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MODELLING STUDENT MATHEMATICAL ARGUMENTATION WITH STRUCTURAL-INTUITIVE AND DEDUCTIVE WARRANT TO SOLVE MATHEMATICS PROBLEM

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ABSTRACTS

Much research has been devoted to the argument in dialo rather than argument not in dialogue. Argument not in dialogue is important because the student tries to demonstrate and ensure the correct view by means of argument addressed to himself, the student tried to convince of himself. When student already have the ability to argument not in dialogue then that individual will have a stock when confronted with the argument in dialogue. Therefore, this study will specifically address the argument not in dialogue. This study aims to modelling students mathematical argumentations use a combination type of warrant that is structural-intuitive and deductive. Modeling argumentation use Toulmin scheme consists of the data, claims, warrants, backing, rebuttals and qualifier. The types of warrant use Inglis theory that structural-intuitive, deductive and inductive. This study used a qualitative approach to gathering data from the results of the written and think aloud subject. The results showed that subjects using the data to support the claim based on structural intuitive thinking that is using the internal representation of the structure and use of his belief that the subject produces conjecture. Subject to checked these conjecture through formal cognition is deductive. The existence of different conclusion from the structural-intuitive and the deductive thought.

Keywords**:** *Mathematical Argumentation, Warrant, Structural Intuitive, Deductive, Mathematics Problems*

I. Introduction

Kinds of mathematical problem if has three term : (l) challenge to be solved and can be understood by students, (2) could not solved with structural procedure that has dominated by the students, and (3) involved some mathematic ideas (Hudoyo, 2001). According the Hudoyo's opinion can be interpreted that the mathematical problem is a question would be a problem for students when the questions that faced to a student must be understood by the student, but the question must challenge for them to answered and the question can not be answered with structural procedures that dominated by students that involved mathematical ideas.

Problem is a situation or the question facing a person or group when they had not rules, algorithms/ specific procedures or laws that may soon be used to determined the answer (Siswono, 2008). Based on the above, could make summary that the mathematic problem is a situation or questions that need an answer or solution, but the answer or the solution can not be known directly, or a situation or question facing someone who does not have rules, algorithms / specific procedures or laws soon be be used to determine the answer.

Cerbin (1988); Cho and Jonassen (2002); Krumm Heuer (1999); Kuhn & Udell (2003) states that solve a problem existence a argumentation that is used to justify solutions and actions.

According to Verheij (1996) states that central to the argumentation is the argument used to justify the conclusion. Furthermore, Rosita (2013) states the ability argumentation is one important component to improve the performance problem solving. Based on some of these opinions can be said that when solving the problem, problem solver needs to support the argument to define, generate and support a reasonable solution. Based on some of these opinions can be said that when solving a problem, problem solver need support of arguments to define, generate and support a reasonable solution. Develop the ability of this argument diperlu by students, for students to give a description of the reasons for strengthening or reject an opinion, conviction, or ideas. When the student has the ability argumentation, students can leave the hesitations and indecision in solving a problem, students are also more freedom in choosing, even students can propose reasonable solution.

Science education must provide students with the opportunity to develop various abilities and skills, including the skill to thinking and especially the ability to argument (Jimenez, Pereiro and Aznar, 2010). In other words, the focus and attention teachers is not only the thinking prosess of students, but also the ability to argument. Bisides to learning the meaning of a concept, students must learn to choose among some different options or explain and gave reasons cause of criteria chosen by the student. Argument is the ability to connect data to made a claim (Jimenez, Pereiro and Aznar, 2010). Argumentation is an important kind of informal reasoning that is central to the intellectual ability involved in solving the problem, make judgments and decisions, and formulate ideas and beliefs (Kuhn & Udell, 2003).

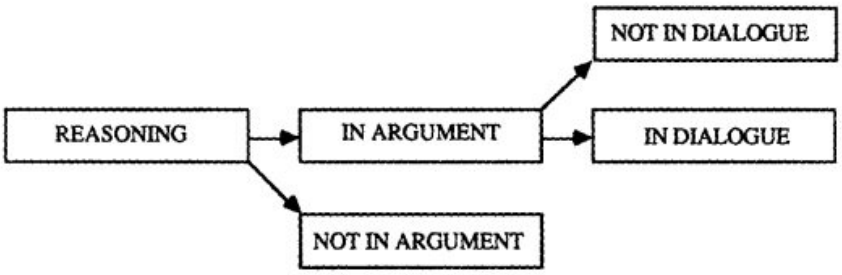
Toulmin (2003) proposed layout for analyzing arguments was called Toulmin scheme. Toulmin scheme consists of the data, claim, warrant, backing, rebuttal and qualifier. The data is a series of specific facts that support the claim (premise). The claim is a statement that will show to be true (conclusion). Warrant is a foundation for data in support of the claim by way of attractive rules, definitions or by making an analogy. Backing is the legal basis used to support a warrant. Rebuttal is an exception to the argument condition. Qualifier is the power level of data provided to the claims by the warrant.

Verheij (2005) stated that there was good work points of the scheme Toulmin that is: the argument can imposed rebuttal and argument can have a quality conclusion. Meaning from it was exception conditions of the argument and the argument based on quanlifier can be determined so that degree of strength from the data that gave in the conclusion. The argument is based on a standard logic quantifiers and related (for all x, for some x, not, and, or, etc.) and determines whether or not a good argument involves the evaluation of substantive and not only formal. This is similar to the Bizup's (2009) statement that is a person can capture the best meaning or the words strength and propositions to see how other people truly use it in a several of contexts.

Use Toulmin scheme in a study to analyze the argumentation in mathematics education conducted in research Vincent & Barry (2005) to formulate profiles arguments of students in solving mathematical problems, which the formulat profiles student argument can gave valuable understanding to teachers on how about students approach in solving problems. Conner (2007) described the preservice concept proof to support his argument in the classroom.

Seen that existing research has been devoted to individual argumentation in class discussion than argument which construction of individual cognitive. Therefore, this study will explain individual arguments. Individual arguments is important because person try to show and ascertain agood point of view with way the arguments which showed to themselves, person trying make sure themselves. When person have been the ability to argument not in dialogue then that person will have a provision when confronted in the argument in dialogue.

Arguments can happen in a dialogue or not in dialogue (Walton, 1990). Examples of the arguments happens in a dialogue is currently a group critical discussion, where each participant trying to show agood point of view with way the arguments which showed to other participants. Examples of argument not in dialogue is planning or solving problems. That activities like planning or solving problem happen of an interactive reasoning with themselves, in which the same person alternately play the role of proponent and responder. There is something approach but not arguing with yourself.



Source: Walton (1990)

Figure 1 Relation of Reasoning and Argument

The importance of research to know and understand the mathematical argumentation models that seen in the warrant component is expressed by Toulmin (2003: 96) that is the opportunity to arrange research with how a someone builds warrant in mathematics with trying to show variablity or field-dependence. Warrant an argument could be dependent to certain restrictions, where such restrictions must be attention that the argument is not contradiction its truth value. Weber and Alcock (2005) stated argumentation consist from at least three important parts are called the core of the argument: data, conclusion, and warrants. When someone present the argument, someone is trying to convince the audience from the particular statement is called conclusion. To support the conclusion, presenter usually continue to exert evidence or data.

Presenter's explanation why the data support the conclusion is called a warrants. In this stage, the audience can receive data but rejects the explanation that the data decided as conclusion, in other words the authority of the warrant may be challenged. If this happens, the presenter must present additional support to justify a warrant, and therefore the core from valid argument.

Inglis (2006), Inglis, Ramos and Simpson (2007) classifies three types of warrants that is: inductive, structural-intuitive and deductive. Inductive Warrant is a a foundation from a process involving the evaluation of one or more specific cases. Warrant structural-intuitive is a foundation from the intuition (intuitive thinking) about the personal structure of internal representation. Deductive warrant is foundation from formal mathematic justification process used to ensure the general conclusions. Inglis, Ramos and Simpson (2007) also stated there was kinds of other types of warrants, for example, a combination from inductive and structural-intuitive. From it the researcher estimate that any other type of warrant that is a combination of three types of warrants that is 3 types of warrants that are structural-intuitive and inductive; structural-intuitive and deductive; inductive and deductive; structural-intuitive, inductive and deductive. In this study, researcher saw the mathematical argumentation in structural intuituif-deductive warrant. That is based on thinking with used intuitive structural generate a conjecture. When someone believes conjecture not necessary to prove so he/she thinks structural intuitive. But someone thinks that his conjecture is believed to be true and he/she also thinks that his conjecture should prove deductively to be more confident. One of the way validation conjecture with the logic of deduction (Harel & Sowder, 1998). NCTM (2000) stated students should be able to make an argument to decide legalise the conjecture. Students should be understand that these conjecture are right or wrong, but does not prove it. Students should saw the power of the conjecture from through deductive proof. So that, student must able to produce logical arguments and formal proofs to explain their reasoning, either in the paragraph or other forms of proof. Arbib also stated one of the statements in mathematics proof is not only from formal logic but through formal techniques and intuition (Inglis, 2006). From the three opinions, it appears that the existence of a combination of structural-intuitive and deductive when someone wants to prove. Structural intuitive-deductive warrant in this study was the merger between structural intuitive and deductive thinking that thought immediately to generate a conjecture, which is believed to the conjecture is true and he/she thinks that needs a justification from formal mathematical used to ensure the conclusion of the argument.

Researcher choose student candidate teachers of Mathematics Education Study as a research subject, because the subject of the study will be a teacher of mathematics, who will influence in the developed process of thinking students in the mathematical arguments. Boero (1999) stated the arguments used by the students dependent on the formed of cultural the theorem in the class, the characteristics of the task, and kind of reasoning which emphasized by the teacher.

Whitenack & Yackel (2002) disclose the teachers actions can encourage students to explain, write and justify their reasons during the class discussion to develop the students' arguments. According Conner (2007) the concept of proof and prove had teacher mathematics in senior high school influence of teaching learning process in facilitating students to the argument.

Based on this theory explained and research results related to mathematical argumentation. Purpose of researcher to describing modeling of student mathematical argumentation in solve the problems with the sreuctural-intuitive and deductive warrant. The process argumentation will be analyzed using the framework of Toulmin scheme.

II. Research Methods

Researcher used a qualitative approach because it is relevant and possible to achieve the purpose of this research. The purpose of this study was to determine and describe modelling the student mathematical argumentation in solving problems. The subject is mathematic student grade 6. The reason for choosen this subject is students had learn concepts of mathematics relation. The process of selected the subject of research conducted as follows:

1. students gave a problem related to Product Cartesian, relations, partial ordered sets, chain and antichain. Students asked maximally to all of thinking along process solve problem, students who answered truly all the problem will be gave the next problem;
2. students gave a problem, students were asked maximally to solve problem with think aloud during the process solve problem, students who use combination the intuitive-deductive strategy set as a research subject;
3. after researcher choose the subject of the study, next activity is researcher interviewed the subject.

The research instrument is a test and a tape recorder. The test is used to describe a type of warrant in mathematical argumentation through something thought out, written and drawn by the subject when he dealt with a problems. Tape recorder is used to record sound when the subject think aloud about what thought and said when the subjek dealing with problems given. Data from written answers and think aloud of subject are combined to obtain completed data. Then the data is reduced for focused the data of subject mathematical argumentation and the data that has value development of the focus of this issue. Final stage is Researchers analyzed the data obtained in accordance with the scheme Toulmin.

III. Results and Discussion

The study involved students mathematics education STKIP PGRI Jombang and done it on March, 28nd to April, 10nd 2015. Researchers conducted this study with purpose to know and describe modelling the student mathematical argumentation in solve problems. Student's argumentation analyzed using Toulmin scheme. Several parts of the Toulmin scheme (often backing and rebuttal) is not explicitly verbalized by the speaker (Inglis, 2006; Inglis, Ramos and Simpson, 2007). Accordance with previous researchers who have used the scheme Toulmin, this research is also faced the same problem that is parts of Toulmin scheme is not only explicitly verbalized by the subject. So that, data which reported besides from the written answer, also explained the behavior and the words spoken by the subject, although the subject is not directly said it.

The process of subject mathematical argumentation while investigating the truth of the proposition "if P is not chain than P is antichain" is as follows:

a. Data

Subject mentioned some data that used P is not chain and P is chain. There was hesitate in the determination of the data to be that used. The fragment think aloud subject:

> "it started from chain or not chain? Yes firstly chain than not chain, but the chain's definition already is here (*pointing to chain definitions*), so yes started not chain... "

b. Claim

Subject mentioned the claim is "if P is not chain then P is antichain". The fragment of think aloud and writing answer data of the subject:

> "that will be showed that if P is not chain then P antichain ..."

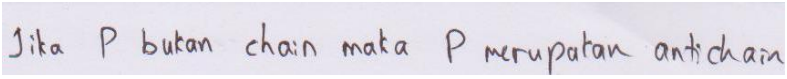


Figure 2 Subject's Written Answer

c. Warrant

Subject convinced that when *P* does not fulfill the chain definition, then *P* fulfill the definition antichain because negation of chain is antichain. Therefore, the subject also stated the proposition "If P is not chain, then P is antichain" is true. Subjects used the the structure internal representation and use of his belief in the warrant of proposition is true, So subject used the structural-intuitive warrant-type. It is based on data from the written answer and think aloud.

> "If P is not chain then P is antichain. That is true because of only consist two possibility such as P does not comply the chain definition so p comply the antichain definition, right. , , if not chain then antichain ... (*subject silent and put pencil than leaned back in seat*), it's the definition of the chain is every two

difference elements comply the relation R, the definition of the antichain is every two different elements does not comply the relation R"

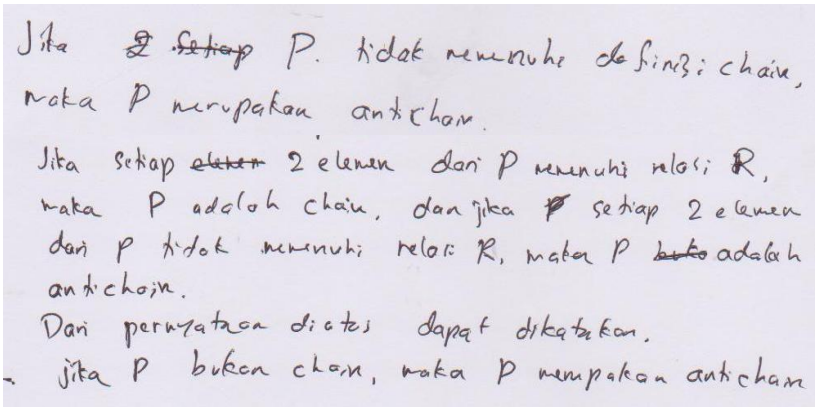


Figure 3 Subject's Written Answer

But, after a few minutes of silent the subject states that "if P is not chain, then P is antichain" is false. It is a subject got when make a negation of the chain definition, then conclude same meaning with the antichain definition. Therefore the subject guaranteed proposition of valuable correctness by used this type of deductive warrant. It is based on think aloud data and written answer data of subjects:

"This ... (silent while musing) every, how ... wrong yes because this is every ... also every ... emmm wrong because how ... yes wrong because this is every, also every, worry there is a did not comply it. Yes ... yes ... false because there will definitely does not comply the antichain definition"

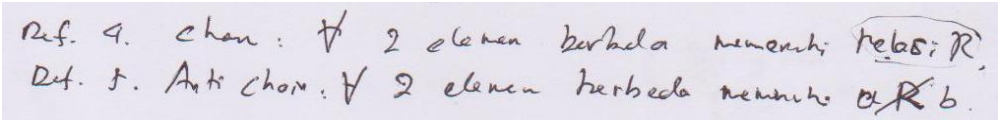


Figure 4 Subject's Written Answer

Seen that the subject used fragments chain and of antichain definition so the subject used deductions from axioms (Inglis, 2007) to solve the case that is deduction of chain definition. Subject to make the negation of deduction chain definition, then compared with the deduction of antichain definition.

d. Backing

In stated the truth of the proposition "if *P* is not chain, then *P* antichain" is true, the subject used the chain and antichain definition as a legal basis warrants. Even or stated correctness of the proposition "If *P* is not chain, then *P* is antichain" is false, subject used a chain definition, antichain definition and the rules of logic that negation of chain definition is there are two different elements does not comply *a* R *b* and *b* R *a* as a legal basis warrants.

e. Rebuttals

When the subject stated "if P is not chain, then P is antichain" is true, subject not gave a rebuttal. But when the subject stated "if P is not chain, then P is antichain" is false, subject gave an counterexample. Rebuttal "if P is not chain, then P is antichain" is false in condition P is not chain which each element does not fulfill *a* R *b* or *b* R *a*. It is based on think aloud data and written answer data of subjects:

> "... Let S is 1, 2, 3, 4, 5 with divide relation, let A is subsets S with 1, 2, 4 this is chain because every elements of A comply *a* R *b*. Then B is 3, 4, 5 is is not chain because there are elements of B comply *a* R *b*, and every elements of B does not comply *a* R *b* or *b* R *a*. For example C is 1, 2, 3, 4, 5 for 1 R 2, 1 R 4, 1 R 5, 2 R 4, but 2 is not R 5, so C is not chain because there is that does not comply *a* R *b*, and C is not antichain because every element of C does not comply *a* not R *b* "

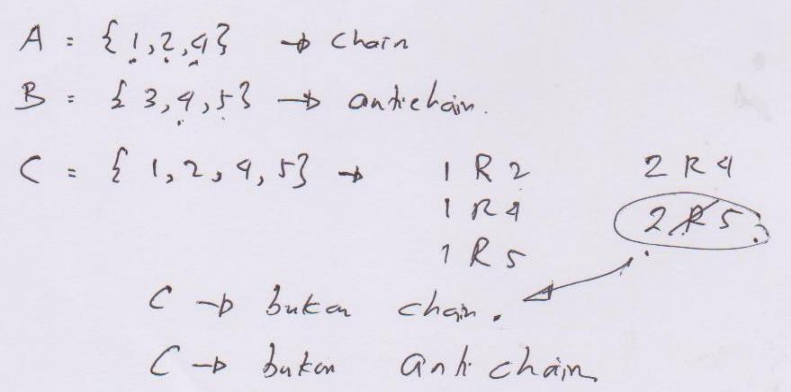


Figure 5 Subject's Written Answer

f. Qualifier

At first the subject stated "if P is not chain, then P is antichain" is true with modal qualifier is probable. It is based on data of subjects think aloud:

> "This possibility (if P is not chain, then P is antichain) is true because the not chain same with the antichain"

Then, with explanations by using chain definition, antichain definition and rule of logic, subject stated "if P is not chain, then P is antichain" is false with modal qualifier is certain. It is based on data of subjects think aloud:

> "yes certainly this is false. , , because there it is does not comply "every", this negation (subjects showed chain definition) "there are two elements" while this (the subject showed the definition antichain) "every two elements", so certainly false "

Modelling Subject mathematical argumentation to investigate the trutly of the proposition in Figure 6. subject used Data (D) is "P is not chain" and Claim (C) is "P is antichain". Subject to probability that the claim was true, but there was not law foundation in supported of the guarantee from those truth, so that qualifier (Q_1) to true valuble the claim is probable. Guarantees that supported data to claim was true used strutural-intuitive warrant (W_{si}) because the subject used representation internal tructure and used a beliefs. In the process of this mathematical

argumentation, the subject does not expressed backing and rebuttal. Subject expounded law foundation (backing "B_1") as warrant foundation that chain definition, definition antichain and negation.

After that, by used the data (D) and claims (C), subject stated claims was false with refusal from a theory, principles or conclusions that true regard or general character. So the subject used a type of deductive warrant. Subject expounded law foundation (backing "B_2") as warrant foundation that chain definition, definition antichain, negation and rules of logic. Thus subject to change his claims was false and qualifier (Q2) is Certain. Subjects also mentioned rebuttal (R) as an counterexample for proposition "If P is not chain then P is not antichain".

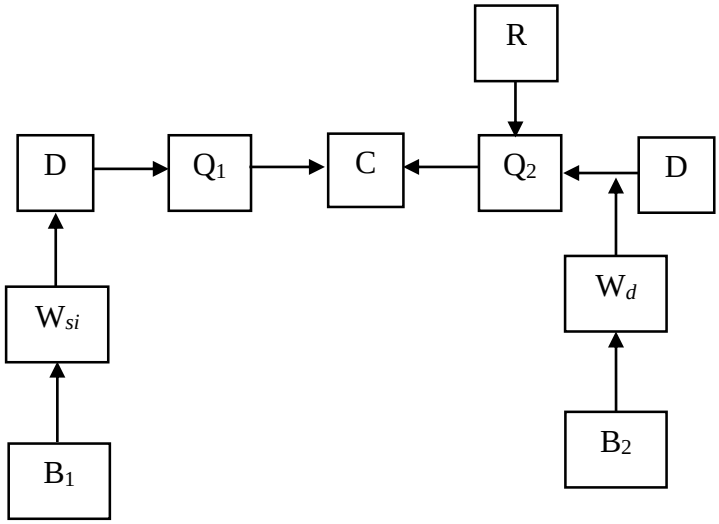


Figure 6 Modelling Subject Mathematical Argumentation

IV. Conclusion

The results showed that the types of structural-intuitive and deductive warrant. Subjects thinking that contained in the structural-intuitive warrant generated a conjecture of answer to solve problem. Although the subject's answer with an intuitive strutural warrant is wrong. But subject can used his intuitive in solve problem.

In supported the conjecture of that answer, subjects used a deductive warrant. Although the answers from structural-intuitive warrant different with answers from warrant deductive. This is showed that there was interaction or conflict because both of them gave different decisions. Roh (2005) strated intuitive cognition (intuition) generate creative ideas, while formal cognitive functions tend to verify and formulate more precise of ideas as the last step of the creative process. That is showed that there was interaction or conflict between formal cognition and intuitive cognition. When someone faced a problem, may both provide the same decision or otherwise. So to further research are expected to describing the thinking process in mathematical argumentation with combination of this structural-intuitive and deductive warrant.

In this study structural intuitive warrant generated conjecture of answer is wrong, but the subject thinking was correctly. While the deductive warrant produce correct answers and thinking. So for further research are expected to describing the mathematical argumentation with structural-intuitive and deductive warrant in correctly of thinking and answer.

Reference

Bizup, J. The Uses of Toulmin in Composition Studies. *The National Council of Teachers of English*. CCC 61:1 (2009).

Cerbin, B. The Nature and Development of Informal. Reasoning Skills in College Students. *ERIC Document Reproduction Service.* No. ED 298 805 (1988).

Harel, G., & Sowder, L. Students' proof schemes: Results from exploratory studies. In A. H. Schoenfeld, J. Kaput, & E. Dubinsky (Eds.), *Research in collegiate mathematics III*, pp.234–282. Providence, Rhode Island: American Mathematical Society (1998).

Hudoyo, H. *Pengembangan Kurikulum dan Pembelajaran Matematika*. Malang: Jica (2001)

Inglis, M. *Dual Processes in Mathematics: Reasoning about Conditionals*. University of Warwick: A thesis submitted for the degree of Doctor of Philosophy (2006).

Inglis, M., Ramos, J.P.M., Simpson, A. Modelling mathematical argumentation: the importance of qualification. *Educ Stud Math* 66:3–21. Springer, Heidelberg (2007).

Jimenez, A. M.P., Pereiro, M. C., & Aznar, C.V.,. Expertise, Argumenation and Scientific Practice: A Case Study about Environmental Education in the 11th Grade. *The National Association for Research in Science Teaching (NARST)* Annual Meeting PB 98-0616. No. ED 493 960. New Orleans (2000).

Kuhn, D & Udell, W. The Development of Argument Skills. *Blackwell Publishing* and *Society for Research in Child Development*, Volume74, Number5, Pages 1245-1260. JSTOR (2003).

National Council of Teachers of Mathematics (NCTM). *Principles and Standards of School Mathematics*. Reston, VA: Author (2000).

Roh, K.H. *College Students' Intuitive Understanding of the Concept of Limit and Their Level of Reverse Thinking*. The Ohio State University: Dissertation (2005).

Rosita, C. D. Meningkatkan kemampuan Argumentasi Matematis Melalui Pembelajaran CIRC. *Proseding Seminar Nasional Matematika dan Pendidikan Matematika STKIP Siliwangi Bandung*. Volume 1, Tahun 2013. ISSN 977-2338831 (2013).

Siswono, T. Y. E. *Model Pembelajaran Matematika Berbasis Pengajuan Masalah dan Pemecahan Masalah untuk Meningkatkan Kemampuan Berpikir Kreatif*. Surabaya: Unesa University Press (2008).

Toulmin, S. *The uses of argumen*. UK: Cambridge University Press (2003).

Verheij, B. Evaluating Argumens Based on Toulmin's Scheme. *Argumenation* 19:347–371. DOI 10.1007/s10503-005-4421-z. Springer, Heidelberg (2006).

Vincent, J., Chick, H., McCrae, B. Argumenation Profile Charts as Toll for Analysing Student's Argumenations. *Proceedings of the 29th Conference of the International Group for the Psychology of Mathematics Education*, Vol. 4, pp. 281-288. Melbourne: PME (2005).

Walton, N.D. What is reasoning? What is an Argument?. *The Journal of Philosophy*. Vol. 87, Issue 8, 399-419. JSTOR (1990).

Weber, K & Alcock, L. Using Warranted Implications to Understand and Validate Proofs. *For the Learning of Mathematics* 25, 1. FLM Publishing Association, Edmonton, Alberta, Canada (2005).

Whitenack, J & Yackel, E. Making Mathematical Argumens in the Primary Grades: The Importance of Explaining and Justifying Ideas. *Teaching Children Mathematics*. 2002, Volume 8, Issue 9, pp. 524-527. National Council of Teachers of Mathematics, Reston (2002).

Implementing ICT Based on Metacognition in Vocational Education

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Abstract: This article presents the results of studies conducted by a number of graduate students of technical and vocational education study program who applied innovative learning models and ICT to improve the quality of teaching and learning outcomes in the areas of technical vocational learning. They are one student of Electronics Engineering Education, one of Mechanical Engineering Education, and one of Culinary Art of Home Economics Education. These three studies were under the umbrella of the graduate research grant entitled "Implementation of Metacognition-Based Information and Communication Technology in the Field of Vocational Education Sector". The researchers were a faculty team of the graduate program. One of the objectives of the research grants is to help accelerate the completion of the students' theses. The use of ICT media is very important in the field of vocational learning. ICT Media that has been developed based-on metacognition helped to improve the quality of teaching and learning outcomes. There are three research questions: 1) Does the development of blended learning-based on instructional plan enhance the students' skills in cooking the continental cuisine? 2) Does the development of interactive books improve the learning outcomes of the microprocessor subject at vocational schools in Surabaya? and 3) Is there any significant effect of CAI-based CNC Basics learning on the students' interactive thinking skills on the subject of operating CNC machine basics in the vocational high schools. The studies were experimental research using tests, observation, and questionnaires as the data collection techniques. The data analysis techniques used were percentages and inferential statistics using t-test. The results showed that ICT media based-on metacognition developed was able to improve students' learning outcomes and metacognition skills. The metacognitive skills include: critical thinking skills, self-directed skills, and repeat themselves and learn in more depth. The implication of this study was that the use of ICT media based on metacognition was essential in improving the process and learning outcomes.

Keywords: *ICT Media, Metacognition, Vocational Learning*

1. Introduction

These last few years, the Government of Indonesia gave more attention to vocational education. It can be seen that the Government of Indonesia has been programming the ratio between vocational high school and senior high school at 70:30. The number of vocational high schools increased greater than the number of high school in order to prepare the need for middle-level manpower.

Meanwhile, the learning composition of the vocational high school is more emphasis on practice rather than theory with the ratio 60:40. Therefore, the suitable learning for vocational high school is active learning, in which students demanded an active role (student-centered). With active learning, students will increase their understanding about the material better, both theory and practice, through learning by doing. Active learning can help students to develop knowledge in a flexible, ability of problem solving in effectively, self-directed learning, collaboration capabilities and an effective intrinsic motivation [1]. Active learning also emphasizes learning through solving the problem through activity [2, 3].

It is important to provide teachers to have the competence to manage teaching and learning more meaningful. Learning skills and innovation are more recognized as skills that distinguish students who are ready for environments of life and work that become increasingly complex in the 21st century with students who are not ready. Focus on creativity, critical thinking, problem solving, learning strategies, communication and collaboration are essential in preparing students for the future.