AIP Conference Proceedings

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Citation: AIP Conf. Proc. **1555**, 94 (2013); doi: 10.1063/1.4821001
View online: http://dx.doi.org/10.1063/1.4821001
View Table of Contents: http://proceedings.aip.org/dbt/dbt.jsp?KEY=APCPCS&Volume=1555&Issue=1
Published by the AIP Publishing LLC.

A Scheme of Pedagogical Problems Solving in Kinematic to Observe Toulmin Argumentation Feasibility

Sondang R Manurung[1,2,*], Nuryani Y Rustaman[1] and Nelson Siregar[1]

[1] *Universitas Pendidikan Indonesia(UPI), Bandung,Indonesia*
[2]*Departement of Physics Education, Universitas Negeri Medan, Indonesia*
**Email: sondangrina@gmail.com*

Abstract. The purpose of this study is to determine the students' ability to map out the problem solving. This paper would show a schematic template map used to analyze the students' tasks in performing problem solving pedagogically. Scheme of problem solving map of student was undertaken based on *Toulmin Argumentation Pattern* (TAP) argumentative discourse. The samples of this study were three work-sheets of physics education students who represented the upper, middle and lower levels of class in one LPTK in Medan. The instrument of this study was an essay test in kinematics topic. The data analyses were performed with schematic template map in order to know the students' ability in mapping the problem solving. The results showed that the student in the Upper level of class followed the appropriate direction pattern, while two others students could not followed the pattern exactly.

Keywords : Toulmin Argumentation Pattern (TAP), Problem Solving Pedagogical, Kinematics
PACS : 00-01.40.gb

INTRODUCTION

Kinematics learning through the hypertext media based on argumentative discourse was considered to be able to enhance students' ability to solve problems structurally. This means, that that it is patterned in two dimensions, *i.e.* sequences and matching (Siregar *et al,* 2009). Subject matter formulated in text will be the result of problem-solving activities. The demands of subject matter mastery contain mastery of skills related to solving the real problem underlying the subject matter. However, it does not mean that students have to solve all of the subject matters, because the demand is less appreciated to the function of pedagogical teaching duties. Subject matter can be shown in the form of problem solving if they meet the instructive criteria. A problem solving process needs simplification and reorganization so that it functions better to serve the principles of science formally, empirically, and technically. Application of problem solving eases students to construct knowledge of subject matter and train their intellectual skills. Pedagogic simplification improves abstract knowledge construction through instructive problem solving. This improvement can ease students to solve problems and furthermore enhance intellectual skills.

According to Cohen (1980), argumentative discourse is a speech that provides the basic examples and strong evidence which convince people to justify it. The efforts that can be done to run the logical navigation is by making hypertext based on argumentative discourse; in a sense that it keeps the consistency in understanding the various levels of abstracts and the overall organization TAP scheme (Toulmin, 1958) with the components as described in Figure 1.

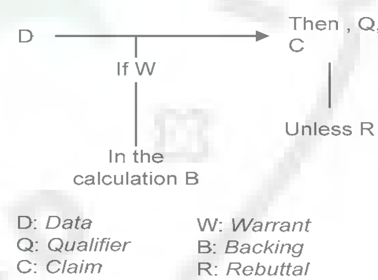


FIGURE 1. TAP Diagram with its components.

The characteristics of the pedagogic problem solving is the use of more clearly steps involving others in which the knowledge is characterized by the application of sequences dimensions and integrating toward the problem-solving process. Integrating the dimension constructs the concept to establish support stage. Problem solving oriented on pedagogy involves unnecessary directed on problem solving. The stages in the dimensions of the problem solving sequence to follow the following steps: (a) Visualization condition issue (b) Description of physics, (c) Planning solution (d) Implementation of the solution, (e) Evaluation and checks (Heller & Heller, 2010). Integration dimension contains elements of concepts, theories or principles that fulfill certain criteria for solving steps as procedures on the steps in the sequence dimensions. The purpose of the study reported in this manuscript is to determine the students' ability to map out the

International Conference on Theoretical and Applied Physics (ICTAP 2012)
AIP Conf. Proc. 1555, 94-98 (2013); doi: 10.1063/1.4821001

problem solving. The new result of study are: (1) The Toulmin argument feasibility in solving the problem can be mapped, (2) cognitive abilities in solving problems can be detected, (3) This lines of reasoning of student in solving problems can be observed.

RESEARCH METHODS

The research method is a qualitative research method through the analysis of TAP, the working paper of students in solving problems will be analyzed to see the feasibility Toulmin argument The samples of this study were three work-sheets of physics education students who represented the upper, middle and lower levels of class in one LPTK in Medan. The instrument of this study was an essay test in kinematics topic. The data analyses were performed with schematic template map in order to know the student ability in mapping the problem solving.

STUDY RESULT AND DISCUSSION

In problem solving, the student who represents the upper level of class followed the stages 1-5. The task on the work-sheet was replaced into SPM form as shown in Figure 2 to Figure 6. The Stages are,

1. Identifying the Problem
2. Finding of car track distance using the Formula 1: $\bar{v}_1 = \frac{x_1 - x_0}{t_1 - t_0}$ Schema of problem solving as shown in Figure 3.
3. Finding of car moving time from starting in the brake until it stops (t_2) use the Formula 2: $\bar{a}_2 = \frac{v_2 - v_1}{t_2 - t_1}$ Schema of problem solving as shown in Figure 4.
4. Finding of car traveled distance after braking to a stop (x_1) used the Formula 3: $x_1 = v_0 t + ½ at^2$, problem solving scheme as shown in Figure 5.
5. Finding distance track car after seeing braking lights until the car stops (x_2) use the Formula 4: $x_2 = x_0 + x_1$, problem solving scheme as shown in Figure 6.

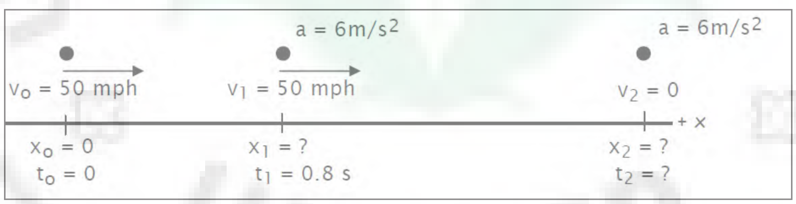


FIGURE 2. The schematic of physical understanding.

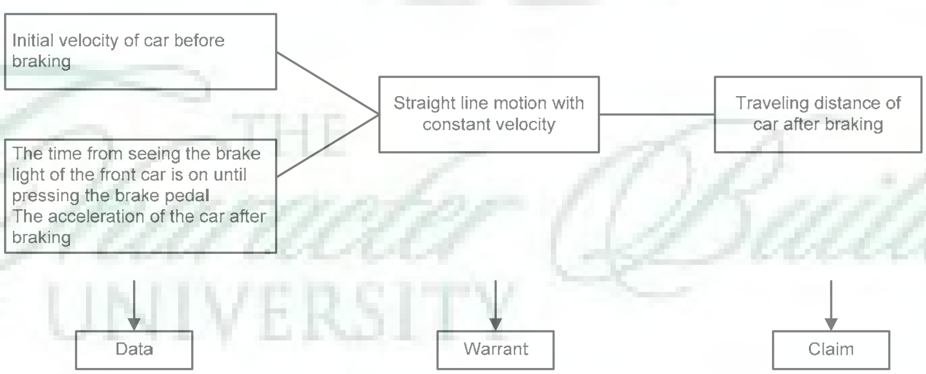


FIGURE 3. Schematic of problem solving finding out the distance track car.

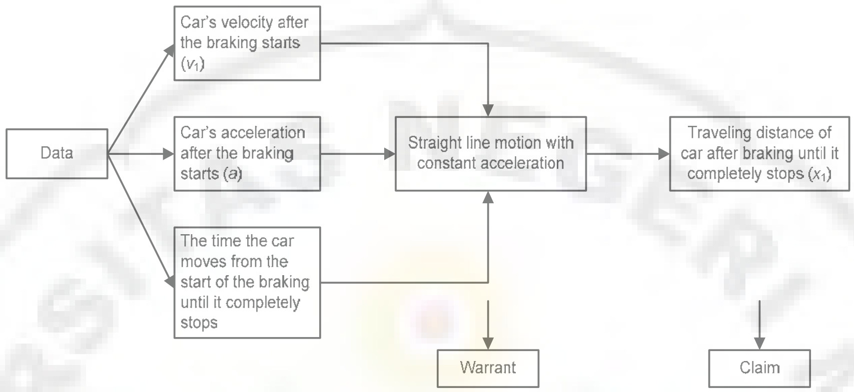


FIGURE 5. Schematic of problem solving finding out the car track distance after braking to a stop.

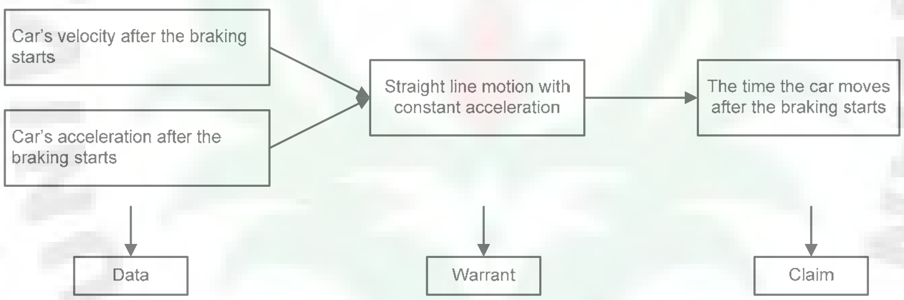
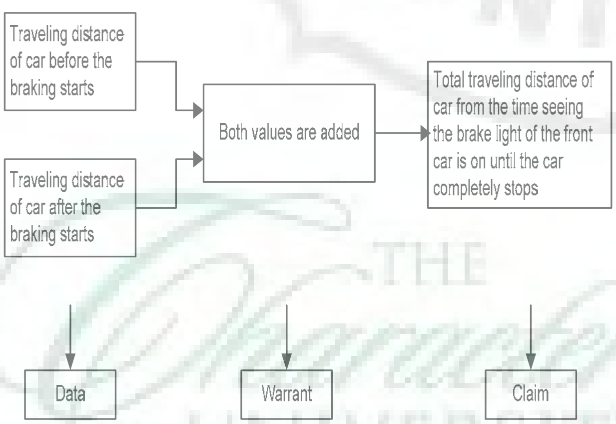


FIGURE 4.Problem Solving Scheme finding out time t2 car moving after braking to a stop



(Adapted from Siregar *et al,* 1995)

FIGURE 6. Schematic of problem solving finding out the distance of the track car after seeing braking lights to car stopping.

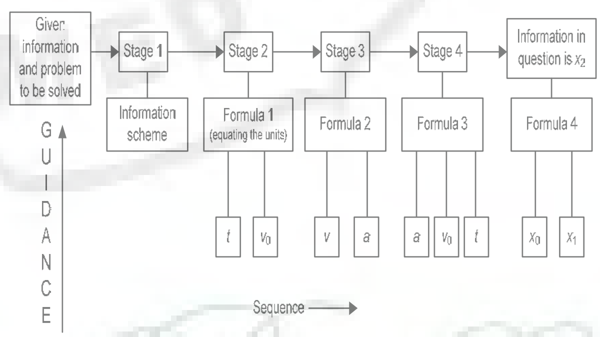


FIGURE 7. Problem solving scheme (SPM) in solving the kinematic.

SPM that is shown in Figure 7 was mapped with the pattern of TAP component appropriately. For example, in Figure 2, the data were variable of physics that is known namely, *i.e*. the initial velocity and the time to see the brake lights. This data is used to find the distance of the car after the brakes (*Claim*) using the rules of motion with constant velocity *(Warrant).* This applies to the Figure 3 until Figure 6.

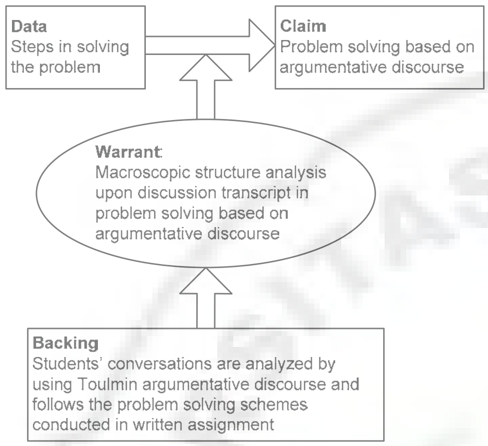


FIGURE 8. Inauguration of the discourse-based problem solving irrefutable argument.

Stage 2 to Stage 6 were mapped to SPM (problem solving scheme) as shown in Figure 7. Analyzing students work sheets in problem solving can be explained as follows: (a) students who represents the upper group, tend to follow the scheme which is used in solving the problem as shown in Figure 7. To present the scheme and identification of known variables and solving steps, (b) student representing the middle group describing the scheme as on Stage 2 - Stage 5 (in Figure 7), as well as the stages did not follow the proper sequence of solutions; (c) a group representing the lower student present the information schema that was not supported the factors that explaining the scheme, identifying the problem was still weak. Similarly, the ability to follow the order of the stages of the solution has not followed the pattern in Figure 7.

SPM showed the image pattern according to the TAP component. For example, in Figure 2, the data are variable and unknown physics that is the initial velocity and time to see the brake lights. This data is used to find the distance of the car after the brakes (*Claim*) using the rules of motion with constant velocity *(Warrant)*. The same applies to the next image. Global SPM in Figure 7, showing claim 1 as a result of an uncontested by *Warrant* 1 on Stage 2 is data 2 at Stage 3 to obtain an uncontested claim 2

Problem solving through group discussion after the transcript was analyzed by reducing micro proposition, shows TAP component. Representation of pedagogic problem solving in the global structure of the macro is shown in Figure 8.

CONCLUSION

From the analysis of the above data it can be seen that student problem solving strategies represent the upper group had done the appropriate SPM compared than students who represent the middle and lower groups. This is consistent with the findings (Reif and Heller, 1982) that the structure of expert (representing the upper group) shows the hierarchy of the organization better than the beginners (representing the middle and lower). The results showed that the 'experts' use *'working-forward'* or strategy 'knowledge development' while 'beginners' use strategies *'working-backward'* or analysis *'means-ends'* (Simon & Simon, 1978; Larkin *et al.,* 1980). Strategies *'working-forward'* indicates that the expert work begin to analyze the problem (initial state) to the goal of finding the answers you need. While the strategy of 'working backwards' work from the goal to the initial goal (Schunk, 2000), cannot solve the problem quickly or using longer (Simon & Simon's, 1978).

Physics characterized as having a hierarchical structure of knowledge is very strong. Therefore, difficulties in learning the subject lie not only in the number of concepts to be learned, but also lies in studying the relationships between concepts. In this case, it can be affirmed that the problem solving steps to demonstrate the power of the arguments to the pattern appropriate to the Toulmin Model, which shows the strength of the epistemology of science. According to Toulmin (1958), the framework scientific reasoning in any context, revealed as an argument the components: data, *warrant,* and claims. Furthermore, he said that the argument, data and the *warrant* must be provided to support the claim and convince others. Further adding that the structure argument is a generic form in the whole domain but quality of the argument is depending on the context. Means, component data, warrant, support, and claims can be observed across domains but which is considered as data, warrant, and support is depending on context (Driver et al., 2000). Thus, the pattern of Toulmin argument (TAP) can be used as a framework to assess reasoning scientific and to teach scientific reasoning dependent on both generic content and skills specific. Problem solving always follow the scientific reasoning-based argumentative discourse with the components of the structure.

ACKNOWLEDGEMENTS

The author pays highest gratitude and appreciation to Aloysius Rusli as co-promoters who have guided the author with caring, sincerity, and patience in completing this article.

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