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Preface

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Preface

The Faculty of Education and Teaching Institut Agama Islam Ngeri (IAIN) Bukittinggi, West Sumatera Indonesia, organized the 1st International Conference on Education (BICED 2019) on 17-18 October 2019 in Bukittinggi, West Sumatera, Indonesia. The 1st BICED 2019 aims to exchange knowledge and research finding among academicians, researchers, profesionals, policy makers, and postgraduate students.

The Awareness to increase the number of publications on the results of research that has been done, deserves appreciation by all parties. Because of that, Faculty of Educatioan and Teaching IAIN Bukittinggi provide motivation and space for researcher to disseminate their research and accomodate the result of research that has been done. Bukittinggi International Conference on Education (BICED 2019), is the first International Conference held by Faculty of Education and Teching with theme "Higher Education's Response to the Fourth Industrial Revolution (4IR)" .

BICED 2019 was attended by 520 participants, and a total of 64 papers were presented and discussed. The papers were authored by researchers from Thailand, Malaysia, and Indonesia. All papers have been scrutinized by a panel of reviewers who provide critical comments and corrections, and thereafter contributed to the improvement of the quality of the papers. Based on the reviewer's reports, 25 papers were selected and eligible to be published in the proceeding.

We sincerely express our gratitude to the international/national advisory committee, presenters, organizing committee members, session chairs, the Dean and all members of the Faculty of Education and Teaching IAIN Bukittinggi, student volunteers, participants, contributors and all the members BICED 2019. Last but not the least, we are thankful to IOP JPCS for producing the proceeding.

The Editors:　　　　　　　　　　　　　　　　　Chairman of the BICED 2019:

Zulfani Sesmiarni　　　　　　　　　　　　　　　Dr. Supratman Zakir, M. Pd., M. Kom
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Peer review statement

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Peer review statement

All papers published in this volume of *Journal of Physics: Conference Series* have been peer reviewed through processes administered by the proceedings Editors. Reviews were conducted by expert referees to the professional and scientific standards expected of a proceedings journal published by IOP Publishing.

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Enhancement Students' Problem-Solving Ability through Inquiry Learning Model Integrated with Advance Organizers on the Concept of Work and Energy

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Enhancement Students' Problem-Solving Ability through Inquiry Learning Model Integrated with Advance Organizers on the Concept of Work and Energy

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Abstract. Problem solving is an ability that involves the process of thinking and working to find problem solutions. In the process of problem solving, students must be able to focus on problems, describe problems in concepts, plan the solutions, implement the plans and evaluate the solutions. This article discusses the effectiveness of the inquiry model integrated with advance organizers in enhancing students' problem solving ability in concepts of work and energy. This research was conducted with one group pretest-posttest design at two different senior high schools. The research instrument used was five questions of the essay test. The enhancement of problem solving ability was analyzed by N-gain score. The results showed that the problem solving ability of two groups increased in medium category for each sub-material, while based on the problem solving stage, stage of focus the problem, plan the solutions and implement the plan increased with the high category in one group, while the other stages were in the medium category. The results of this study have proven that the inquiry model integrated with advance organizers is effective in increasing students' ability to solve problems in the concept of work and energy.

Keyword: Problem solving, inquiry learning, advance organizer, work and energy

1. Introduction

Development of 21st-century competencies is a crucial issue in curriculum and education throughout the world including in Indonesia. 21st-century competencies are divided into four categories, namely ways of thinking, ways of working, literacy and how to live in the world. One example of the integration of 21st-century competencies with learning is to make students learn to solve problems related to science, technology or life situations [1].
Physics is a branch of science that is closely related to human life, for example, on the topic of matter and energy, or on fields of technology and medicine [2, 3]. In addition, physics is rich in concepts,

theories, equations and mathematical calculations which means that almost all aspects of physics are related to problem solving. Thus, physics education must be able to create students who have good problem solving ability [4].

Problem solving is a cognitive process to find a solution or goal [5]. Problem solving skills include the ability to think as to understand the problems and to work within the stages to find a solution. Stages of problem solving in physics are focused on the problems, describe the problems in concepts, plan the solutions, implement the plans and evaluate the solutions [6]. Students' problem solving ability in physics can be trained during the learning process [7], this ability can be trained through inquiry learning activities such as formulating problems and hypotheses, arranging experimental or exploration steps and making conclusions.

Previous research reported that the implementation of inquiry learning could improve students' problem solving ability in physics [8, 9]. Inquiry activities involve the ability to think and work independently so that not all students can do this directly. Differences in prior knowledge and ability of students can be facilitated by integrating inquiry learning models with advance organizers [10].

Prior knowledge usually interconnected and stable in a cognitive structure that can be activated [11]. An advance organizer is information that is presented in the form of concepts and relationships between concepts before learning that is used to help students connect new knowledge with the knowledge they already have [12]. The purpose of giving the advance organizer is to help students know the framework of conceptual and work in problem solving during inquiry learning [13, 14].

The integrate of inquiry learning models with advance organizers was adapted from inquiry learning phases developed by Pedaste et al. [15] and the advance organizer model developed by Joyce et al. [16]. Implementation of inquiry learning models integrated with the advance organizer is divided into three stages, namely, the initial stage, presentation of advance organizer conducted at the beginning of learning that aims to activate prior knowledge so students are ready to carry out inquiry activities. An advance organizer is presented in the form of a concept map. Concept maps are used to link knowledge that will be learned with prior knowledge so that it helps students know about the organizing of work and energy concepts. The core stage, inquiry activities that aim to train students' problem solving ability, this stage consist of five activities, namely orientation, conceptualization, investigation, conclusions and discussion. In the final stage, integrative reconciliation aims to help meaningful assimilation of learning material and to strengthen the cognitive structure of students.

Characteristics of students who can solve problems if they can connect information with knowledge that theirs owned to solve problems both related to lessons or daily life [17, 18]. Work and energy material is one of the physics material that is composed of concepts and relationships between concepts that are strictly related to students 'daily lives, so the purpose of this study is to know enhancement students' problem solving ability through inquiry models integrated with the advance organizer on the concept of work and energy.

2.   Method

This development research has been at the testing stage using one group pretest-posttest design. The research subjects were high school students in two different schools divided into Group A and Group B. Before the implementation of the inquiry model integrated with advance organizer, two groups were given a pretest. Learning activities were carried out for three meetings, after which students are given a post-test. Data were collected using five questions of the essay test. The problems in questions relate to concepts of work, kinetic energy, potential energy, conservative and non-conservative forces and conservation laws of mechanical energy. Problem solving ability was assessed based on scoring in accordance with the rubric and problem solving stages according to Heller et al. [6]. Data were analyzed using the N-Gain score to determine the enhancement of students' problem solving ability after implementation of the inquiry model integrated with the advance organizer. Data was interpreted in the low category (N-gain <30.0), medium (70.0> N-gain ≥ 30.0), high (N-gain> 70.0) [19].

3.   Result and Discussion

Enhancement students' problem solving ability in this study can be observed from the increase between students' pretest and posttest scores. The level of problem solving ability of students was analyzed based on the sub-material of the concept of work and energy and stages of problem solving.
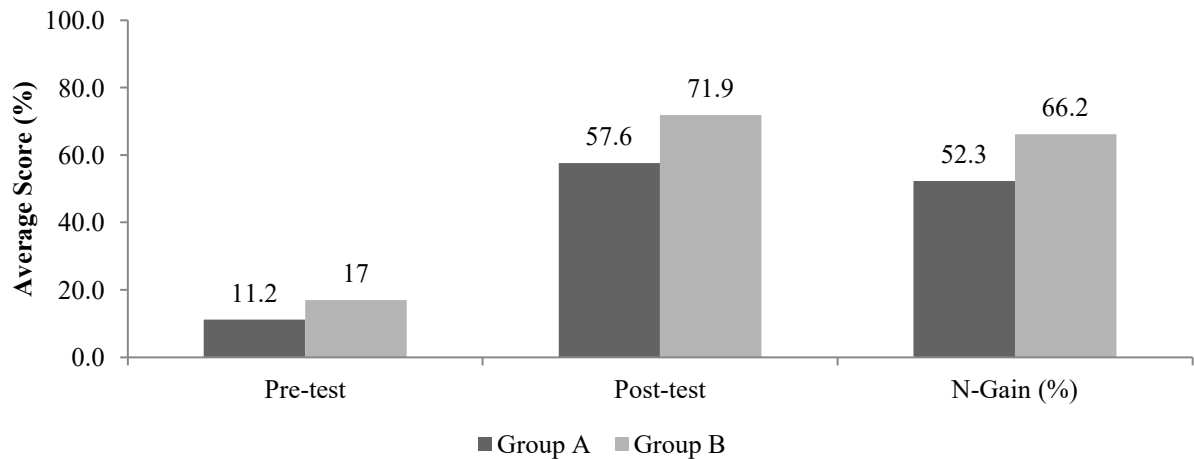

Figure 1. Comparison Average Score of Students' Problem Solving Ability

Figure 1 shows that the enhancement students' problem-solving ability in the two groups in the medium category with the average N-gain score in Group A is 52.3%, and Group B is 66.2%. This increase occurred because the application of the inquiry model integrated with the advance organizer. Presentation of the advance organizer can help students organize information and link knowledge to be learned with prior knowledge of work and energy material, so students can find out the conceptual frameworks used in problem solving during inquiry learning. These results are in accordance with the Amanah et al. [20], using advance organizers in physics learning has a positive impact on students' problem solving ability. In addition, the implementation of the inquiry model integrated with advance organizers in physics learning can foster motivation and arouse the activity and collaboration of students [21].
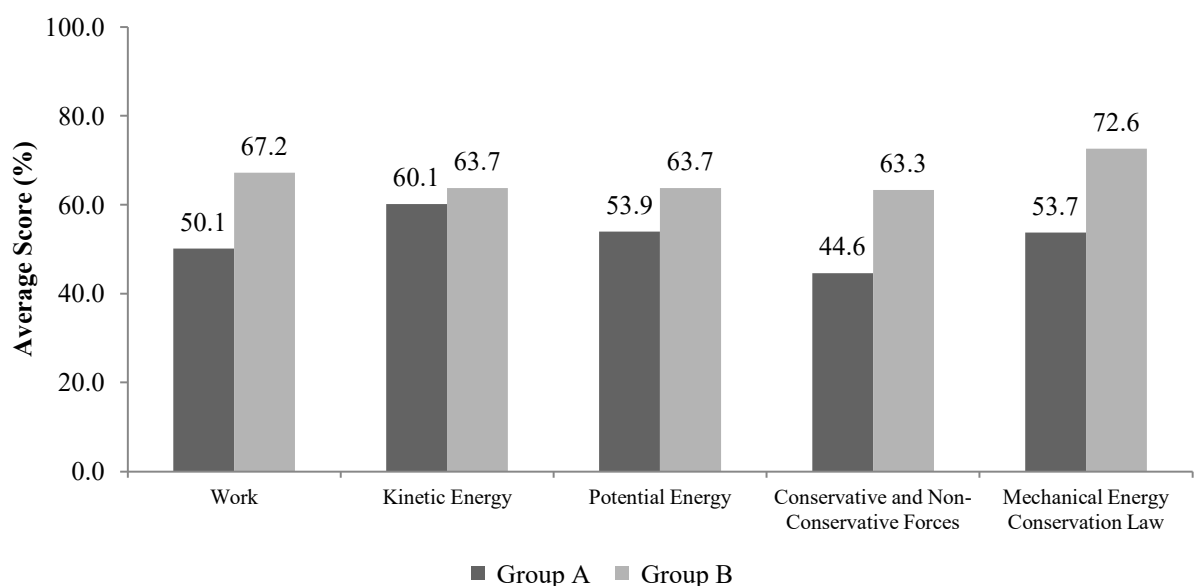

Figure 2. Comparison of Enhancement Score of Students in Each Concept

The level of students' problem solving ability in this study was also analyzed based on the sub-material of work and energy as shown in Figure 2. Figure 2 shows that in general, the enhancement of problem solving ability in both groups in the medium-high category. These results are in accordance with the research of Gunawan et al. [22] which found that the use of media in learning physics concepts has a positive influence on students' problem solving ability. In addition, the integration of inquiry learning models with advance organizers effectively helps increase students' understanding of physics concepts [23]. Harjono et al. [24] also found that the integration of learning models with advanced organizers proved to be able to improve student physics learning outcomes. The analysis result found that the highest score of Group A is on the sub material of kinetic energy and Group B on mechanical conservation law. While the lowest scores of the two groups were conservative and non-conservative, this result is because the mastery of students' concepts in the material related to the forces acting on a system still needs to be improved.
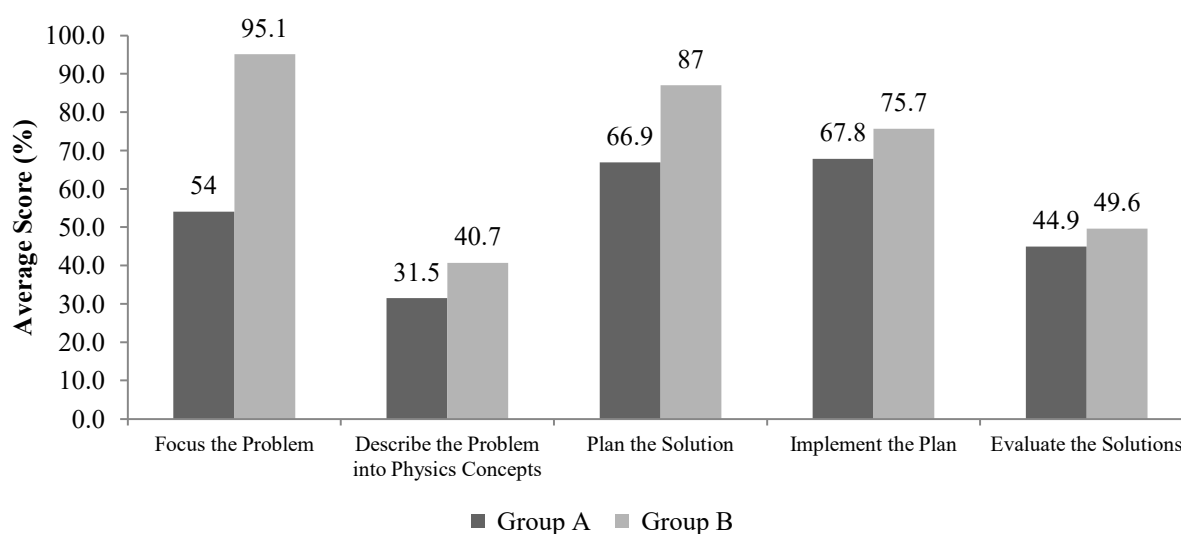

Figure 3. Comparison Enhancement of Students' Ability on Each Stage of Problem Solving

A comparison of enhancement students' abilities based on problem solving stages in two groups can be seen in Figure 3. Figure 3 shows that enhancement students' ability in all stages of problem solving is generally in the medium-high category. These results related to Hermansyah et al. [25], implementation of inquiry model-assisted media can improve students' analytical thinking and evaluative ability. In another study found that the use of appropriate learning media had a positive effect on increasing the stage of students' problem solving ability, especially on the stage of identifying and defining the problem, establish goals and objectives, and make the plan for problem-solving [7].

The analysis result was found that there were differences in the increase of students' ability between Group A and Group B, namely at the stage of focus the problem, plan the solutions and implement the plan. In these three stages of students' ability in Group B increases in the high category, while group A is in the moderate category. The other problem solving phases increases in the medium category. The first stage focuses on the problem related to the ability of students to identify or recognize and interpret problems into visual representation [6]. This ability is trained through the provision of stimulus in the form of problems and questions which aimed to direct students to make answers based on the prior knowledge and presentation of the advance organizer.

The second stage describes the problem into the physics concept, this stage relates to the ability of students to determine physics concepts correspond with the problems [6]. Enhancement students' ability on this stage in two groups is in the medium category. This ability is trained through activities to formulate problems and hypotheses. Artayasa et al. [26] stated that activities as making questions

and hypotheses could facilitate students to think and connect concepts that are appropriate to the problem or phenomenon.

The third and fourth stages are planned the solutions and implement the plan. Enhancement students' ability in these two stages is different between the two groups. The increase in Group A is in the medium category, while Group B is in the high category. The plan the solution and implement the planning stage relates to the ability of students to form relationships between concepts and execute it into equations or work steps to find solutions. The development of this ability is facilitated through investigative activities, where students arrange steps and conduct experiments or explorations, and collect and analyze data to answer questions or problems in the worksheet [27]. Inquiry learning models integrated with appropriate media are proven to be able to improve students' science process skills and critical thinking skills [27, 28].

The final stage of problem solving is evaluating the solution. Enhancement students' ability in both groups on this stage in the medium category. The evaluate solutions stage relates to students' ability to make data-based judgments and provide explanations [29]. This ability is trained through activities to conclude the data obtained then compare with the hypothesis or the problem presented.

4.   Conclusion

The implementation of the inquiry model integrated with the advanced organizer on the concept of work and energy can improve students' problem solving ability. The enhancement students 'problem solving ability in general in both groups was in the medium category, while based on the analysis of sub-material and the problem solving stage, the enhancement students' ability in both groups was in medium-high category.

Acknowledgments

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