, guided inquiry, problem-based learning, project-based learning, learning cycles, modules, and worksheets.
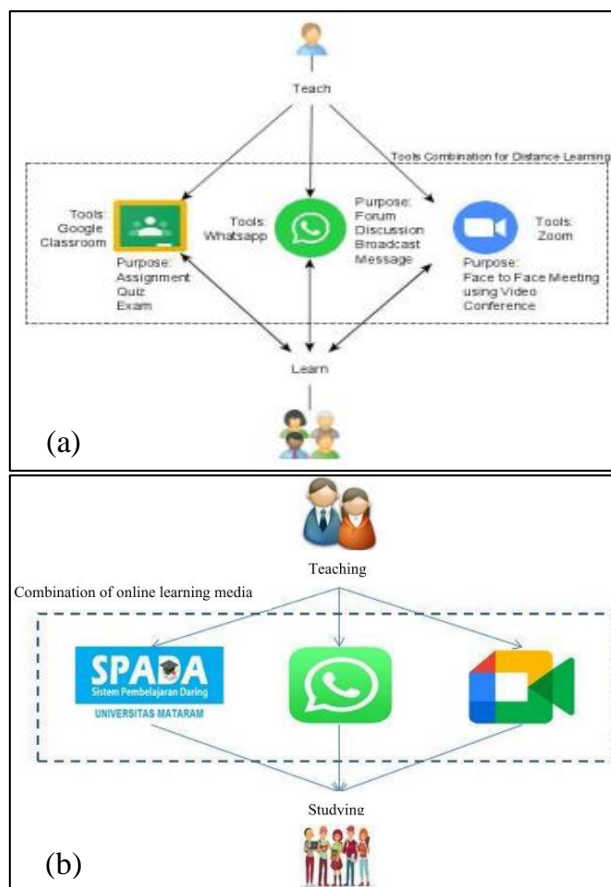
Figures 2a and 2b. Recommendations of a combination of online learning tools for the implementation of Distance Learning.

Conclusion

Based on the objectives, it can be concluded that the level of understanding of science concepts for elementary school teacher students is still below 50%, especially in the sun, temperature and heat, electricity, magnetic fields, and the solar system. Meanwhile, if viewed based on the four materials measured, the understanding of science concepts for prospective teacher students who understand the concept well is the highest in the Electrical material, namely 48.87%, and the lowest in the Solar System material at 43.50%. This means that the most mastered topic is the subject of electricity, while the most difficult material is the solar system. Although the category includes the most mastered material, the proportion of prospective teachers who actually master the concepts in electrical material is less than half. This fact shows that all topics (temperature and heat, electricity, magnetic fields, and the solar system) are still difficult for most of the prospective elementary school teacher students at FKIP Mataram University.

Acknowledgements

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