Journal Homepage: -www.journalijar.com
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)
Article DOI:10.21474/IJAR01/7478
DOI URL: http://dx.doi.org/10.21474/IJAR01/7478

RESEARCH ARTICLE

CONSISTENCY EFFECTIVENESS OF ARGUMENTATION STRATEGY IN DIRECT INSTRUCTION MODEL TO IMPROVE STUDENT PROBLEM SOLVING SKILL.

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Manuscript Info

Manuscript History

Received: 24 May 2018
Final Accepted: 26 June 2018
Published: July 2018

Keywords:-
Problem solving skills; direct instruction model; strategy of argumentation.

Abstract

This research aims to find consistency of argumentation strategy in direct instruction model to improve problem solving skill students on thermodynamic course. This study is the stage of implementation of the direct instruction model with argumentation strategy. The implementation is done to 66 physics education students from two classes in FKIP ULM that programmed the thermodynamics module as research subject. To see the consistency of effectiveness of the learning strategy in improving problem solving skills an independent t-test was performed on the normalized gain score analysis of the pre-test post-test scores for both classes. The result of n-gain analysis for both classes is in moderate category with n-gain score for first and second class are 0.69 and 0.60. The independent t-test of the n-gain results shows that the t_{count} of 1.75 and the $t_{critical}$ of 1.99. Since the value of t_{count} is smaller than the $t_{critical}$ value means there is no significant difference between the improvements of students' problem solving skills taught by the argumentation strategy in the direct instruction for the two classes. Based on the results of the analysis it can be concluded that the implementation of argumentation strategy in direct instruction model consistent in improving students' problem solving skills in the thermodynamics module.

Introduction:-

Problem solving is one of the 21st century skill which is recommended to be owned by invidual in daily life. Problem solving skill as a mental and intellectual process which is used by students to relate the prior knowledge and the problems they are facing, and also call on the past experience of problem solving so that they get a solution of the problem (Kirkley, 2003). Problem solving has the components of filing argument, strategy identification, and evaluation of solution (Snyder & Snyder, 2008). Argumentation itself is viewed as an important thing in science learning because it is a very basic core activity in which students need argumentation to strengthen their understanding in learning (Erduran, Simon, & Osborne, 2004). Argumentation is defined as reasoning process which contributes in the activity of considering alternative in a situation or theory. Scientific argumentation can help students to improve knowledge and support their problem solving skill.

Relevant to the demands of 21st century skills, Indonesian government has developed and applied Kerangka Kurikulum Nasional Indonesia (KKNI) or Indonesian National Curriculum Framework to achieve college graduates

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competence standards which fit the job demands and 21st century skills demands. Duschl (2008) explains that the teaching of physics needs to shift to what students need to do (*to do*) to study science. Duschl (2008) further states that *to do* is a process of dialogue in building knowledge to make explanations, predictions, and reasoning that involve students' thinking skills to fit the job demands and 21st century skills demands.

Conditions to build student knowledge, explanations, predictions, and reasoning are part of the problem solving skills. In the study of physics, problem solving skills are very necessary for students to understand the flow and systematical problem solving. Experts see physics as general and coherent concepts structure which describe the nature and use systematic approach, reasoning, problem solving based on concept which is applied in various situation (Wieman & Pierkins, 2005). A good implementation of physics learning can promote intellectual development. Intellectual mental development does not aim to produce more scientists, but develop their thinking potentials (Gedrave, 2009; Fuller, *et al*., 1977). Thermodynamics is a knowledge to learn the relationship between heat and work, and the characteristics supporting it. It also can be said that thermodynamics teaches about energy and transformation (Hadi, 1996). Thermodynamic study requires three approaches: macroscopic, statistical and microscopic. Gas kinetic theory is one of the topics studied in thermodynamics modules. This topic becomes a bridge to connect the microscopic view with a macroscopic view. Thermodynamics as a branch of physics has a structure of coherent concepts and uses approach systematic, based concepts that apply to variety situation. The results of preliminary observations indicate that the problem solving skills are lacking students on the kinetic theory of gases in thermodynamic lectures.

Direct instruction model is particularly designed to develop declarative and procedural knowledge given by gradual activities pattern, step by step (Suhana, 2014). Direct instruction is an approach which teaches about basic skills for subjects that is oriented on a strictly structured learning purpose and environment (Nur, 2008; Atqiya, Arifuddin, & Mahardika, 2016). Argumentation related with stages for get and compile components data and facts with something statement can develop critical attitude on student (Duschl& Osborne, 2002). Argumentation itself is viewed as an important thing in science learning because it is a very basic core activity in which students need argumentation to strengthen their understanding in learning (Erduran, Simon, & Osborne, 2004). Scientific argument can help student for improve problem solving skills in learning. An initial observation that methods used in recovery still oriented on results learn student, yet effective in improving student problem solving skills. Based on the facts, an appropriate learning strategy is then needed by integrating argumentation in direct instruction model to improve physics problem solving skill in thermodynamics module.

Method:-

The focus of this study is to see the consistency effectiveness students' problem solving skill in physics by using argumentation strategy in direct instruction model in thermodynamics module. This research goes through these stages: (a) direct instruction model syntax by including argumentation strategy which is operationalized in form of thermodynamics teaching material, (b) implementing the strategy by using a valid teaching material in two classes.

In order to see the consistency effectivenesss of learning strategy, it is implemented to 66 Physics students FKIP ULM which are registered in thermodynamics module as the research subject grouped into two classes/ groups. The first group consisted of 35 students and the second group consisted of 31 students. The used instrument to collect data is a problem solving test instrument with the indicators of filing argument, strategy identification, and evaluation of solution. Pre-test and post-test are done to see the effectiveness of strategy in improving students' problem solving skill, then the gained data is analyzed by using normalized gain score analysis. Normalized gain score analysis is based on the following formula (Hake, 1998):

$$\langle g \rangle = \frac{\%\langle S_f \rangle - \%\langle S_i \rangle}{100\% - \%\langle S_i \rangle}$$

With:
$\langle g \rangle$ = normalizedgain
$\langle S_f \rangle$ =pre-test score
$\langle S_i \rangle$ = post-test score

The data gained in implementation stage is consulted on Table 1 to see the effect of learning strategy which is developed toward the improvement of problem solving skill. The reference of gain score (Hake, 1998) is as following:

Table1:-Gain score reference

Scale	*Criteria*
(<g>) > 0.7	*High-g*
0.7 > (<g>) > 0.3	*Medium-g*
(<g>) < 0.3	*Low-g*

To determine the consistency of the problem solving skills improvement, an independent t-test was performed to the n-gain score of the two experimental subject groups. Analysis t-test using to see consistency n-gain score from two experimental subject groups, with the test criterion if $t_{count}<t_{critical}$ forn-gain score means there is no difference in the increase of n-gain score of both subject groups or both group outcomes is consistent, and if $t_{count}>t_{critical}$ for the n-gain score means there is an increase in the value of n-gain both groups of subjects try or both group outcomes is inconsistent.

Results and Discussions:-

The effectiveness of the direct instruction model using argumentation strategies to improve student problem solving skills in the thermodynamic course of gas kinetic theoretical topics for the two experimental subjects can be seen in Table 2.

Table 2:-Skill Test Results Problem solving skills

Information	**Group1**		**Group 2**	
	Pre-Test	**Post-Test**	**Pre-Test**	**Post-Test**
Number of students	35	35	31	31
Highest score	53	84	48	88
Lowest score	25	67	28	64
Total average	37.51	77.23	31.18	72.35
N-gain	0.69		0.60	
t_{count}	1.75			
$t_{critical}$	1.99			

Result of problem solving skill test in Table 2 generally shows an increase in the mean values from *pre-test* to *post-test* for both group 1 and group 2. For group 1, the *pre-test* average score of 37.51 increased to 77.23 for *post-test* with n-gain of 0.69 and included in the moderate category. For group 2, the average score *of pre-test* by 31.18 increased to 72.35 for *post-test* with n-gain of 0.60 and included in the medium category. Table 2 above shows that implementation direct instruction model with the argumentation strategy had a positive impact on improving problem solving skills of the students on the topic of the kinetic theory of gases. Table 2 also shows that t_{count} for both n-gain score of 1.75 while for the $t_{critical}$ of 1.99. This result shows that t_{count} smaller than $t_{critical}$, it shows that direct instruction with argumentation strategy consistently improves students' problem solving skills in the moderate category.

Implementation stage of the direct teaching model is done with the following steps. On phase 1 of direct instruction model, researcher tells the purpose of research and get the students ready. Researcher also explains the outline of material which will be learned and builds the students' confidence to reach the learning purpose. The learning activity then continues to the phase 2. On the phase 2 of knowledge demonstration, researcher teaches the way to solve problems with the steps of filing arguments, strategy identification, and evaluation of solution (Arifuddin, Mastuang, & Mahardika, 2017). Researcher gives emphasis on how to identify the correct strategy in solving a physics problem. After problem solving step is demonstrated, continues to phase 3 of direct instruction model which is guiding. On this phase, students learn to follow the steps which is already explained by researcher (imitation). It corresponds the theory of social learning which is explained by Albert Bandura in which students can learn through imitation and presentation of behavioral examples (modeling). Researcher checks students' understanding and gives feedback on phase 4. On this phase, researcher gives assignment whose difficulty level is harder than the exercise and question example. It aims to check students' understanding. Researcher then gives feedback, it is done in the

same time when students compare their answers with the answer key, and also gives motivation to students' answers. The last phase is giving opportunity for advance learning and application, researcher gives homework to students and conclude the lesson. Thermodynamic learning that implements the phases of filing argument, strategy identification, and evaluation of solution in the direct instruction model has proved effective and consistent in improving student problem solving skills on the topic of gas kinetic theory.

Conclusion:-

Based on the result of this research, it can be concluded that through the implementation of the argumentation strategy on the direct instruction model consistent in improving student's problem solving skills on the topic of gas kinetic theory in the thermodynamics module.

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