

# Modelling Scientific Argumentation in the Classroom : Teachers perception and practice

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**Abstract.** The purposes of this study were to investigate teacher's perception about scientific argumentation and how they practice it in their classroom. Thirty biology teachers in high school participated in this study and illustrated their perception of scientific argumentation through a questionnaire. This survey research was developed to measure teachers' understanding of scientific argumentation, what they know about scientific argumentation, the differentiation between argument and reasoning, how they plan teaching strategies in order to make students' scientific argumentation better and the obstacles in teaching scientific argumentation. The result conclude that generally, teachers modified various representation to accommodate student's active participation, but most of them assume that argument and reasoning are similar. Less motivation, tools and limited science's knowledge were considered as obstacles in teaching argumentation. The findings can be helpful to improving students' abilities of doing scientific argumentation as a part of inquiry.

## 1. Introduction

Lately a lot of educational research that examines the importance of argumentation in learning, both on the subjects of social and exact sciences. Facts show that many students who have the skills to argue because he was not accustomed to doing so. In learning science, scientific arguments are part of a form of scientific communication which is an integral part of the nature of science. Low ability scientific argument indicates the limited ability of students in scientific thinking and understanding of science as a whole, both the content and context, but learn not only assumed as absorbing or transfer of knowledge, but rather build or reorganize knowledge [1][2]. Several studies have shown that the weakness of the arguments do not only occur in primary or secondary education, but also on higher education. Most students only partially understand the concept of argumentation alone and this is mainly due to a lack of knowledge about the importance of the argument to define their own position in the academic discussion [3]. The purposes of this study were to investigate teacher's perception about scientific argumentation and how they practice it in their classroom.

### 1.1. Deliberate Discourse in Scientific Argumentation

Classroom discourse plays an important role for the achievement of learning goals in science, especially those relating to scientific communication. This mainly refers to the use of language used by teachers and students in classroom interaction. In relation to science learning, classroom discourse is focused on the use of scientific language and how the situation after a practicum class discussion or lesson. Scientific discussion involving the participation of students in the form of a question, answer, assertion and argument to clarify the resolution of a case or problem. Argumentation in science learning does not end merely positioned as brainstorming, but led to an innovation, either in the form of a change of attitude, perspective or knowledge. In this case the students can work individually or in collaboration with others. Some things to note in this regard is considerable discussion time, place and



situation conducive to stimulate students to exchange ideas and thoughts without making others feel inferior or cornered [4]. Deliberative discourse in the scientific arguments made in the form of participatory communication and collaborative cooperation focused on solving the problem on a particular topic. In deliberative discourse, the debate in the discussion would make the students know how a problem is seen from different views with reasons and arguments respectively.

### *1.2. Argumentation and Scientific Explanation*

Many people who claim that argumentation and scientific explanation are basically similar, assuming both are equally in need of a statement with the reasons. In fact, the arguments have different standards of adequacy with the scientific explanation. Scientific explanation is considered good if it can be clearly understood, convincing, and relevant. The argument requires different standards is strong evidence and anything that can make the explanation can be explained both by the context and the content so that students can see the explanation more than just facts and challenges them to build an explanation for addressing problems [5]. However, explanation and argumentation together complete the practice of science through the construction process knowledge in the scientific community. Both of these components work in synergy and complement. Scientific explanation was obtained through the efforts of individuals, whereas others involve arguments that need to be assigned their position, whether it supports or opposes the idea it conveys. The success of the arguments requires their statements, evidence and convincing explanation [6]. The argument is needed to validate the scientific explanation because it is often found several different explanations for the same phenomenon [7].

### *1.3. Justifying Scientific Argumentation in the Classroom*

In practice, the scientific justification of argumentation in science classes include two things, the truth is the truth content and structure. Structurally, the argument can be measured with Toulmin's Argument Pattern (TAP), which contains four aspects of the argument, namely the claim, data, warrants and backing. Data, claims, and warrant a fundamental element of the argument. Claim is a statement obtained through argument. Data are facts that support the claim. Warrant used to explain the claim through the evidence obtained. Backing consolidate warrant and describes the relationship between data, warrants and claims [8]. The structure of the argument can be different, depending on the context. In many cases, often encountered the confusion between the arguments that are structurally appropriate but the content is wrong, or vice versa [9].

## **2. Methods**

The study involved 15 participants' biology teacher in the scope of Central Java, which were selected through purposive random sampling taking into account interest and their interest towards learning arguments in class. All participants are biology teachers who have taught for at least five years in high school between the ages of 30-45 years. Methods of data collection is done by filling questionnaire survey regarding the views of the argument, what distinguishes the argument in science classes with others, why the scientific arguments essential for science learning and the extent to which they accommodate students to argue. Furthermore, researchers and the teachers do a focus group to get recommendations on the appropriate learning models to stimulate and enhance the ability of the student's argument. As a supporter, made the observation at a grade one teacher who gets the best ratings to see how the implementation of learning that are thought to increase the motivation and skills of the students argued. The study analysed qualitatively to obtain an overview of the arguments of teachers in science classroom.

## **3. Findings and discussion**

### *3.1. Teachers Perception of Argumentation in Learning Science*

Observations and structured interviews with teachers show many differences of opinion regarding the scientific argumentation teacher. Most teachers still consider that the same scientific argumentation with reasoning and explanation.

**Table 1.** Teachers perception of scientific argumentation

Name	Institution	Perception of scientific argumentation	Teaching argumentation in the class
A	State high school	The argument is the student's ability to give a reason	Yes
B	Private high school	The argument must be accompanied by tangible evidence	Yes
C	State high school	The argument must be through discussion	Yes
D	State high school	The argument is identical to the factual truth	Sometimes
E	State high school	Arguments part of the scientific method	Yes
F	Private high school	The same arguments with reasoning	Yes
G	State high school	Scientific argument is difficult because not all students are actively participating	Yes
H	State high school	Arguments = reason with proof	Yes
I	State high school	The argument is the ability to convince others	No
J	State high school	Arguments need data and facts	Sometimes
K	Private high school	Scientific argument is part of the discussion to find the truth	Yes
L	State high school	Arguments = grounds with a solid foundation	Yes
M	Private high school	Arguments = reasoning	No
O	Private high school	Arguments = an argument	Yes

The table above shows that most teachers feel that they have done the learning skills of argumentation accommodate students, although many still do not understand the meaning, structure and how scientific argumentation is formed. The results of the interview further mentioned that most of the activities carried out in the form of argumentation class discussions and presentations.

### 3.2. Obstacles with scientific argumentation

Some difficulties in teaching argumentation in science classes are presented as follows:

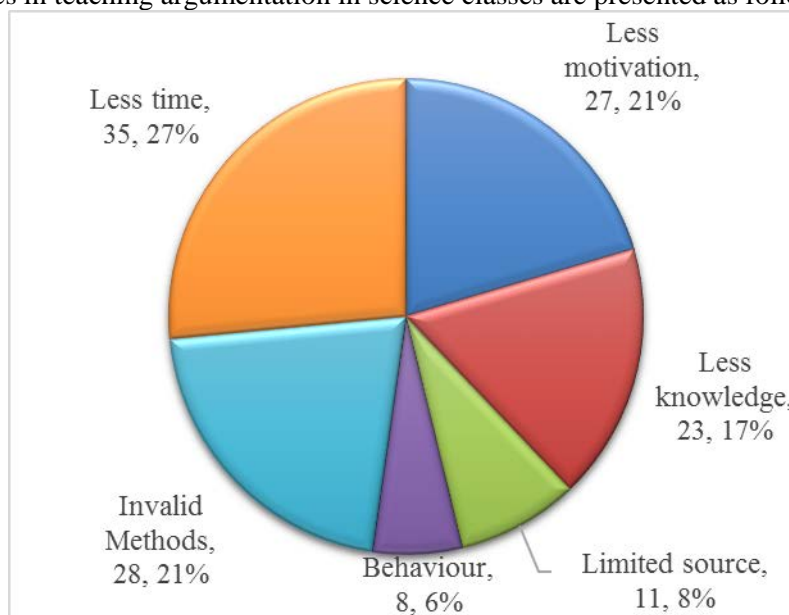
**Figure 1.** Teachers obstacles with teaching argumentation

Figure 1 shows that the difficulty in teaching the scientific arguments in school mainly due to circumstances that are not conducive. The results of the investigation with the teacher mentioned that some of the obstacles are : the limited time, less student motivation, lack of knowledge, limited learning resources, the environment is not supportive, and less accuracy of learning methods. Some teachers still consider that the application of argumentation in science learning takes more time, because it should be done through open discussion, but on the other side, the time schedule of their lesson plan is running.

### 3.3. Teachers activities daily notes in teaching argumentation

Some examples of daily records of teachers in science learning is presented below :

3.3.1. *Hydrilla sp* and fishes. are the components of abiotic, while water is a abiotic components in pond ecosystem. Student 1 = True, because Hydrilla sp. and animals are living things, and be able to breathe, so it can meet the biotic component categories. While the water is not a living being so that said abiotic components (A good argument because there are some proper and appropriate reason) Student 2, Abiotic: physical and chemical components in the ecosystem. Biotic: all living things (The argument is not appropriate for the wrong reasons)

3.3.2. *Each trophi.* levels in the food chain could eat or be eaten for one organism or more in the other trophic levels. Students 3 = Correct, because the food web consists of some of the food chain and an organism that occupy trophic levels in the food chain not only eat one type of food, nor eaten by one type of organism, such as cattle and buffalo grass eaten. (A good argument because there are some proper and appropriate reason) Students 4 = Right, because the food web is not only one trophic. (The argument is not appropriate for the wrong reasons)

The samples above indicates that the teacher gives the student activity assessment argument based on their reasons and their relevance to the question asked, not referring to the standard argument intact. Teachers reported that the debriefing and discussion activities students are also still dominated by many students who say "do not want" and "agree with ....." but still they can not able to provide the strong and logical reasons. The standard argument is the simplest such claims, evidence and reasoning [10] has not been seen here.

### 3.4. Limitation of modelling argumentation in the classroom

The argument is crucial to develop critical thinking and give more deep understanding of ideas and opinions, referring to the proposition with supporting evidence and reasoning [11]. Students perform the process of thinking and social interaction to build and evaluate the arguments of others so that they understand how they think a true scientist [12]. It is a major concern in the learning of argumentation in science classes is how to condition conducive learning environment for students so that students really enjoy the excitement of finding new ideas or even disappointment if there are inaccuracies in giving argument. Internal factors such as motivation and the feeling is very influential here so in practice, teachers have to be smart to choose a model and learning strategies that can stimulate students to win the argument without feeling burdened. In practice, the teacher considers the argument hardly taught because of the assumption that the ability to argue, pull out the ideas, the natural talent of the students. In addition there is the assumption that as long as the students can understand the concepts being taught and to answer exam questions are given, meaning the learning objectives have been achieved, and scientific arguments are less important to students because it is not all about the type of open-ended question or require detailed reasons. It should be understood, how teachers teach students to understand that the simplest argument is more than just giving a reason, but must meet certain components, such as from the claim, evidence, and reasoning [13]. Claim is a statement to answer a question or problem. Truth claims are determined by evidence and reasoning used. Claim is considered correct when it was able to answer questions, along with supporting evidence and reasoning that provide justification or excuse. Evidence is evidence or scientific data supporting the claim, such as measurement data, results of research, observation, and others. Reasoning contain scientific principles that explain the relationship evidence to claim higher levels of the argument made,

the evidence presented in more detail. Reasoning is the justification or reason for linking evidence used by the claim [10].

Learning strategies to improve students' skills of argumentation should be directed to the investigation or inquiry as well as how they communicate during the investigations carried out [14]. The argument is very useful to support the scientific communication so that students can see an invention with different viewpoints and support their scientific attitude.

#### 4. Conclusion

This study investigated teacher's perception about scientific argumentation and how they practice it in their classroom. Based on the results, some conclusions are made as follows : generally, teachers modified various representation to accommodate student's active participation, but most of them assume that argument and reasoning are similar. Less motivation, tools and limited science's knowledge were considered as obstacles in teaching argumentation. The findings can be helpful to improving students' abilities of doing scientific argumentation as a part of inquiry.

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