Problem Solving Ability of Distance Education Student on Electrostatic Topic

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Abstract. In this paper, we present the result of a study on the identifying problem-solving ability on distance education students’ physics. Descriptive-qualitative is used for method of research. The subjects of the study were in-service students’ physics of distance education. Sample were 19 students from all of student taking electricity and magnetism course in term 2019/2020. Essay test of electrostatics problem solving is used for collecting data technique. Test of problem solving is given at the beginning of the course in asynchronous tutoring of electric and magnetic cores. The finding of the study indicated problem solving ability of in-service students’ physics of distance education are categorized low (44.56%) in solving the problems. Therefore, it is necessary to make efforts to improve students’ ability to solve problems, through asynchronous tutorials by applying problem-solving strategies in interactive discussion and collaborative work in groups.

1. Introduction
Era of globalization that is growing so fast and demands of imposing curriculum have made educational institutions carry out the 21st century skill innovations that are beneficial to education world [1]. The abilities are in line with the demands of the 21st century include problem solving skills. Learning and assessment of problem-solving skills is very necessary and driven by the needs of students at the institution and career level to be able to work in groups and apply problem solving skills in real social situations [2-4]. Problem solving skills are the main skills that must be developed in 21st century learning practice, in addition to critical thinking skills, communication and collaboration skills [5]. Problem solving skills are defined as the ability to identify, analyze, design or plan, implement or practice, evaluate, and find solutions in formulating new answers to solve a problem [6]. In addition, the problem-solving process includes the process of identifying problems, formulating problems, and formulating hypotheses, proving hypotheses through experimental activities or discussion processes, and choosing the most appropriate alternative solutions [7].

Problem solving skills are important in physics [8, 9]. One of the goals in learning physics is to teach problem-solving skills. Physics really needs this ability because the problems in physics are complex problems and are related to everyday life [10]. Physics, especially mechanics and electricity and magnetism topics, often emphasize quantitative aspects of problem solving such as mathematical equations and procedures rather than qualitative analysis to select appropriate concepts and principles [8]. Learning mechanics and electricity and magnetism requires students’ ability to understand formulations, graphs, drawings, read tables, and express relationships between variables, which are very important skills that students must possess. The concepts of physics, especially electricity and
magnetism include electrostatic topic, have many complex concepts when explained verbal [11, 12], but they will be simpler if they are formulated into mathematical formulas, graphs, or sketch [13, 14]. Physics problem solving can be trained by enabling strategies to develop rational solutions to these problems that must be adapted to various kinds of problems faced in life so that it leads to analytical thinking [15, 16]. Mastery of these abilities can help students simplify problems and organize knowledge so that it is easier to communicate and understand physics [17, 18]. Integrating conceptual knowledge with problem solving is a desired goal in learning physics, but students must be able to integrate conceptual knowledge and problem solving to develop knowledge of physics concepts and help students solve problems that occur by designing authentic problems [8, 19, 20].

Various research related to problem solving have been carried out, for example the development of problem-solving skills in science learning has been widely studied starting from primary education [21, 22], secondary education [23-26], higher education [27, 28], to research for science teachers [29, 30]. These various studies were carried out in different scientific contexts (biology, chemistry, physics). Research that tries to develop various instruments to measure problem-solving skills and problem-solving processes with various models [31-34]. The use of technology in developing problem-solving skills has also been widely developed, for example the use of mobile learning [35, 36], interactive multimedia [37], Virtual laboratories [38-40] and online learning [41, 42].

Universitas Terbuka as a distance education uses online tutorials as a learning aid for students. Online tutorial using Modular objective oriented dynamics, learning (Moodle) as learning management system [43]. This research is intended to determine the problem-solving ability of students in electrical and magnetic courses with learning assistance through online tutorials and to increase the use of facilities in Moodle for learning, which in the end is designed to improve problem solving skills.

2. Method
This research is a descriptive research, which is a method of examining the status of a group of people, an object, a set of conditions, a system of thought or a class of events in the present. The goal of descriptive research is to describe a phenomenon and its characteristics. This research is more concerned with what rather than how or why something has happened. Therefore, observation and survey tools are often used to gather data. In such research, the data may be collected qualitatively, but it is often analyzed quantitatively, using frequencies, percentages, averages, or other statistical analyses to determine relationships [44]. Research subjects are students of physics education program of Faculty of teaching and education of Universitas Terbuka who had taken electric and magnetism courses in the 2019/2020 academic year. The number of students who became research subjects was 19 people. The data studied were answer sheets for student tutorial assignments on electrostatic topics. The instrument used in this study was a test structured so that students answered based on five problem solving indicators. The five indicators of problem-solving ability are (1) the ability to understand problems, (2) the ability to describe problems, (3) the ability to plan solutions through choosing the right problem-solving strategy, (4) the ability to solve problems through correct answer and appropriate calculation process, and (5) the ability to check to ensure the results obtained are correct. The type of test used in this study is a subjective test, which is generally in the form of a description test in which students express their thoughts in answering questions. In this way students can explore their knowledge as much as possible.

3. Result and Discussion
The results of the research carried out contain the demographic characteristics of students and students’ problem-solving abilities

3.1. Demographic characteristics of students
Based on studies, the respondents consist of 58% female and 42% male. Respondents’ ages ranged from 21-45 years, with predominantly under 30 years of age (47%) for those who have both taught high school. Respondents are scattered throughout Indonesia, but domicile is still dominated by the island of Java (47%) then Sumatra (37%), Kalimantan (11%) and Maluku (5%).
Figure 1 shows that the educational background of respondents is dominated by high school graduates (68%) then diploma graduates (5%), undergraduate and graduate (27%) with a specialty come from engineering who will study physical education as a provision for teaching in secondary schools. When the research was conducted, most of the respondents were in semesters 2-4 as many as 79% were in accordance with the curriculum that the electric and magnetic course was an advanced course after taking basic physics courses. For students who are in high semesters taking this course due to various reasons, namely course exams clash with other courses so that they have not been taken in the previous semester or due to repeating to get better grades. Meanwhile, for the academic level, the respondents were represented balanced for all levels from low to high, for students who had a high academic GPA > 3.00, as much as 26%, followed a good GPA from 2.50 to 3.00 (22%), Moderate GPA 2.00-2.50 (21%) and low GPA < 2.00 (21%).

3.2. Level of Problem-Solving Abilities

The scoring results obtained from the students' answers are as follows.

Based on the 19 students who became respondents, 15 students (78%) got low scores, so it can be said that most students have not been able to solve problems in electricity and magnetism course,
especially on the topic of electrostatics. Meanwhile, the student's ability in each indicator can be shown in Figure 3.

![Figure 3. Student ability in every indicator of Problem Solving](image.png)

The result shows the lowest indicator is in executing the plan (36.29%), this shows that most students have not been trained in doing calculations that involve mathematical language, so they often make fundamental mistakes in doing calculations. That most students experience difficulties in answering calculation or proof questions. The following is an example of a student's answer to the electric fields topic. The selection of respondent student answers is based on similarities in student demographics so that only problem-solving abilities will be seen. Both students were chosen because they have the same educational background, region, age, so the assessment is only based on the ability of students to solve problems.

Figure 4 explained student low ability when student answered between there no connect between concept to another item when solving problems. More picture explained, figure 5, student with high abilities. There are connected between concept when solving problems. Even though there are mistakes made by student experts, especially at the execute solution to solve problems stage, from the way they answer, there is a relation between one answer and the answer to another question.

In the field of physics, solving physics problems regarding the concepts of physics. Factors that influence solving physics problems are the knowledge structure of students who solve problems and the character of the problems [45]. The difference between students who have low (novice) and high (expert) abilities in solving physics problems is how students organize and use knowledge and connect one concept to another when solving problems [46-50]. Students who have high ability in solving physics problems tend to use qualitative arguments based on the physics concept that underlies the problem (deep features), evaluate solutions, and tend to use representational tools. On the contrary, students who have low ability in solving physics problems tend to recognize problems based on the problem presentation, do not evaluate, and tend to use formulas in solving problems [47, 50].

The results of the research conducted indicate that the ability of students in planning and implementing plans in solving problems is still low, it is necessary to enrich learning supports for students, especially in online tutorials with examples of problem solving in the presentation of material and collaborative discussions.
4. Conclusion
From the results of research and discussion, it was concluded that the ability student problem solving in electricity and magnetism courses are classified in the low category with indicator problem solving. The lowest indicator is executing a solution plan for problem solving. With this condition of students, weaknesses, and strengths of students in problem solving abilities. So that this can underlie the steps next thing to do in order student weaknesses can be fixed, and the advantages can be increased. Through learning support, especially online tutorials, it can be suggested that there are many examples of how to solve problems and collaborate discussions between students.

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