



ICMSE 2015

INTERNATIONAL CONFERENCE ON MATHEMATICS,
SCIENCE, AND EDUCATION



Proceeding of

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SCIENCE, AND EDUCATION 2015**

*Applied Research of Mathematics and Natural Sciences
to Improve Its Usefulness for Knowledge and Society*

**Aston Hotel, Semarang
5 – 6 September 2015**

Organized by
Faculty of Mathematics and Natural Sciences,
Semarang State University - Indonesia



**PROCEEDING
INTERNATIONAL CONFERENCE ON MATHEMATICS,
SCIENCE, AND EDUCATION**

**"Applied Research of Mathematics and Natural Sciences to
Improve Its Usefulness for Knowledge and Society"**

Reviewers:

Prof. Dr. Hans-Dieter Barke
Prof. Ir. Ibnu Maryanto, M.Si., Ph.D.
Prof. MD Rahim Sahar
Prof. Dr. Supama, M.Si.
Prof. San Pin Jiang
Prof. M.Supar Rohani
Prof. Dr. Poonsuk Prasertsan
Prof. Dr. Wiyanto, M.Si.
Prof. Dr. Edy Cahyono, M.Si.
Assoc. Prof. Visith Chavasit
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Assoc. Prof. Dr. Artoto Arkundato
Assoc. Prof. Dr. Hasniah Aliah
Prof. Dr. Supriyadi, M.Si.
Prof. Dr. Sutikno, M.Si.

Editors:

Prof. Dr. Sutikno, ST, MT
Arif Widiyatmoko, M.Pd
Dr. Masturi, M.Si
Aji Purwinarko, M.Cs

**FACULTY OF MATHEMATICS AND NATURAL SCIENCES
SEMARANG STATE UNIVERSITY
2015**

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Faculty of Mathematics and Natural Sciences
Semarang State University
Gedung D12 Lt 1 Kampus Sekaran Gunungpati Semarang, Indonesia 50229
Phone : +62248508112, +62818241519
Website: <http://icmseunnes.com>
Email: icmse2015@gmail.com

PREFACE

Thanks to God Almighty this International Conference Proceeding could be completed. All articles in this proceeding are presented in International Conference On Mathematics, Science, and Education – Applied Research of Mathematics and Natural Sciences to Improve Its Usefulness for Knowledge and Society on September 5-6, 2015 at Aston Hotel Semarang. This Conference is organized by Faculty of Mathematics and Natural Science. This proceeding has been reviewed of Mathematics and Science experts before it is published.

This conference is designed to improve the discussion and research scope in mathematics, science, and education area in the international level. Sub topics in this proceeding cover mathematics, applied mathematics, and mathematics education in accelerating character building. Enhancing biology and biology education research for a better life. Green chemistry in research and education. Physics and physics education for trending research. Hopefully this publication of proceeding will be profitable for all of us.

Semarang, 3 December 2015

Regards
Committee of ICMSE 2015

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MESSAGE FROM THE DEAN OF FMIPA UNNES

Dear Participants of ICMSE 2015,

It is a pleasure to welcome all of you in the first International Conference on Mathematics and Science Educations (ICMSE 2015) held by Faculty of Mathematics and Natural Sciences, Semarang State University.

Faculty of Mathematics and Natural Science Semarang State University or more popularly known as FMIPA Unnes has 6 departments and 11 study programs of Mathematics and Natural Sciences education backgrounds and non education backgrounds. FMIPA Unnes has the mission of being an excellent and meaningful faculty by improving human resources through scientific activity.

One of efforts to result excellent and meaningful human resources through scientific activity is by performing discussion and knowledge sharing. To widen discussion of science and research development in mathematics and science educations scopes in national and international level, ICMSE 2015 was initiated as the medium of that discussion. I believe that ICMSE 2015 as the first international conference held by FMIPA Unnes can facilitate the knowledge sharing in mathematics and science educations area in order to establish a global cooperation among experts and researchers.

With the hope that this conference will be the medium to optimize the role of Mathematics, Science and Education in global cooperation, I am proud to welcome all of you and I wish you a pleasant sharing and discussion in this conference and enjoyable stay in Semarang, Indonesia.

Prof. Dr. Wiyanto, M.Si.

Dean of Faculty of Mathematics and Natural Sciences
Semarang State University

MESSAGE FROM CONFERENCE CHAIRMAN

My pleasure, welcome to you today on the occasion of this International Conference on Mathematics, Science, and Education (ICMSE 2015). I would like to extend my warmest welcome to all of the distinguished participants, especially those who have travelled long distances to be present here. This conference has already established itself as a key event to offer various thoughts and knowledge in enhancing our understanding in fundamental sciences and education.

This conference focus on “Applied Research of Mathematics and Natural Sciences to Improve Its Usefulness for Knowledge and Society”, offers all of us the opportunity to explore exciting information. The aim of the conference is to provide an interdisciplinary forum for scientist engaged in the full spectrum of research and development activities. The meeting intends to bring together researchers, scientists, and scholars to exchange and share their experiences, new ideas, and research result in related fields and discuss the practical challenges encountered and the solutions adopted. I invite all of you to approach this year's events to take advantage of the many ways in which you too might explore the unfamiliar - and discover a great deal in the process.

First, the various sessions that have been organized for the next day promise exciting revelation for all who attend them. Each speakers who are experts in their respective fields, will address a major topic or issue related to Fundamental Sciences,. You might learn more about a topic with which you were already familiar; or you might also find yourself discovering a whole new world of ideas and information you didn't know existed. Either way, you'll have many opportunities to explore fascinating new terrain with these reputable speakers.

Second, the key note speakers will provide, for all of us, an important window into the world of the future. We are privileged to have them as our key note speakers Prof. Barke, Munster University Germany, Prof. Martin Stein, Munster University Germany, Prof. Simone Krees, Munster University Germany, Prof. Matthias Ludwig, University Frankfurt Germany, Prof. Van Horsen, Delf Univesity Netherland, Prof. Rahim Sahar, UTM Malaysia and Dr. Margareta Rahayuningsih, M.Si experience has taken them through the whole cycle of Life and General science.

Finally, as you attend these various events, keep in mind that other people can also serve as doorways to new worlds. Hearing of someone else's background and experiences can often make for fascinating discoveries that can educate and profoundly affect us. So take advantage of this rare gathering of hundreds of people working in various fields to meet one another, talk with one another, and learn from one another.

In conclusion, I hope that you will find your time with us exciting. We have a great agenda for you with esteemed speakers and presenters from our profession. I do hope you will enjoy the next couple of days. I would like to once again extend my gratitude to all the participants, generous sponsor and I look forward to a most successful and fruitful conference.

Professor Dr. Supriyadi, M.Si
Chairman of ICMSE 2015

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ARGUMENTS REPRESENTATION OF STUDENTS TO THE SOSIOSCIENTIFIC ISSUE ABOUT VITAMIN D RESOURCES FOR HUMAN

Ipah Budi Minarti¹⁾, Muhammad Syaipul Hayat²⁾

¹⁾ Biology Education Program of UPGRIS

²⁾ Biology Education Program of UPGRIS

ABSTRACT

Exploration study was conducted to analyze the students argument representation of the sosioscientific issue. Analysis carried out on the answers which given to the students about the issue of vitamin D resources for humans. To understand the student argument representation, analysis is done on the quality and student argumentation schemes. Exploration conducted on 32 students of biology education UPGRIS that following the anatomy and physiology of the human body course. Toulmin's Argumentation Pattern (TAP) was used to asses quality of the student's argument. Based on its quality, the student argument on simple category that only consists of claims, evidence, and reasoning, some students showed advanced argumentation capabilities to provide an alternative explanation and rebuttals. Arguments scheme which used by the student to express explanation includes causal schemes, inductive schemes, and arguments from examples.

Keywords: argumentation scheme, representation, the quality of argumentation

INTRODUCTION

Physiology was a branch of biology that has a domain study of physiology. Materials coverage includes mechanisms at the molecular level up mechanism at the level of the organism (Sherwood, 1996; Matter, 2001). Feder et. al. (2012) states that physiology teaches that all of biological phenomena were interrelated. Meanwhile Ritchison (2007) revealed that the physiology reveal how organisms did its function and survive in an ever-changing environment. Thus concepts in studying the physiology associated with each other to form a concept systems (Lawson, 2003).

Think comprehensively needed to study physiology. Mehanna (2004) states that after studying the physiology concepts students are expected to think comprehensively, that was capable to connect between the physiological processes that occur in the human body systems and able to analyze physiological phenomena occur. Michael (2009) states that there were nine core principles that must be understood in the study of physiology, namely: evolution, ecosystem and environment, mechanisms of cause and effect, the cell, relationship of structure and function, the level of organization, information flow, change and energy transfer, and homeostasis. This implies that the

physiology will be more meaningful if the student were able to relate the concepts in physiology with these principles.

Critical thinking skills needed to analyze in relating concepts of physiology with the principles for assessing physiology presented in the form of case study analysis (Clift, 1996), active learning (Russell, 2003), as well as through the issues in physiology (Silverthorn, 2006). Critical thinking skills developed along with building skills of argumentation. Argument was a process which used by someone to analyze information on a topic and then results of the analysis were communicated to others (Inch & Warnick., 2006). Thus the using of argumentation in science learning was part of the development of higher order thinking skills (Thiberghien in Erduran, 2008).

The using of argumentation in science learning has three theoretical framework. The first framework, scientists involves argumentation to develop and improve the knowledge (Lawson, 2003; Aufschnaiter et al., 2007). The second framework, the public must use arguments to engage in scientific debate (Simon et al., 2003; Aufschnaiter et al., 2007). The third framework of science learning process, students need arguments (Osborn et al., 2004; Aufschnaiter et al., 2007). Thus the

using of argumentation in learning has implications for the understanding of the nature of science, ability to communicate critically and the need to explain scientific concepts in scientific.

The study results of Andrews et al. (2006) states that every field of study has the different characteristic of arguments discourse. Biology as one of the disciplines of science that examines the phenomenon of life has special characteristics, especially the branch of physiology. Physiologists examines the phenomenon of cause and effect (causality) ranging from interaction between molecular level elements up to the level of organs and organisms. Thus an understanding of the physiology with the phenomenon of causation needs to be invested from lower education to higher education. As well as scientists, students need to understand the causal

mechanism of living beings that begins by examining its body. Thus the scheme of causality argument can be used by students to make scientific explanations related to the phenomena related to the concept of physiology.

According to Toulmin (1984) argument resembles an organism that has the individual parts with different functions related to the claim. Toulmin model includes three sections in each argument (evidence, reasoning, claim) and parts that were included in the advanced arguments (counterargument, rebuttal). These components work together and explain how they adapted the argument to the variety of situations and contexts, as seen in Figure 1.1. Toulmin's Argumentation Pattern (TAP) offers a method for analyzing and critiquing arguments, so that each component of the argument can be tested, graded strength.

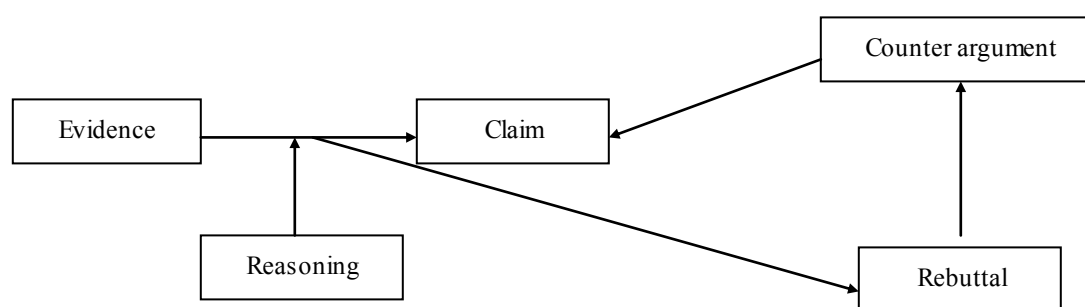


Figure 1. Toulmin's argumentation pattern, based on Toulmin (1984)

Roshayanti research results (2009) concluded that the using of arguments assessment can improve the student argument ability, however, requires a longer learning period when students were involved in the argument discourse. It also corresponded to the using of arguments on inquiry activities also require two times more than prescription inquiry learning (Katchevich, et al., 2013). Based on the using of arguments in assessing the physiological implications in longer learning time, so it need a device that can help more efficiently. Based on it, so it was necessary to make a device to develop the skills of argument. However, to design such devices needed information about how the quality of the students argumentation as well as information about the

argumentation scheme that was used to construct arguments.

METHODS

Exploratory research to describe the representation of student argument using quantitative and qualitative approaches. Open ended test instruments used to collect data about the quality of arguments and to identify the types of schemes used to construct arguments. Quantitative data about the quality of argumentation assessed using the argument instrument assessment rubric adapted from Toulmin's Argumentation Pattern (TAP) aspects (Table 1).

Table 1. Argument assessment rubric instrument (Schen, 2013)

Aspect	0-Poor	1- Weak	2 -Adequat	3 - Strong
Claim	No claim made or is irrelevant to data	Weakly supported by data	Clearly supported by data/scenario and concervative	N/A
Evidence	No evidence given,	Raw data given as list	Non-specific	Specific evidence

	is irrelevant to claim	of columns or rows or no trends identified	evidence given with some trends identified and list of raw data	given with trends and particular list of data
Reasoning	No reasoning made or is irrelevant to data	Restatement of data or vague principle given	Principle stated is relative but not specifically connected to evidence or claim	Principle stated with clear, specific relationship to evidence and/or claim
Counterclaim	No claim made, is irrelevant to data	Weakly supported by data or is weakly opposed to original claim	Clearly supported by data/conservative and directly opposed to original claim	N/A
Rebuttal	No rebuttal made, is irrelevant data	Restatement of original claim or rational or new, vague principle given	Expands previous claim/rationale to address counterclaim	New principle stated with clear support for previous claim/rationale and targets counterclaim directly

To analyze the strategies used by students in constructing arguments then used argumentation schemes. Argumentation schemes used was developed based on the using of warrants in the argument, such as table 2 (Basel, et.al., 2013). Next to describe the quality of the arguments and argumentation schemes that were used to construct the argument by the students, then the quantitative data were analyzed descriptively.

Qualitative data were used to find the constraints faced by students in constructing arguments. For this purpose, the method applied in depth interviews. Results of subsequent interviews coded according to the aspects of the Toulmin's Argumentation Pattern (TAP). Results of the next coding was used as the basis for categorizing student difficulties in constructing arguments based on Toulmin's Argumentation Pattern (TAP).

RESULTS AND DISCUSSION

The quality of the student's argument shows how students stated a claim, used reasoning to formulate evidence to support the claim, as well as the ability to show the weakness of claim to give a rebuttal. Analysis results of the student's argument quality with the topic discussion of how to fulfil the need of vitamin D by the body was presented in Figure 1 below.

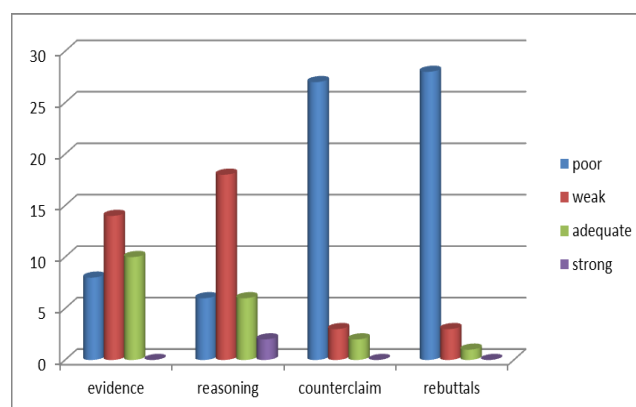


Figure 1. Representation of the student's argument quality with the topic of how to fulfil the needs of vitamin D by the body.

Based on the figure 1, students have been able to state a claim. However, the quality of the student's claims were lacking. It was proven by there were 31% of students claim quality adequate category, while others were weak and poor. The ability to state claim corresponds to the ability to use evidence to support the statement of claim. Students have not seen the trends of the data (44% of students) to support the claim. The ability of students to state a claim was also influenced by the ability of reasoning. Based on Figure 1, many students (56%) using reasoning to restates the data, it was unclear the principles of reasoning used. It was also corresponds with Basel, et al. (2013) research that the student's argument in the theory of evolution was only simply justified. While Berland & Mc Neill (2010) states that most students find its difficult to justify their claims and give reasons to provide evidence that supporting the claim.

The fact also represent how the using of critical thinking for students. It showed from many students who have not been able to declare counterclaim or rebuttals. Thus it can be said that the students' ability to formulate arguments must be trained. It was based on the facts on the table 2 below.

Table 2. The Quality of Student's Argumentation

aspects	min	max	mean	SD
claim	1.00	2.00	1.41	0.50
evidence	0.00	2.00	1.06	0.76
reasoning	0.00	3.00	1.03	0.79
counterclaim	0.00	2.00	0.22	0.55
rebuttals	0.00	2.00	0.19	0.47
initial argumentation	1.00	7.00	3.59	1.78
advanced argumentation	0.00	4.00	0.41	1.01

Based on Table 2, the ability of argumentation was still low and it was the state average student when viewed from the deviation standard. In general, students were only involved in the ability of initial argumentation, while the capabilities as advanced argumentation was very low.

Thiberghien in Erduran (2008) states that the using of argumentation in science learning was part of the development of higher order thinking skills. Developing critical thinking skills along with building skills of argumentation. Argument was a process which used someone to analyze information on a topic and then the results of the analysis were communicated to others (Inch, et al., 2006).

Most of students use argumentation scheme which built from sample covered 34%, while the other was based on causal schemes reached 19%, against preposition reached 16% and inductive schemes 6%. This indicates that the student has had the potential to do reasoning with various schemes, but it was not optimal.

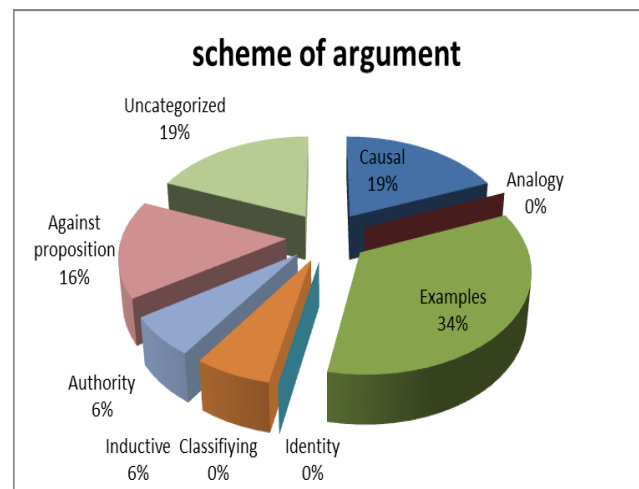


Figure 1. Argumentation schemes which used by student in argumentation with the topic of how the need of vitamin D.

Interviews results for students to reveal difficulties in argumentation, represented excerpt of interview from the two students follows.

Table 3. Excerpt of Interview with the Students

Interview with student A		Interview with student B	
Question	Answer	Question	Answer
Whats your opinion about the statement that to get vitamin D it must be get the sun?	I agree with that statement, for example : in the morning the baby get sunlight to get strong bone. It because sunlight is the resourches of vitamin D, and vitamin D need to make strong bone.	Whats your opinion about the statement that to get vitamin D, it must be get the sun?	I think to get vitamin D it must not come from sunlight, but from the vitamin D resourches, like vitamin D supplements. So, I disagree.
Why you use the baby as the samples?	Because I found it and they sure that the baby will have strong bone if it get sunlight, because there were vitamin D.	Have you the reason why to get vitamin D, it must not need the sunlight?	Maybe not at all like sunlight because they afraid if the skin become black.
How if the baby become sensitive to the sunlight, for example: it has albino	I don't think about it and I don't know.	How about the dangerous of cancer which caused by UV light from	Yes, may be it is the better reason.

abnormalities. Why you don't think about it?		sunlight?	
How about the dangerous of cancer which caused by UV light from the sun?	May be, it doesn't matter if the intensity in getting sunlight is enough.	Have you another examples?	I think not at all resistant to the sunlight, for example a person with albino abnormalities.
So, how to construct the argument?	I think it need variety of alternative.	So, how to construct the argument? Is it only different opinion?	Maybe, but I think it need many knowledge so our opinion can be comprehensively.

Based on the results of interviews with students showed that there were misconceptions, which believed that the sun was a source of vitamins. It was represented by student "A" answers (representation of most of the students). Students difficulties in did argumentation identified because it was not using its variety of knowledge (for example: about cancer and albino abnormalities), was also way of thinking that has not been comprehensively and consider various alternatives.

It was also stated by Mahinda (2008) that after studying the physiology concepts, students are expected to think comprehensively, that was capable to connect between the physiological processes that occur in the human body systems and was able to analyze physiological phenomena occur. Thus the implication of this research was how the argument discourse strategies can be applied in learning and it also invites the participation of the students involved, meaning that students realize to engage in argument, they should be ready with a comprehensive knowledge. But if it was applied that should be considered was the resources that available if it only sufficient time to perform and train arguments for students. Therefore argumentation acquisition scheme as epistemic aspects to build the argument should be considered in exercising argument. Through exercised to build arguments based on the scheme have argued, it hope they were able to make it easier to apply the principles stated claims and justify it. In addition to support the knowledge that they have to provide in supporting for the argument, if required device that accommodates variety of relevant information sources to the argument topic. Thus students will be accustomed to think comprehensively and consider various alternatives in argumentation.

CONCLUSION

Quality, simple category arguments of the student was low in justifying argument. Few students demonstrated advanced argumentation capabilities to provide an alternative explanation and rebuttals. Arguments scheme used by the student to express explanation includes causal schemes, inductive schemes, and arguments from examples. Thus, it need to develop tools that can help students rehearse the arguments so

they have the ability to think critically, comprehensively and consider various alternatives.

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