International Journal of Innovation, Creativity and Change. www.ijicc.net
Volume 11, Issue 8, 2020

Exploring Metacognitive Strategies in Mathematics through Lesson Study: Evidence from Univet Bantara Sukoharjo Indonesia

Djatmiko Hidajat[a], Siti Maghfirotun Amin[b], Yusuf Fuad[c], [a]Mathematics Education Univet Bantara Sukoharjo, Indonesia, [b,c]Mathematics Education State University of Surabaya, Indonesia, Email: [a]djatmikohidajat16070936010@mhs.unesa.ac.id, [b]amin3105@yahoo.com, [c]yusuffuad@unesa.ac.id

This paper explores how metacognitive strategies are applied in lesson study by students to solve mathematics problems. Lesson study, as a collaborative teaching learning process between students and a team of teachers, was applied to the research design and data was analysed using a qualitative approach. Principally, lesson study was implemented in three steps: plan, do and see. There were 73 students who joined in two classes of a maths course at Vetaran Bangun Nusantara University, Sukoharjo Indonesia and were recruited as participants and 4 maths teachers were involved as the research subjects. Data was collected using observations and an in-depth interview, resulting in recording of verbatim data that was qualitatively analysed. The results show that planning sessions contributed to the modification and creative improvement of the contents of teaching materials and teaching methods, as a result of discussion among teacher collaborators. The implementation of metacognitive strategies by students, indicates valuable processes in the activation of metacognitive awareness, individual metacognition and metacognitive evaluation. Metacognitive awareness demonstrates how creativity is encouraged through critical thinking during planning and process. Individual metacognitive strategies arose because of self-confidence, achievement and critical thinking to apply analysis and synthesis strategies. Finally, evaluative metacognitive strategies were promoted to solve problems that students had to overcome individually and in group contexts, during discussion in the classroom.

Key words: *Description, metacognitive, lesson study, plan, do, see.*

Introduction

This study aims to describe students' metacognitive strategies when participating in lesson study-based learning. Metacognitive knowledge is self-awareness about one's own abilities and weaknesses so it is important that it is described (Brown, 1987; Dafik, et al., 2019; Flavell, 1979). Metacognitive learning of mathematics is the mastery of mathematical abilities, training to be an independent learner, and enabling student self-awareness of their weaknesses and strengths; so that it can be used to control their knowledge (Dardjito, 2019; Ramli, et al., 2019; Suratno, et al., 2019).

Awareness of metacognitive learning can improve critical and creative thinking skills in solving a mathematical problem to achieve optimal learning outcomes (Harjo, et al., 2019; Zainudin, et al., 2019). Optimal learning outcomes from awareness of individual metacognitive knowledge is obtained by understanding and representing the problem, choosing or planning solutions, solving problems according to plan, and re-examining the results obtained (Asy'ari, et al., 2019; Misu, et al., 2019; Hasbullah, et al., 2017). It is a requirement of lecturers to be able to ensure their creativity in achieving mastery of the outcomes of the material given to their students because "lecturers are considered to be nation builders and responsible for the formation of student character" (Exacta & Hidajat, 2017). In learning, of course, a lecturer has a mastery of achieving the learning outcome, through using a learning model where "the learning model refers to learning objectives, stages in learning activities, and the learning environment in classroom management" (Hidajat, et al., 2015; Pantiwati & Husamah, 2017; Risnawati, et al., 2019).

Looking for solutions to the problems above, a metacognitive description of students' strategies will be sought through lesson study learning. Lesson study is a collaborative activity carried out by a group of educators, in order to improve the performance and quality of learning by designing structured, creative and innovative learning, with the aim of increasing competence and professionalism (Mahmudi, 2009; Rizki, 2014). A good learning process will improve the quality of education. As stated by Hidajat et al (2018), learning achievement is the realisation of potential skills or capacities that a person has. Providing learning experiences for pre-service teachers of study-based lessons requires good knowledge, teaching competence and literacy competence (Umbara & Suryadi, 2019; Vitantri & Asriningsih, 2016).

The application of lesson study can improve planning, innovation development, character building, self-confidence, responsible attitude, sportive, openness, enthusiasm, cooperation and respect (Elvinawati, et al., 2012; Murtisal, et al., 2016). In Indonesia, lesson study is done, because it can improve the quality of education carried out by the government, through various training programs. This method is generally limited to increasing understanding of subject matter, while the introduction of learning methods is done separately from subject matter, it makes it difficult for teachers to integrate.

In an effort to overcome this problem, it is necessary to describe metacognitive thinking for students learning mathematics in solving problems through lesson study. In accordance with Permata et al. (2012, p.) "Metacognitive is a word related to what learners know about themselves as an individual learner and how they control and adjust their behaviour". This refers to how a learner increases self-awareness about the thought process in learning, by thinking about designing, monitoring and assessing what he is learning. As stated by Livingston (2003); Aminah et al., (2018); and Nunaki et al (2019) metacognition consists of metacognitive knowledge and experience, or metacognitive arrangements.

In this study the subjects are the students of a Mathematics Study Program at the University of Bangun Nusantara Sukoharjo, These students are from a class taking the complex 5 th semester analysis course. Consideration was given to the selection of the 5th semester students because the course is associated with the stages of intellectual development according to Piaget's view. In these stages the cognitive structure of the individual has reached the highest level of development, and according to Piaget (year) the highest stage of thinking ability is the stage of formal thinking. Piaget (year), also states that the formal reasoning stage is shown by the ability to think about abstract ideas, arrange ideas and reason about what will happen. At this stage, if students are faced with a problem they can formulate guesses or hypotheses, and then deduce the consequences based on these allegations or hypotheses.

Review of Literature

Mathematics is a science that has many branches, including arithmetic. Many people provide statements about mathematics; that mathematics is difficult to describe because it is abstract (Lahinda & Jailani, 2015). While the nature of mathematics is to have an abstract objective, which relies on agreement and a deductive mindset (Farida, 2015), when developing mathematical communication skills it is very important to improve knowledge, behaviour and skills in order to be able to process learning materials (Inayah, 2016; Winarno, et al., 2019). Therefore mathematics is the study of numbers through the process of calculation and measurement and it is also about symbols and organized structures.

When learning mathematics learners have different learning styles. The styles are a combination of how a person absorbs, organises and processes information that results in achievement of a result in learning (Sahidin, et al., 2019; Hidajat, et al., 2018; Nurbaeti, et al., 2015). Likewise, when learning, learners often find difficulties in solving problems that appear not in accordance with what they want, so they need solutions to solve them. Often when learners are solving problems, they need to improve their understanding of lecture material because it is the core of mathematics learning (Sari, et al., 2019; Syarifudin, et al., 2019).

A learner is considered to have and face a problem if they experience the following 4 conditions: 1) clearly understand the condition or situation that is happening; 2) clearly understand the expected goals of having various goals to solve the problem and can lead to one goal of resolution; 3) understand a set of resources that can be used to deal with situations that occurs in accordance with the desired goals, it includes time, knowledge, skills, technology or certain goods, and 4) have the ability to use various resources to achieve goals. A leaner is said to face a problem if they have self-awareness of the problems that arise and the challenge in finding solutions.

A problem can be divided into two, specifically the closed-ended and the open-ended problem. According to the results of the IMSTEP-JICA survey in Bandung, one of the causes of a lack of understanding in mathematics is that in the process of learning, too much concentration is placed on solving problems that are more procedural and mechanistic. Frequently giving learners mathematical problems to solve turned out to provide five advantages, 1) more participation, 2) provide many opportunities in using knowledge and skills, 3) enabling those with low ability to be able to solve problems their own way, 4) intrinsically motivated learners to be able to provide evidence, 5) add ideas for those who have already obtained a solution (Setiawan & Harta, 2014; Aedi, 2018).

Problem solving is an attempt to find solutions for difficulties by using knowledge, skills, and understanding. to achieve goals that have not been experienced before (Lidinillah, 2008). Problem-based learning demands that learners be more active in learning activities, to solve problems provided by the lecturer. The ability to solve a problem is important because it develops knowledge, understanding, and performance (Hidajat, et al., 2018; Wulandari, et al., 2015).

Retrieval of data based on the four steps of Polya's model of problem solving as identified by Evans (2012); Kurniasari & Hiltrimartin (2014); and Lidinillah (2008) is: 1) understanding the problem as an initial problem solving step, the activity of understanding this problem can be: what is unknown? What is asked? What's the condition and can it be written down?; 2) make a plan to find a connection between known and unknown data. The learner may be required to consider additional issues if a direct connection cannot be found or make a solution plan; 3) implement the solution plan, and check each step. Clearly grasp that the step is correct?, and 4) evaluate; the fourth step to solve the problem by checking the solution is obtained. Can the results be checked? Can the argument be checked? Can the results be obtained differently? Based on the description above, solving the problem in this research is considered as an effort needed to find a solution to a problem that has more than one way of finding the correct end result.

The idea of Metacognition was first introduced by Flavell in the late 1970s. The emergence of the word metacognitive was debated by scientists at that time. The Metacognitive is a concept about ability and awareness of one's thinking regarding knowledge and beliefs in cognitive processes and conscious efforts, when engaging in thought processes to improve learning processes and memory (Kurniawati & Leonardi, 2013; Rukminingrum, et al., 2017). Metacognitive is an important piece of knowledge possessed by learners in their learning activities. This is reinforced by Eggan et al. (1979) and Hayati (2016) who state that the development of metacognitive skills in learners, is a valuable educational goal because these skills can help them become self-regulated learners. Self-regulated learners are responsible for the progress of their own learning and adapt their learning strategies to achieve the target of the task. Knowledge of the metacognitive is very helpful for students in carrying out many of their learning tasks more effectively.

Trends in the development of metacognitive learning includes: 1) the use of spontaneous, conscious, and increasingly effective repetition strategies; 2) increasing the use of organisational strategies as a deliberate learning strategy; 3) the emergence of self-regulated learning strategies, for example, deliberate efforts to focus attention; 4) the emergence of awareness that learning is an active and constructive process; 5) increased awareness and ability to distinguish one's own strengths and weaknesses; 6) increased ability to reflect on one's own thoughts; 7) continually developing ability to assess performance and progress on their own; 8) the emergence of stable interests, and 9) increased focus on goals (Rukminingrum et al, 2017).

Hoorfar & Taleb (2015); Kaune *et al* (2011) and Du Toit & Kotze (2009) reveal that metacognitive understanding of knowledge is something that is not easily detected by self. The ability of a deep understanding of knowledge will enable good self-awareness when faced with a problem. Metacognition is assessed on cognitive aspects, because cognitive knowledge is the awareness of what is really known and how cognitive regulation is carried out effectively. Cognitive knowledge includes declarative, procedural, and conditional knowledge; while cognitive regulation includes planning, prediction, monitoring, testing, improvement, checking, and evaluation activities.

The ability of learners to recognise metacognitive strategies is very influential on the success of learning. The Metacognitive is knowledge about cognitive awareness itself, how cognition works and how to manage it. The following are cognitive activities: 1) develop a plan of learning activities; 2) identify strengths and weaknesses with regard to learning activities; 3) compile a learning program for new concepts, skills and ideas; 4) identify and use daily experiences as learning resources; 5) use modern technology as a source of learning; 6) lead and participate in group discussions and problem solving; 7) learn and take advantage of the experience of certain people who have succeeded in certain fields, and 8) understand the factors supporting the success of their learning (Annur, et al., 2016, p.).

Zainudin & Puspananda (2015) state that knowledge of metacognitive awareness will increase the success of a learning process. The learning process is influenced by various components including: objectives, materials, learning models, media, educators and students. The learning process in the classroom using lesson study can improve teaching and learning activities. Although lesson study is not a method or learning strategy, lesson study activities can use various methods, strategies, or learning approaches that are appropriate to the situation, conditions, and problems faced by educators (Mahmudi, 2009). Lesson study is a coaching model to improve the learning process carried out collaboratively and continuously in planning, implementing, observing and reporting the results of reflections on learning activities (Jasmaniah, et al., 2013; Vitantri & Asriningsih, 2016).

Lesson study is a Japanese translation of jugyokenkyu. It is derived from the word jugyo, which means learning and kenkyu, which means study. The application of scientific learning approaches in the setting of lesson study can improve the ability of educators to prepare learning tools, carry out learning in class, and improve learning outcomes (Tadanugi, 2015). Lesson studies motivate the process of student interaction in group discussions so that understanding and mastery of concepts can increase (Handayani, et al., 2015; Sholihah & Mahmudi, 2015).

The use of lesson studies increases collaborative inquiry for students and lecturers. It provides information on the basis of experience, regarding choices about how to create improved learning for students. The virtue of lesson study is that it can improve skills or abilities in conducting learning activities carried out, which is learning from learning. Lesson studies can create cooperation among educators in developing learning, provide opportunities for educators to solve learning problems together, and enable better communication amongst educators. Lesson study is a model of fostering the profession of educators through collaborative and sustainable learning assessment, based on the principles of collegiality and mutual learning to build learning communities.

Method

A qualitative approach was undertaken in this research, based on the philosophy of post positivism. Post positivism is often referred to as an interpretive and constructive paradigm that views social reality as holistic, complex, dynamic, meaningful, and interactive. A qualitative approach to research is not easily observed directly and is not easily measured quantitatively

(Kartikasari & Khotimah, 2015). Qualitative research is also called the naturalistic research approach because the research is carried out on natural subjects. This means that the research is not manipulated by the researcher and the presence of the researcher does not affect the dynamics.

For this research data retrieval or phenomenon selection was carried out from a reasonable condition. This approach viewed reality as a multi-dimensional, whole and one entity. Therefore, it is not possible to compile a detailed research design and the research design can develop during the study. In this qualitative approach, the researcher and the subject under investigation interacted and the researchers' implementation process functioned as a research tool. A qualitative approach emphasises that a deep and comprehensive understanding of the subject under study is necessary to produce conclusions in the context of the time and situation in question.

This research is descriptive research that reveals events or facts, circumstances, phenomena, variables and circumstances that occur when the research takes place by presenting what actually happened. The purpose of descriptive research is to make a systematic, factual and accurate description to illustrate the facts, properties and relationships between the phenomena investigated. Thus, this research was a type of descriptive research with a qualitative approach, which has the aim of describing the metacognitive learners ability to solve open-ended problems with Polya's solving steps.

The subject in this study consisted of learners who are taking a complex analysis course in a mathematics education study program at the Veterans University of Bangun Nusantara Sukoharjo. Subject selection was based on a lesson study by conducting a meeting with researchers. Consideration was given to the involvement of several lecturers as a team and an observer, so that the research is closely related to the day and time of implementation. This was done so the open lesson study could run as expected.

The instruments in this study were divided into two, namely the main and the supporting instrument. The main instrument in this study is the researcher. Therefore, at the time of data collection in the field, researchers participated during the research process and actively participated in the research subject activities related to data collection both in writing and verbally. With respect to the subject, the researchers in this study did not intervene in solving the problem. The subject was given the opportunity by the researcher to express their thought during the teaching and learning process, and during group discussions to solve problems. All class activities were observed and documented by observers with the understanding that the data would be analysed later.

The instrument used for solving the problem was Polya's problem solving steps. A problem solving test is given three times because open lesson study is done three times, with different times and different types of questions. The observer utilised two observation instruments; documentary observations in the form of photographs and videos which were obtained during the second step in the lesson study. Observations were also made by written message by a note-taker during the third step in the study.

The data collection in this study was similar to the research done by Astutiet et al, (2017); Hadi (2017); Murtisal et al (2016); and Nurafni (2016). The data was taken according to the stages of lesson study through the plan, do, and see. The data taken is in accordance with the objectives of the study, which is describing students' metacognitive skills in solving mathematical problems. The data from the results of student work was the initial information recorded by the observer through observation. This was implemented to get an overview of the metacognitive characteristics of students in solving mathematical problems in the complex analysis courses.

Findings

The research data used is the data in the open lesson study stage, obtained from three open lessons. This is:

1. Plan step, this is the first step in open lesson study. The results of the plan are: 1) the implementation team of the open lesson study program consisted of Djatmiko Hidajat, M.Pd, Dr. Hery Agus Susanto, Erika Laras Astutiningtyas, M.Pd, Andhika Ayu Wulandari, S.Sc., M.Pd; 2) the lecturer team agreed to implement open lesson study three times; 3) The first plan was carried out on April 9th, 2018, the second plan was implemented on April 16th, 2018, the third Plan was implemented on April 20th, 2018; 4) the model lecturer is researcher Djatmiko Hidajat, M.Pd; 5) the place and time of the "do" phase in the three open lessons was adjusted to the students' schedule so there were no clashes with other schedules; 6) in the interests of efficiency the implementation of the "see" phase in three open lessons remained in the "do" room; 7) material in the three implementations of open lesson in sequence are complex number systems, absolute values and axioms of complex numbers, graphs and polar shapes of complex numbers; 8) RMP, student worksheets, focus sheet observations prepared during the plan; 9) documentation tools were prepared at each stage of the open lesson study, and 10) the briefing was done only once, before doing the first open lesson.
2. The Do step is the second step of the open lesson study. This step is an open lesson study learning process based on the previous plan, the following is data for the lesson study: 1) "do" was carried out three times in a row. It was first carried out on Tuesday April 10th 2018, secondly on Tuesday April 17th 2018, and thirdly on Tuesday, April 24th, 2018; 2). The five observers who attended the first "do" were lecturers, the observers

who attended the second "do" were four lecturers, and the observers present in the third "do" were four lecturers; 3) time and place of the implementation of the three times as agreed in the plan; 4) all observers always looked for a place of observation freely in accordance with their own choice which they think is suitable for data collection in observation; 5) observers in data retrieval did not move too much; 6) a list of students and observers must always be present; 7) all observers must bring data collection equipment both written, photo, and video, and 8) the arrangement of the composition of group members in the first only paid attention to the average ability in each group, in the second do complete the average in each group, in addition to the ability also type sex, in the third do the same as the second do.

3. The See step; "see" is the evaluation stage of the implementation of the do in each open lesson study. See is carried out directly after the do and the lecturers who are present became observers. Each time the student was given a number and a ribbon was put around their neck with the number on their back. The aim of this is to make it easier for observers to identify students. The data submitted by the observer was as follows: 1) see in the first open lesson: student no.7 in group 2 when working on problems was very focused on their work with a little discussion, student no.13 when working on questions was very coherent in accordance with the example given by a lecturer, student no. 2 was relaxed and read the hand out delivered by the lecturer and seemed not to focus on the lecturer's explanation, student no.16 when the discussion took place seemed to be waiting for the answer to the problem. Student no.9 when asked questions answered confidently while showing the reason; 2)
4. The "see" step in the second open lesson. The data submitted by the observer is as follows: when the lecturer gave a question in discussion student number 5 answered quickly with the right answer so that the lecturer spontaneously gave a gift in the form of ballpoint pen which the student immediately pocketed, student number 17 looked, then retrived his bag a few meters away from him to get his water bottle and drank from ; group 4 looked more lively than the other groups, student no.2 very much enjoyed the work and after finishing showed it to other members who also enjoyed their work but had not yet finished, student no.6 had an argument with student no.8 when discussing their respective opinions even though the principle was the same, and 3) student no.1 presented for group number 1 whose work was very coherent and they explained it easily so that others may understand. Afterwards I noticed the work was actually unfinished but the explanation was comprehensive, student no.14 looks polite and smiles a lot, I had a discussion when asked for an opinion, first he smiled and then answered the questions of his friends, groups 1 and 2 are more quiet than groups 3 and 4, student no.12 In the beginning they commented on the lecturer and their answers were coherent. The lecturer was given a compliment, then blushed and shared his notes again, student no.4 arrived late, following the lecture, then there was a question from the lecturer, which

was answered, when I approached it turned out the student had brought other reference books besides handout from the lecturer.

Discussion

Theoretically, a lecturer must analyse material carefully and plan learning before presenting in the classroom (Skemp, 1971; Aedi (2018)). Lesson study is a collaborative learning strategy between educators who prepare learning requirements before delivery (Skemp, 1971 and Ardi, 2018). The following is a discussion of the results of the research:

At each of the three stages the lesson plan is discussed by the model lecturer, and on this occasion the model lecturer is also the researcher. During the third observation focus is on the activity of the students. They were asked to discuss their metacognitive processes during learning, when asked to solve open-ended problems presented by the model lecturer. Observations were made of the students metacognitive processes while learning mathematics. From the three open lesson materials discussed in this study, the sequence is a complex number system, looking for absolute values with axiomatic basics of a complex number system, and a graph of the form of poles of complex numbers. Lecturers present in the plan are all members of the study and other lecturers are also willing to participate. The place and time of the do and see take place three times during the open lesson study according to the plan, as well as for the RMP, student worksheets and observation focus sheets. Documentation is done at each stage of the open lesson study, and the briefing is done only once before doing the first open lesson because there is a need to check all the files and tools that will be used, which must be in accordance with the plan. In the next open lesson it is not necessary because checking has occurred in each previous plan.

The second step of the open lesson study is the stage. All members of the research are always present, all observers observe student activities in accordance with the direction of the plan. Documentation by the observer is carried out with a camera and a cellphone with and stationery to take notes. The model lecturer always instructs the students to discuss the problems, alternating between men and women to maximize the individual's ability to discuss. Observers may not interfere with student freedom of movement. In order to maximize observations, it is suggested the observer choose students that are more focused and the observer must describe the students' character in accordance with the research objectives.

The last step of the open lesson study is *"see"*, this step is led by a moderator to encourage conclusive discussion and to evaluate the implementation of "do". All views stated by the model lecturer and observer will be made with written notes and are to be concluded at the end of the discussion. From the data sourced as stated by the observer at the three times open lesson study with a metacognitive student in solving an open-ended problem with Polya can be described as follows:

The first lesson group did not understand the problem well, but is able to express what is known and asked correctly. Evenly, all discussion groups have not been able to reveal information outside the question to help solve the problem. In the second open lesson, students can begin to understand the problem well. The students remember the previous material which is still fresh and show knowledge and understand what is being asked of them. Group discussions are rigorous and students remember the information to link and help solve the problems. In the third open lesson, the knowledge of understanding the problem becomes more apparent. The group delegation delivers desirable results and is able to express knowledge and ask questions, as well as articulate what they already know to to help solve the problem .

In the plan step, the first open lesson of all groups shows they have not been able to determine the relationship between what is known and asked for to solve. This means that the problem problem solving plan is completely irrelevant to solving the material complex number system. In the second open lesson it seems that all groups are trying to remember what they know when asked to solve an open-ended problem, so that they begin to make plans for solving problems. But the problem-solving plan that was made is still not right because there is no maximum resolution of the previous material. In the third open lesson, after the lecturer has previously explained what to do, all groups can begin to appropriately plan problem solving because they remember what is known and asked about the problem.

At the step of implementing a problem-solving plan, in the first open lesson almost all groups can carry out the steps of a problem-solving plan that was made, but the problem-solving plan that was made from the beginning was already inaccurate so that it failed in getting a solution. This happened because of some understanding of the system's material complex numbers and other supporting material is still lacking. In the second open lesson almost all groups can carry out the steps of the problem solving plan that was made, but have not yet gotten perfect results. This is because there is only some understanding of the material in the first lesson and other supporting materials are still lacking. In the third open lesson all groups are able to carry out the steps of the problem solving plan appropriately because of better understanding of the material and understanding how it was done previously.

When evaluating the answers, in the first open lesson in the stage of re-checking the answers, almost all groups cannot determine alternative solutions to solve the problem because they do not understand, so they do not re-examine the answers they get. In the second open lesson, not all groups re-examine answers and not all are able to determine alternative solutions to problem solving. Some discussion groups check answers from the beginning and check their work, while other discussion groups do not check answers because they already feel they got the answer right. In the third open lesson almost all re-examine the answers, so they can determine alternative solutions to problem solving.

The description above shows that the metacognitive level of students in solving open-ended problems from the first, second and third open lessons is always variable. This is because the model lecturers at each end of the open lesson encourage students to link material already given with new material and because the students worked together in the stages of lesson study. If observed the subject of the discussion group experiences metacognition activities of type of awareness, regulation and evaluation. Metacognitive awareness occurs when the subject realizes prior knowledge can help improve performance in solving problems (Kamid, 2013; Tachie & Molepo, 2019; Tok, et al., 2010).

After going through the metacognitive awareness of the subject in the discussion group it will be included in the metacognitive regulation. Metacognitive regulation refers to mental activities that are used to regulate cognitive strategies in planning problem solving (Jacobse & Harskamp, 2012). When a subject in a group changes the way it is used to solve a problem, the decision to do is metacognitive regulation whereas when he writes it in a worksheet it is a cognitive activity. In this study, metacognitive regulation occurs when the subject in a group decides to rethink the steps he uses repeatedly before concluding what he is thinking and when the subject decides to try to solve the problem using another method, this is in accordance with (Purnomo, et al., 2016).

Individual metacognitive descriptions can be seen in problem solving process activities such as analysing problems, making plans, implementing plans, and verifying answers obtained and this can be said to be a metacognitive evaluation activity (Kaur, 1997; Purnomo, et al., 2016). Metacognitive evaluation in this study occurs when subjects in the group assess that the answer is correct after checking repeatedly. This is in line with what Shahbari, et al., (2014) states regarding checking repeatedly before assessing what the student thinks is a metacognitive evaluation.

Conclusion

Based on the background of the problem, the theoretical study, research methods, and data analysis it can be concluded that; the fifth semester students taking a course of complex analysis based on lesson study, in problem solving by group discussion, with a balanced average ability according to Polya's steps, by involving the students and lecturers in the preparation of lesson studies and observers who make observations when they do by providing information on their findings then the metacognitive description of students in groups can be divided into three categories, namely: 1) metacognitive awareness - the knowledge of personal abilities about how to think mathematically in solving problems that include: what is known, what relevant knowledge is known to be related to the problem, and what will be done to help solve the problem; 2) metacognitive regulation, namely knowledge of personal abilities about mathematical thinking that includes: planning a strategy of taking steps in solving problems, thinking about what steps can be done afterwards, and choosing alternative problem solving strategies to be used; and 3) metacognitive evaluation, namely knowledge of personal abilities about mathematical thinking that includes: an assessment of the limitations of the process of self-thinking, the effectiveness of the strategies chosen, an assessment of the results obtained, an assessment of the difficulties encountered, and an assessment of the development of the ability of the self towards understanding.

REFERENCE

Aedi, W. G. (2018). Upaya Meningkatkan Minat Belajar Matematika dengan Pendekatan Open-Ended. *Jurnal Pendidikan Matematika Indonesia(JPMI); p-ISSN: 2477-5967 e-ISSN: 2477-8443*, *3*(2), 41–46.

Aminah, M., Kusumah, Y. S., Suryadi, D., & Sumarmo, U. (2018). The Effect of Metacognitive Teaching and Mathematical Prior Knowledge on Mathematical Logical Thinking Ability and Self-Regulated Learning. *International Journal of Instruction; e-ISSN: 1308-1470; p-ISSN: 1694-609X*, *11*(3), 45–62. https://doi.org/10.12973/iji.2018.1134a

Annur, M. F., Sujadi, I., & Subanti, S. (2016). Aktivitas Metakognisi dalam Pemecahan Masalahan Matematika ditinjau dari Gaya Kognitif. *Jurnal Elektronik Pembelajaran Matematika, ISSN: 2339-1685 Http://Jurnal.Fkip.Uns.Ac.Id*, *4*(7), 720–730.

Astuti, P., Purwoko, & Indaryanti. (2017). Melatih Kemampuan Berpikir Kritis dalam Belajar Matematika di kelas. *Jurnal Gantang , p-ISSN. 2503-0671, e-ISSN. 2548-5547*, *II*(2), 145–156.

Asy'ari, M., Ikhsan, M., & Muhali. (2019). The effectiveness of inquiry learning model in improving prospective teachers' metacognition knowledge and metacognition awareness. *International Journal of Instruction; e-ISSN: 1308-1470; p-ISSN: 1694-609X*, *12*(2), 455–470. https://doi.org/10.29333/iji.2019.12229a

Brown, A. (1987). Metacognition, executive control, self-regulation, and other more mysterious mechanisms. *Metacognition, Motivation, and Understanding*, pp. 65–116.

Dafik, Sucianto, B., Irvan, M., & Rohim, M. A. (2019). The Analysis of Student Metacognition Skill in Solving Rainbow Connection Problem under the Implementation of Research-Based Learning Model. *International Journal of Instruction; e-ISSN: 1308-1470; p-ISSN: 1694-609X*, *12*(4), 593–610.

Dardjito, H. (2019). Students ' Metacognitive Reading Awareness and Academic English Reading Comprehension in EFL Context. *International Journal of Instruction; e-ISSN: 1308-1470; p-ISSN: 1694-609X*, *12*(4), 611–624.

Du Toit, S., & Kotze, G. (2009). Metacognitive strategies in the teaching and learning of mathematics. *Pythagoras*, *0*(70), 57–67. https://doi.org/10.4102/pythagoras.v0i70.39

Eggan, P. D., Kauchak, D. P., & Harder, R. J. (1979). Strategies for Teachers: Information Processing Models in the Classroom. *Journal of Teacher Education*, 58–58. https://doi.org/10.1177/002248718003100420

Elvinawati, Sumpono, & Amir, H. (2012). Lesson Study sebagai Upaya Peningkatan Kualitas Pembelajaran dan Pembangunan Karakter. *Jurnal Exacta, ISSN 1412-3617*, *X*(2), 156–159.

Evans, B. R. (2012). Problem Solving Abilities and Perceptions in Alternative Certification Mathematics Teachers. *Northeastern Educational Research Association (NERA) Annual Conference*, *7*(2), 34–43. Retrieved from https://files.eric.ed.gov/fulltext/EJ1053509.pdf; December 21, 2018, at 23: 5

Exacta, A. P., & Hidajat, D. (2017). Tingkat Kecemasan Mahasiswa Menjelang Ujian Akhir Semester. *Edudikara, ISSN: 2541-0261*, *2*(3), 243–250.

Farida, N. (2015). Analisis Kesalahan Menyelesaikan Masalah Soal Cerita Matematika. *Jurnal Pendidikan Matematika FKIP Univ. Muhammadiyah Metro; ISSN 2442-5419*, *4*(2), 42–52.

Hadi, S. (2017). Umpan Balik dan Gaya Kognitif Matakuliah Pembelajaran Matematika. *BRILLIANT: Jurnal Riset Dan Konseptual*, *2*(1), 113–123.

Handayani, R. D., Ryskiadi, A., Machrus, A., & Acik, R. (2015). Penerapan Lesson Study Untuk Meningkatan Kemampuan Mengajar Mahasiswa Calon Guru Fisika. *Jurnal Pengajaran MIPA*, *20*(1), 27–31. https://doi.org/http://dx.doi.org/10.18269/jpmipa.v20i1.558

Harjo, B., Kartowagiran, B., & Mahmudi, A. (2019). Development of Critical Thinking Skill Instruments on Mathematical Learning High School. *International Journal of Instruction; e-ISSN: 1308-1470; p-ISSN: 1694-609X*, *12*(4), 149–166.

Hasbullah, Muchtar, H., & Wibawa, B. (2017). Pengaruh Strategi Pembelajaran Metakognitif dan Gaya Kognitif Terhadap Kemampuan Pemecahan Masalah Matematika. *Jurnal Teknologi Pendidikan,19*(2), 72–84.

Hayati, N. (2016). Peningkatan Kesadaran Metakognitif dan Hasil Belajar Melalui Penerapan Diagram Roundhouse Dipadu Model Pembelajaran CIRC. *Ed-Humanistics*, *01*(01), 44–55.

Hidajat, D., Amin, S. M., & Fuad, Y. (2018). Implementation of Lesson Study in Mathematics Learning Based on Student Cognitive Style. *Prosiding Atlantis Press, ISSN: 2352-5401, ISBN: 978-94-6252-593-1, Doi: 10.2991/Icase-18.2018.23, Vol. 175*, *175*(Icase), 84–87.

Hidajat, D., Susilowati, D., & Wijayanti, M. (2015). Pengaruh Model Pembelajaran Cooperatif Integrated Reading and Composition Terhadap Prestasi Belajar Matematika. *Jurnal Math Educator Nusantara, ISSN: 2459-97345*, *1*(2), 195–203.

Hoorfar, H., & Taleb, Z. (2015). Correlation Between Mathematics Anxiety with Metacognitive Knowledge. *Procedia - Social and Behavioral Sciences*, *182*, 737–741. https://doi.org/10.1016/j.sbspro.2015.04.822

Inayah, N. (2016). Pengaruh kemampuan penalaran matematis dan gaya kognitif terhadap kemampuan komunikasi dan koneksi pada materi statistika. *Jurnal of EST, p-ISSN: 2460-1497 e-ISSN: 2477-3840*, *2*(2), 74–80.

Jacobse, A. E., & Harskamp, E. G. (2012). Towards efficient measurement of metacognition in mathematical problem solving. *Metacognition and Learning*, *7*(2), 133–149. https://doi.org/10.1007/s11409-012-9088-x

Jasmaniah, Karim, A., & Zulkifli. (2013). Implementation Pembelajaran Bilangan dan Operasinya Melalui Lesson Study. *Jurnal Pendidikan Almuslim*, *1*(1), 15–17.

John H Flavell. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist*, *34*(10), 906–911. https://doi.org/10.1002/bit.23191

Kamid. (2013). Metakognisi Siswa dalam menyelesaikan Soal Matematika. *Edumatica; ISSN: 2088-2157*, *03*(01), 64–72.

Kartikasari, M., & Khotimah, R. P. (2015). Pola Pikir Mahasiswa dalam Menyelesaikan Persamaan Differensial Ditinjau dari Gaya Kognitif Field Dependent dan Gaya Belajar Reflectors. *Prosiding Seminar Nasional Pendidikan Matematika UMS ; ISBN : 978.602.719.934.7*, 23–33.

Kaune, C., Fresenborg, E. C., & Nowinska, E. (2011). Development of Metacognitive and Discursive Activities in Indonesian Maths Teaching. *Journal on Mathematics Education*, *2*(1), 15–40. https://doi.org/10.22342/jme.2.1.777.15-40

Kaur, B. (1997). Difficulties with Problem Solving in Mathematics. *The Mathematics Educators*, *2*(1), 93–112.

Kurniasari, A., & Hiltrimartin, C. (2014). Student's Strategy in Answering Mathematical Problem-Solving Question. *SULE.IC- ISBN: 978-602-70378-0-9*, 685–690.

Kurniawati, R., & Leonardi, T. (2013). Hubungan Antara Metakognisi dengan Prestasi Akademik pada Mahasiswa Fakultas Psikologi Universitas Airlangga yang Aktif Berorganisasi di Organisasi Mahasiswa Tingkat Fakultas. *Jurnal Psiklogi Pendidikan Dan Perkembangan*, *2*(1), 1–6.

Lahinda, Y., & Jailani. (2015). Analisis Proses Pemecahan Masalah Matematika. *Jurnal Riset*

Pendidikan Matematika; ISSN: 2356-2684, Online ISSN: 2477-1503, *2*(1), 148–161.

Lidinillah, D. A. M. (2008). Strategi Pembelajaran Pemecahan Masalah. *Jurnal: Pendidikan Dasar,2*(2), 6–10.

Livingston, J. A. (2003). Metacognition: An Overview. *Educational Resources Information Center; University at Buffalo State University of New York; ED474273 - TM034808*, 1–7. https://doi.org/10.1080/0950069032000119401

Mahmudi, A. (2009). Mengembangkan Kompetensi Guru Melalui Lesson Study. *Jurnal Forum Kependidikan FKIP UNSRI; ISSN 0215-9392*, *28*(2), 1–10.

Misu, L., Budayasa, I. K., Lukito, A., Hasnawati, & Rahim, U. (2019). Profile of metacognition of mathematics education students in understanding the concept of integral in category classifying and summarizing. *International Journal of Instruction; e-ISSN: 1308-1470; p-ISSN: 1694-609X*, *12*(3), 481–496. https://doi.org/10.29333/iji.2019.12329a

Murtisal, E., Nurmaliah, C., & Safrida. (2016). Implementasi Pembelajaran Berbasis Lesson Study Terhadap Kompetensi Pedagogik dan Keterampilan Proses Sains. *Jurnal Biotik; ISSN: 2337-9812,4*(1), 81–94.

Nunaki, J. H., Damopolii, I., Kandowangko, N. Y., & Nusantari, E. (2019). The Effectiveness of Inquiry-based Learning to Train the Students' Metacognitive Skills Based on Gender Differences. *International Journal of Instruction*, *12*(2), 505–516. https://doi.org/10.29333/iji.2019.12232a

Nurafni. (2016). Gaya Kognitif Field Dependent terhadap Pemahaman Konsep Limit Mahasiswa. *KALAMATIKA Jurnal Pendidikan Matematika*, *1*(2), 183–194. https://doi.org/10.22236/kalamatika.vol1no2.2016pp183-194

Nurbaeti, Nuryanti, S., & Pursitasari, I. D. (2015). Hubungan Gaya Belajar dengan Keterampilan Berpikir Kritis dan Kemampuan Kognitif. *E-Jurnal Mitra Sains, ISSN: 2302-2027*, *3*(2), 24–33. Retrieved from http://jurnal.untad.ac.id/jurnal/index.php/MitraSains/article/download/4265/3180

Pantiwati, Y., & Husamah. (2017). Self and Peer Assessments in Active Learning Model to Increase Metacognitive Awareness and Cognitive Abilities. *International Journal of Instruction; e-ISSN: 1308-1470; p-ISSN: 1694-609X*, *10*(4), 185–202. https://doi.org/10.12973/iji.2017.10411a

Permata, S. P., Suherman, & Rosha, M. (2012). Penerapan Strategi Metakognitif dalam Pembelajaran Matematika. *Jurnal Pendidikan Matematika*, *1*(1), 8–13.

Purnomo, D., Toto Nusantara, Subanji, & Rahardjo, S. (2016). Metacognition Process Characteristics Of The Students In Solving Mathematics Problems. *IOSR Journal of Research & Method in Education; e-ISSN: 2320–7388,p-ISSN: 2320–737X*, *6*(5), 26–35. https://doi.org/10.9790/7388-0605032635

Ramli, Mukminatien, N., Saukah, A., & Prayogo, J. A. (2019). Word recognition from speech, syntactic knowledge, metacognitive awareness, self-efficacy as determination for l2 listening comprehension. *International Journal of Instruction; e-ISSN: 1308-1470; p-ISSN: 1694-609X*, *12*(3), 89–104. https://doi.org/10.29333/iji.2019.1236a

Risnawati, Andrian, D., Azmi, M. P., Amir, Z., & Nurdin, E. (2019). Development of a definition maps-based plane geometry module to improve the student teachers' mathematical reasoning ability. *International Journal of Instruction*, *12*(3), 541–560. https://doi.org/10.29333/iji.2019.12333a

Rizki, S. (2014). Efek Lesson Study terhadap Peningkatan Kompetensi Pedagogik Calon Guru. *Aksioma Jurnal Pendidikan Matematika FKIP Univ. Muhammadiyah Metro; ISSN 2442-5419*, *3*(1), 17–27.

Rukminingrum, D. V., Hanurawan, F., & Mudiono, A. (2017). Pengetahuan Metakognitif Belajar Siswa. *Jurnal Pendidikan, EISSN: 2502-471X*, *2*(2), 280–284.

Sahidin, L., Budiarto, M. T., & Fuad, Y. (2019). Developing Vignettes to Assess Mathematical Knowledge for Teaching based Conceptual. *International Journal of Instruction; e-ISSN: 1308-1470; p-ISSN: 1694-609X*, *12*(3), 651–664. https://doi.org/10.29333/iji.2019.12339a

Sari, N. M., Yaniawati, P., Darhim, & Kartasasmita, B. G. (2019). The Effect of Different Ways in Presenting Teaching Materials on Students ' Mathematical Problem Solving Abilities. *International Journal of Instruction; e-ISSN: 1308-1470; p-ISSN: 1694-609X*, *12*(4), 495–512.

Setiawan, R. H., & Harta, I. (2014). Pengaruh Pendekatan Open-Ended dan Pendekatan Kontekstual Terhadap Kemampuan Pemecahan Masalah dan Sikap Terhadap Matematika. *Jurnal Riset Pendidikan Matematika*, *1*(2), 240–256.

Shahbari, J. A., Daher, W., & Rasslan, S. (2014). Mathematical knowledge and the cognitive and metacognitive processes emerged in model-eliciting activities. *International Journal on New Trends in Education and Their Implications; ISSN 1309-6249*, *5*(2), 209–219.

Sholihah, D. A., & Mahmudi, A. (2015). Keefektifan Experiential Learning Pembelajaran Matematika pada Bangun Ruang Sisi Datar. *Jurnal Riset Pendidikan Matematika*, *2*(2), 175–185.

Skemp, R. R. (1971). *The Psychology of Learning Mathematics.* Retrieved from file:///C:/Users/PERSONAL/Downloads/kundoc.com_the-psychology-of-learning-mathematics.pdf

Suratno, Komaria, N., Yushardi, Dafik, & Wicaksono, I. (2019). The effect of using synectics model on creative thinking and metacognition skills of junior high school students. *International Journal of Instruction; e-ISSN: 1308-1470; p-ISSN: 1694-609X*, *12*(3), 133–150. https://doi.org/10.29333/iji.2019.1239a

Syarifudin, Purwanto, Irawan, E. B., Sulandra, I. M., & Fikriyah, U. (2019). Student verbal interaction in geometry problem-solving through cognitive activities. *International Journal of Instruction; e-ISSN: 1308-1470; p-ISSN: 1694-609X*, *12*(3), 167–182. https://doi.org/10.29333/iji.2019.12311a

Tachie, S. A., & Molepo, J. M. (2019). Exploring Teachers' Meta-Cognitive Skills in Mathematics Classes in Selected Rural Primary Schools in Eastern Cape, South Africa. *Africa Education Review; ISSN: 1814-6627*, *16*(2), 143–161. https://doi.org/10.1080/18146627.2017.1384700

Tadanugi, F. A. (2015). Efektivitas Lesson Study dalam Pembelajaran Matematika. *JURNAL KIP*, *IV*(2), 887–894.

Tok, H., Özgan, H., & Dos, B. (2010). Assessing Metacognitive Awareness and Learning Strategies as Positive Predictors for Success in a Distance Learning Class. *Mustafa Kemal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *7*(14), 123–134.

Umbara, U., & Suryadi, D. (2019). Re-Interpretation of Mathematical Literacy Based on the Teacher ' s Perspective. *International Journal of Instruction; e-ISSN: 1308-1470; p-ISSN: 1694-609X*, *12*(4), 789–806.

Vitantri, C. A., & Asriningsih, T. M. (2016). Efektivitas Lesson Study pada Peningkatan Kompetensi Calon Guru Matematika. *Jurnal Matematika Dan Pendidikan Matematika*, *I*(1), 23–33.

Winarno, Zuhri, M., Mansur, Sutopo, I., & Widhyahrini, K. (2019). Development of Assessment for the Learning of the Humanistic Model to Improve Evaluation of Elementary School Mathematics. *International Journal of Instruction; e-ISSN: 1308-1470; p-ISSN: 1694-609X*, *12*(4), 49–64.

Wulandari, B., Arifin, F., & Irmawati, D. (2015). Peningkatan Kemampuan Kerjasama dalam Tim Melalui Pembelajaran Berbasis Lesson Study. *Jurnal Electronics, Informatics, and*

Vocational Education (ELINVO), *1*(1), 9–16.

Zainudin, M., & Puspananda, D. R. (2015). Efektivitas Direct Instruction dengan Involving Students In Self-And Peer Evaluation terhadap Hasil Belajar Ditinjau dari Gaya Kognitif. *Varia Pendidikan, ISSN: 0852-0976*, *27*(2), 192–199.

Zainudin, M., Subali, B., & Jailani. (2019). Construct validity of mathematical creativity instrument: First-order and second-order confirmatory factor analysis. *International Journal of Instruction; e-ISSN: 1308-1470; p-ISSN: 1694-609X*, *12*(3), 595–614. https://doi.org/10.29333/iji.2019.12336a