MESIU Learning Model based on Lesson Study to Train Natural Science Teacher Candidates' Thinking Skills

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Abstract: The Mind mapping, Exploring, Sharing, Implementing, concluding (MESIU) learning model is an innovative learning model designed to train thinking skills: problem solving, metacognitive, and cognitive skills. This study aimed to analyze the practicality of the MESIU learning models developed. The study was conducted through limited trials to 33 students of science education program who were studying Ecology courses. Data was obtained by observing the learning feasibility using the MESIU learning model and the results of the student response questionnaires. The results of learning observations showed average score of 3.86, and average reliability of 97.52% (reliable). Students responded positively to the MESIU learning model to train problem solving, metacognitive skills, and understanding concepts. The results of the study concluded that the MESIU learning model was proven practical for training the thinking skills of science teacher candidates.

Keywords: MESIU; Natural science teacher; Lesson study; Thinking skills.

1. Introduction
Someone who wants to succeed in life in the 21st century must master various skills. This statement is related to the four life pillars of the 21st Century namely learning to know, learning to do, learning to be and learning to live together [1]. The 21st Century education paradigm no longer only emphasizes subject content mastery, but demands on learning, innovation and life skills [2]. The need for learning skills, it is necessary to train these skills to students through learning. The intended life skills are problem-solving skills, and metacognitive skills, in the hope that it will have an impact on students' understanding of the material. Learning to train 21st century skills must be designed to be problem-based, empower metacognition, and be student-centered so that interactions with friends occur in learning activities [3], [4].

Some researches on problem solving show low results [5], [6], [7]. Exploration of problem solving skills by using open tests shows that students do not understand the problem, do no analysis, and only memorize the same problems that they have faced before, thus becoming the proposed solution plan. A person’s skill dealing with problems indicate the thinking of the certain person. A person who has reached a high level of thinking has the opportunity to have metacognitive skills [8]. As part of 21st century skills, metacognitive skills have not been trained [9], so that the impact on planning, monitoring, and evaluating activities in learning has not been carried out properly [10]. Problem
solving skills and metacognitive skills can be trained by exposing students to the real problems of everyday life through learning Natural Sciences.

Natural Sciences are activities of learning natural phenomena to gain knowledge about nature and its surroundings by using mind. Biology is a branch of natural sciences that studies living things and their interaction with the environment. Biological objects are the observed matters, both object and event, that allow problems in studying biology taking place. Ecology as a branch of biology in development shows that ecology becomes science that discusses the structure and function of ecosystems (nature), and then it can analyse and provide answers to environmental problems, such as flood, environmental pollution, global warming, and forest destruction [11]. Ecology is highly needed in almost every life problem solving, including in the application of the latest environmental management. Ecology is interdisciplinary science, in understanding Ecology information is needed from various interrelated fields, and then it can be used to solve ecological problems. Ecology learning must be designed by involving students to come up with ideas in order to solve problems.

Efforts to train the skill can be done using a learning model [12], [13]. The learning model needed is practical and involves students in gaining knowledge [14]. One of them is using the MESIU learning model (Mindmapping, Exploring, Sharing, and Implementing, conclUding). The MESIU model is a learning model designed to train problem-solving skill, metacognitive skill, and students' understanding to the learned material.

This study aimed to analyze the practicality of the MESIU learning model developed to train problem-solving skill and metacognitive skill to the students of science teacher candidate through Ecology courses.

The rest of this paper is organized as follow: Section 2 describes the proposed research method. Section 3 presents the obtained results and following by discussion. Finally Section 4 concludes this work.

2. Research Method
This research is part of the learning model development activities carried out based on Lesson Study (LS) on Natural Sciences Study Program students, Malang State University, who are taking Ecology courses, 2017/2018 academic year, as many as 33 students. LS activities consist of three stages: the planning stage (Plan), implementation (Do), and reflection (See). The planning stage was carried out before learning, lecturers, model lecturers, and observers collaborated to examine the Per-Semester Implementation Plan (PSIP) that had been prepared by the model lecturer and elaborated in the form of a Lesson Plan (LP). The structured lesson study was used as an instrument for observing lectures by using the MESIU learning model. Stage Do was an activity in the classroom to find out the implementation of learning based on the LP with the MESIU model that had been prepared and carried out by observers. Then, in Stage See, the lecturer and observer provided suggestion to the model lecturer regarding the learning activities that was just done and provided suggestion for improvement in the next learning.

Two observers observed the process with an observation instrument (4: Very good, 3: Good, 2: Poor, 1: Not good). Reliability of compliance observation instruments was obtained from an inter-observer agreement, which was calculated using the percentage agreement formula. The instrument for implementing the MESIU model was said to be reliable if the reliability value is ≥ 75% [15]. The data obtained in the form of observations and student responses were analyzed quantitatively in average and percentage form.

3. Results and Discussion
This section presents the obtained results and following by discussion.

3.1. Results of Learning Implementation Observations
Limited trials of learning with the MESIU models for 33 students of Natural Sciences Study Program, 2016 class B, Malang State University, and three meetings were presented in Table 1.
Table 1. Observation results of learning implementation with the MESIU model

| Aspect               | Average Score | Reliability (%) | Criteria |
|----------------------|---------------|-----------------|----------|
| **Lesson Plan 1. Community** |               |                 |          |
| Introduction         | 3.50          | 96.86           | Reliable |
| Mind mapping         | 3.50          | 93.00           | Reliable |
| Exploring            | 4.00          | 98.40           | Reliable |
| Sharing              | 4.00          | 100             | Reliable |
| Implementing         | 4.00          | 97.60           | Reliable |
| Concluding           | 3.50          | 94.66           | Reliable |
| Closing              | 4.00          | 100             | Reliable |
| **Lesson Plan 2. Ecosystem** |       |                 |          |
| Introduction         | 3.83          | 95.33           | Reliable |
| Mind mapping         | 3.75          | 93.00           | Reliable |
| Exploring            | 3.83          | 95.33           | Reliable |
| Sharing              | 4.00          | 100             | Reliable |
| Implementing         | 3.75          | 93.00           | Reliable |
| Concluding           | 3.80          | 90.70           | Reliable |
| Closing              | 4.00          | 100             | Reliable |
| **Lesson Plan 3. Food chain & Food Webs** |               |                 |          |
| Introduction         | 4.00          | 100             | Reliable |
| Mind mapping         | 3.75          | 100             | Reliable |
| Exploring            | 3.83          | 100             | Reliable |
| Sharing              | 4.00          | 100             | Reliable |
| Implementing         | 4.00          | 100             | Reliable |
| Concluding           | 4.00          | 100             | Reliable |
| Closing              | 4.00          | 100             | Reliable |
| **Average**          | **3.86**      | **97.52**       | Reliable |

*R = coefficient of inter-observer agreement*

All the steps of learning community, ecosystem, food chain and food web learning materials were done well. Table 1 showed that learning using the MESIU learning model could be done well, and all of the instruments used have reliable criteria. MESIU learning model developed to train problem-solving skill, metacognitive skill, and students’ cognitive learning result. Complex skill such as problem solving and metacognition need to be integratively trained in the learning [16]. Limited trial of MESIU learning model had done well according to the learning attendance and students’ response.

The limited trial of the MESIU learning model with the researcher as a model lecturer was three times, indicating that at the first meeting, the entire syntax was implemented well, but the timing was not good. The results of reflection (see) activities, conducted after learning, obtained data that at the beginning of the meeting using the MESIU model, students needed time to adapt the model, time was taken up to work worksheet, so that the activity of filling out the Follow-up Plan (FUP) format had little allocation. Students said they were still confused of the activities to be done in the MESIU learning model.

The implementation of learning at the second meeting showed that all of syntax was implemented well. Based on suggestion on the 1st meeting, in time management aspect, the researcher should be more careful in doing each syntax. Researchers as model lecturers act as facilitators and guide students during learning, as an effort to control timing and implementation of syntax. The results of observations on do2 activities showed that all of the syntax could be implemented. Supported by
students’ interview, they were getting used to activities in phase 1: mind mapping, followed by phase 2: exploring, by working on group problem-solving worksheet, and on the learning closures by filling FUP. Implementation at the third meeting showed that the entire syntax had been implemented properly. The time allocation had been done precisely to the draft in the lesson plan. Lecturer guidance was still needed but with reduced portion. The data showed that students got used to MESIU models and enjoy each stage of the activity.

The implementation of learning with the MESIU model was supported by the implementation of the actions in the Lesson Study as presented in Table 2.

| Meeting | Plan (%) | Do (%) | See (%) |
|---------|----------|--------|---------|
| 1<sup>st</sup> | 72 | 80 | 88 |
| 2<sup>nd</sup> | 88 | 88 | 90 |
| 3<sup>rd</sup> | 100 | 100 | 97 |

Table 2 showed the percentage of LS activities in the three meetings, which showed improvement at each stage. Each meeting of the model lecturer got suggestion from the observer, so it was expected that there was enhancement in each meeting. Lesson Study was believed to be able realizing improvement, since there was a phase seen as a forum to receive suggestion for lecturers, to improve things that were lacking in the previous meeting, so the next meeting would be better.

The trial implementation was limited by using the MESIU learning model, operating the syntax, and paying attention to characteristics to become a complete learning model. The results of the trial evaluation were presented in Table 3.

Table 3. Evaluation Results of Limited Trials in class B of the 2016 class IPA Study Program of Malang State University

| No | Evaluation Component | Result |
|----|-----------------------|--------|
| 1. | MESIU models syntax | Five phases in the models could be implemented well to train students’ problem-solving skill, metacognitive, and learning outcomes |
| 2. | Social system | The MESIU learning model provided a learning environment that allowed students to interact among students, as well as students with lecturers, for example in the phase of exploring and sharing. The lecturer acted as a facilitator and mentor in the learning process, as an effort to encourage the idea of solving problems |
| 3. | Reaction principal | Lecturers had a role to remind students to solve problems and reflect knowledge held in group. Lecturers gave praise, opportunities for students to ask questions, express opinions, and criticize solutions delivered by other groups, as well as feedback on activities done by students |
| 4. | The MESIU models support system | Problem-solving skills training was done by using a worksheet, training in metacognitive skills using the Follow-up Plan (FUP) format, cognitive ability was trained through the creation of mind maps. Tests were conducted to determine the improvement of problem-solving skill, metacognitive skill, and cognitive learning outcomes |
| 5. | Instructional impact and following impact | A good internet network supported the learning process, so it could help while looking for references to problem-solving skill. |

Learning is an activity to help student getting knowledge and skill [17]. The developed learning model has operated components in syntax and helps to achieve learning purpose. The good learning
The MESIU learning model has five main components: 1) Syntax; 2) Social System; 3) Reaction Principal; 4) Supporting System; 5) instructional components and following components [18]. The learning theory that underlies the developing of MESIU learning model was cognitive learning theory, constructivist, and information processing.

The syntax of MESIU learning model consists of five phases that had done well, supported by good learning environment to train problem-solving skill, metacognitive skill, and students’ cognitive learning result. Learning activity from LP (Lesson Plan) was adapted from syntax of MESIU model: phase 1) Mind mapping, as product of reading reference that would be discussed. By mind mapping, students should find main points of the reference [19]. The activity of mind mapping was done in home, then students had keystone to receive more certain material. Mind mapping in syntax of learning model had purposed to increase students’ skill by remembering process, connecting idea, evaluating, and taking decision [20].

Phase 2) Exploring; students, by using student work sheet, learned to solve the problem, done in the group to make interaction among the students. Problem-solving skill involved the finding of proper way to solve the problem, dong by identifying problem, producing idea, choosing solution, and deciding relevant information in order to be able to solve problem in real life [21], [22], [23], [24]. The lecturer as facilitator gave instruction to the needed group. Students could learn with their peers that more capable or adults to solve the problem, as said by Vygotsky by social learning theory about the Zone of Proximal Development [25]. Interaction among another people would open mind to some ideas, in order to produce better innovation [26].

Phase 3) Sharing, the phase for communicating group discussion result to send the solution plan of previous identified problem. Sharing was one of the social interaction forms that are important to construct knowledge [25]

Phase 4) Implementing; after doing phase two and three, students operated the solution plan that had been presented in order to be implemented by practice. Implementation was used together by another cognitive process, such as understanding and creating [27]. In this phase, skill was needed to write idea by obvious sentence.

Phase 5) conclUding, was the phase to make conclusion from the activity that had been done and observe the knowledge achieved. Skill of controlling knowledge obtained was defined as metacognitive skill or ‘thinking about thinking’ [28]. Metacognitive skill was the process of executive control that could be used to control cognition [29]. Concluding skill could be developed by using media, such as student work sheet [30]. In this phase, students could find solution from the identified problem. Concluding phase was also helped by produced mind map, since mind map was constructed to sum the written material, consisted of keywords that was written in the main concept, and then diverged to related sub-concept to sum the material become more effective [31], [26].

The MESIU learning model has a support system in the form of learning tools that are in accordance with the MESIU learning model. Learning tools consist of Per-Semester Implementation Plan (PSIP), worksheets, handouts, and ecology course tests. Learning tools are operational from the developed learning model, so they have a very important role.

3.2. Students responses

Student responses to the implementation of learning using the MESIU model were obtained based on questionnaire responses by students after learning was completed. The recapitulation of student response presented in Table 4 showed that the MESIU learning model could be used to train problem-solving skill, metacognitive skill, and student cognitive learning outcomes. Students showed good responses during learning, since it was interesting and could help understanding the material (85.6%), impressing with the MESIU learning model (68%) as a new model that could be applied to Ecology lectures and might be tried in other lectures, because it helped facilitate learning process (58%), and the implementation of the MESIU learning model had minimum obstacle (48%). Student responses results on this limited trial were also used as a reference for improving the MESIU learning model.
Students responded well to learn by using the MESIU learning model. In learning, students were asked to work individually and work in group to solve problems. This statement was supported by a complex cognitive process theory that gave students experience to be able to increase intrinsic motivation [32].

Table 4. Student Response Analysis

| Analysis                                                                 | Percentage (%) |
|-------------------------------------------------------------------------|----------------|
| 1. Was the learning model interested?                                    | 79 21          |
| 2. Were you happy learning with this model?                              | 64 36          |
| 3. Had the learning improve your skills to identify your understanding about the content and to make a plan how to understand the content? | 97 3           |
| 4. Did the learning model polish your problem-solving skills?            | 100 0          |
| 5. Did the learning model increase your understanding about Ecosystem?   | 88 12          |
| **Average**                                                             | **85.6 14.4**  |
| 6. Your impression during Ecology lesson using MESIU Learning Model:     |                |
| a. Was very interesting and easy to understand the content              | 70 30          |
| b. Was Easier and faster to understand the content                      | 73 27          |
| c. Study became more fun and easy                                      | 67 33          |
| d. The lesson was relaxing, made student more focused and creative, and was not boring | 61 39          |
| **Average**                                                             | **68 33**      |
| 7. What was your opinion of another lesson apply MESIU Learning model?   |                |
| a. Agree, this model must apply this model in the learning process      | 52 48          |
| b. There is a possibility to understand the content                      | 45 55          |
| c. Help students to understand the content more easy                    | 76 24          |
| **Average**                                                             | **58 42**      |
| 8. Write your obstacles during the lesson using MESIU learning model    |                |
| a. There was no obstacle                                                | 52 48          |
| b. The teaching was too fast                                            | 48 52          |
| c. Too hard to read reference                                           | 61 39          |
| d. The content was kind of lacking                                      | 33 67          |
| **Average**                                                             | **48 52**      |

4. Conclusion

The results of this study showed that the development of LS-based learning models results in a practical MESIU learning model used in learning to train problem-solving skill and metacognitive skill of science teacher students. The MESIU learning model was stated to be practical by the average of the implementation scores and the reliability of the instruments used. In addition, the MESIU learning model was supported by learning theory, systematic syntax, conductive learning environment, the principle of reaction, instructional impact, and following impact. So, this research needs to be done on a larger sample in the future.

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