Development of lesson plan device based on inquiry based learning to improve learning outcome and critical thinking skill

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Abstract. This research is a development research that aims to evaluate the validity, practicality, and effectiveness of lesson plan device based on inquiry based learning which has been developed on interaction of living things and its environment topic in junior high school. This research adapts Tessier’s model to developed the lesson plan device include syllabi, lesson plan, worksheet, learning material, and media. The instruments used in this research were validation sheet, response questionnaire, learning outcome test, and critical thinking skills observation sheet. The results showed that: 1) the validity of lesson plan device based on expert assessment was in a valid category, b) the practically of the lesson plan device categorized as very good and c) the effectiveness based on learning outcome and critical thinking skills. The subjects for the field test were 29 grade VII students at Public Junior High School 13 Banjarmasin, South Kalimantan. The learning outcome result showed that has exceeded the passing grade and the critical thinking skill was in a very good category. This result concluded that the lesson plan device based on inquiry based learning developed have been proved worthy for biology learning, especially on on interaction of living things and its environment topic.

1. Introduction
Entering the 21st century students have to emphasize on global skill mastery. Students are not just prepared to master the knowledge and skills only, but also must have the skills to face the 21st century challenges successfully. Learning activities need to accommodate the development of students' thinking skills, one of which is critical thinking skill. Critical thinking skill is one of the main goals that expected to be achieved on learning process [1].

The teacher duty already completed when the lesson was over and abilities that will be measured already fulfilled. In fact, teacher still ignore the learning process, inform the materials, sort the materials, motivate the students, and develop good evaluations. He doesn't pay attention to how students absorb the materials, master it, and get good scores. As a result, student’s thinking skills will not increase [2].

According to OECD [3] PISA cognitive questions that aim to measure science literacy presented in 2 groups i.e. 1) standard unit that consist of static materials include text, graphic, table, and graphic and
related questions, and 2) interactive unit that consist of interactive stimulate materials and related questions. Standard unit demands learning experience through scientific work and interactive unit demand students’ technology literacy. Both of these abilities need to be encouraged so the students will have science and technology literacy.

The ability of scientific literacy is a fundamental thing that must be possessed by students in facing challenges in the 21st century, it is necessary to design the learning activities and assessment that could stimulate the increase of science literacy. A scientifically literate student must be able to demonstrating the most essential skills of science literacy, communicate his or her ideas through writing or speaking. Therefore, the students must have the knowledge in order to explore specific types of scientific issues in depth [4]. One way that could be done is by design the learning based on observation or investigation, one of them is inquiry-based learning.

Lesson plan device in school need to be reconstructed through development research. This research process an iterative design that focus on implementation and development in education [5]. The “development research” term popularized by Richey & Klein [6] as a systematic study of design process, development, and evaluation that aims to create learning or non-learning products (device). There are two main paradigms on design-based research i.e. design as problem solving and design as action reflection [7]. teaching sets based on development research is a learning process innovation. Through this way, will be produced a valid, practical, and effective lesson plan device (high quality intervention) [8]. Development result product stated valid (relevant) because of intervention and design based on scientific knowledge [8].

Most studies about teaching sets based on development researches using inquiry based learning have been conducted, and only few data are available about lesson plan device based on inquiry based learning about interaction of living things and its environment topic. Therefore, the aim of this research is to evaluate the validity, practicality, and effectivity of lesson plan device based on inquiry based learning which has been developed on interaction of living things and its environment topic in junior high school.

2. Methods
Tessier model used in this research because each steps aim to improve the quality of prototype as final product. Those steps are 1) self-evaluation, 2) expert test, 3) individual test, 4) small group test and 5) field test.

Research conducted for six months (July-December 2015) at SMPN 13 Banjarmasin. Research subjects are expert team consists of 3 lecturers from biology education that actively validating lesson plan device since 4 years ago. For individual test subject consists of 3 students from 7th A grade, small group test subject consists of 15 students from 7th B grade. Subject for the field test consists of 29 students from class 7th A grade. Subjects come from the same school. Research subjects determined purposively i.e. students with different academic ability. Validity data obtained from expert team decision using lesson plan validation assessment format. Practicality data obtained from observer assessment toward learning implementation by partner teacher, using lesson plan implementation assessment format. Effectivity data obtained from cognitive learning outcome and critical thinking ability observation.

Data analysis to state the lesson plan device validity using score 1-4 (1= less, 2= moderate, 3= valid, and 4= very valid). Data analysis to state the effectivity id lesson plan device i.e. 1) cognitive learning outcome based on the total of correct answers, then referred to passing grade criteria (passing grade = 85), and critical thinking skills results analyzed descriptively.

3. Results and Discussion

3.1. The Validity of Lesson Plan Device
Lesson plan device validity obtained from experts’ opinion about syllabi, lesson plan, worksheets, teaching materials and learning media. Table 1 report the results of the lesson plan device validation analysis from experts’ opinion.
Table 1. The Results of Lesson Plan Device Validity

| Indicators                                                                 | Score | Category       |
|---------------------------------------------------------------------------|-------|----------------|
| Syllabi                                                                   |       |                |
| Systematic                                                                | 4     | Very Valid     |
| Suitability basic competency (BC) with core competency (CC)              | 4     | Very Valid     |
| Material coverage                                                         | 3     | Valid          |
| Learning plan suits students’ potency                                     | 3     | Valid          |
| Include scientific approach                                               | 3     | Valid          |
| Assessment based on BC, CC, and main material                             | 3     | Valid          |
| Media, tools, and learning materials in accordance with BC, CC, and main material | 3   | Valid          |
| Time allocation in accordance with learning activities                    | 4     | Very Valid     |
| Lesson Plan                                                               |       |                |
| Completeness of lesson plan components                                    | 4     | Very Valid     |
| Activity to motivate students                                            | 4     | Very Valid     |
| Formulation of learning objectives to encourage critical thinking ability | 3     | Valid          |
| Formulation of the using purpose                                         | 3     | Valid          |
| Integrated character education on lesson plan                             | 3     | Valid          |
| There are preliminary, core, and closing activity                        | 4     | Very Valid     |
| Suitability between learning experiences, objectives, and time allocation | 3     | Valid          |
| Include scientific approach                                               | 3     | Valid          |
| Learning steps allow the life proficiency to emerge                       | 3     | Valid          |
| Learning activities emphasize learning experiences                        | 4     | Very Valid     |
| Utilization of contextual learning resources                              | 3     | Valid          |
| Learning media are practical to use                                       | 4     | Very Valid     |
| Learning model require active students                                    | 3     | Valid          |
| Include tools and materials                                               | 3     | Valid          |
| Include assessment instruments                                            | 4     | Very Valid     |
| Include references on lesson plan                                        | 3     | Valid          |
| Students’ Worksheet                                                      |       |                |
| Systematic                                                                | 4     | Very Valid     |
| Emphasize scientific process                                              | 3     | Valid          |
| Use default language                                                      | 4     | Very Valid     |
| Interesting outlook                                                      | 3     | Valid          |
| Efficiency (time, cost, and effort)                                       | 4     | Very Valid     |
| Teaching Material                                                        |       |                |
| Systematic                                                                | 3     | Valid          |
| Materials are relevant with basic competency                              | 3     | Valid          |
| Materials descriptions in accordance to students’ development level       | 3     | Valid          |
| Materials in accordance with scientific truth                             | 3     | Valid          |
| Materials are up-to-date                                                  | 3     | Valid          |
| Materials in accordance with daily life                                   | 4     | Very Valid     |
| Encourage curiosity                                                      | 3     | Valid          |
| Encourage students’ interaction with learning resource                    | 3     | Valid          |
| Encourage students to build their own knowledge                           | 3     | Valid          |
| Sentences structure in accordance with students’ comprehension level      | 3     | Valid          |
| Image utilization to support material descriptions                        | 3     | Valid          |
| Spelling accuracy                                                        | 4     | Very Valid     |
| Terms and sentences structure accuracy                                    | 4     | Very Valid     |
| Systematic                                                                | 3     | Valid          |
| Materials are relevant with basic competency                              | 3     | Valid          |
| Learning Media                                                           |       |                |
| Media in accordance with learning objectives                              | 3     | Valid          |
Based on the validation results, the lesson plan device that developed is valid and very valid. Lesson plan device validity also obtained from students’ opinion about worksheet, teaching materials and evaluation tools. The results of students’ opinion of lesson plan device are shown in the table 2.

**Table 2. The Results of Students’ Opinion about Lesson Plan Device**

| Indicators                                      | Score | Category       |
|------------------------------------------------|-------|----------------|
| **Students’ Worksheet**                       |       |                |
| Outlook                                        | 3     | Good           |
| Worksheet could be studied individually or in group | 3     | Good           |
| Learning activities on worksheet are fun        | 3     | Good           |
| Worksheet materials comprehension              | 3     | Good           |
| Increase scientific knowledge                  | 4     | Very Good      |
| Used language                                  | 3     | Good           |
| Inquiry model emerge learning interest         | 3     | Good           |
| Worksheet instructions                         | 3     | Good           |
| Emerge thinking ability                        | 4     | Very Good      |
| **Teaching Materials**                         |       |                |
| Studied science teaching materials             | 3     | Good           |
| Pictures attached                              | 3     | Good           |
| Additional informations to add knowledge       | 3     | Good           |
| Materials could be used to increase awareness to preserve environment | 4     | Very Good      |
| Foreign terms comprehension                    | 3     | Good           |
| Teaching materials increase learning interest  | 3     | Good           |
| Teaching materials increase learning outcome   | 3     | Good           |
| **Evaluation Tools**                           |       |                |
| Sentences on each question                     | 3     | Good           |
| Instructions                                   | 3     | Good           |
| Picture attached                               | 3     | Good           |
| Main question formulation                      | 3     | Good           |
| Table on each question                         | 3     | Good           |

Note: 1 = Less, 2 = Moderate, 3 = Good, dan 4 = Very Good

Based on the students’ opinion results, the lesson plan device that developed is categorized good and very good. The results of lesson plan device validation show that this research produced a valid device based on the expert assessment and the student opinion. This finding is supported by previous researches [9,10]. Device stated valid if assessment toward all validated aspects are in good category [9] and also the valid lesson plan device is if components in accordance with lesson plan device validation indicators [10].
3.2. **The Practicality of Lesson Plan Device**

The practicality of lesson plan device was measured through the lesson plan implementation by partner teacher and students’ responses toward learning implementation. The results of lesson plan implementation by partner teacher are presented in Table 3.

**Table 3. The Result of Lesson Plan Implementation by Partner Teacher**

| Aspects                     | Score | Category     |
|-----------------------------|-------|--------------|
| Preliminary activities      | 4     | Very Good    |
| Core activities             |       |              |
| Orientation                 | 3     | Good         |
| Formulate the problems      | 4     | Very Good    |
| Formulate the hypotheses    | 3     | Good         |
| Collect the data            | 4     | Very Good    |
| Test the hypotheses         | 3     | Good         |
| Formulate the conclusions   | 4     | Very Good    |
| Closing activities          | 3     | Good         |

Based on Table 3, partner teacher’s ability to implement the lesson plan categorized good and very good. This result shows practicality of lesson plan device which have been developed because the partner teacher can implement the lesson plan well. The ability of teachers to implement lesson plans properly has a big impact toward teaching-learning process and students’ individual development [11]. Therefore, the teacher's ability to implement the learning plan developed is an important thing.

Design-based research is a synergy between practice and research, encourage practices development as many as possible. Furthermore, the results of student responses toward inquiry-based learning implementation are presented in Table 4.

**Table 4. The Results of Students’ Responses toward Learning Implementation**

| Statements                                      | Agree |
|------------------------------------------------|-------|
| Learning model useful on learning science       | F 15  |
| Learning model is attractive                    | % 100 |
| Learning model help to understanding science materials |
| This model motivates to learn science            | F 12  |
| This model encourages to active learning        | % 80  |
| Steps are easy to follow                        | F 12  |
| Save times                                      | % 80  |
| Easy to relate materials with daily life’s problem | F 14  |
| Enhancing group works                            | % 93.3|

Based on Table 4, students’ responses toward learning implementation categorized good and very good. This is supported by previous researches which show that inquiry-based lesson plan device that developed get positive responses from [12].

3.3. **The Effectivity of Lesson Plan Device**

The effectivity of lesson plan device was measured through cognitive learning outcome and critical thinking skills. The analysis results of cognitive learning outcome are presented in Table 5.

**Table 5. The Results of Cognitive Learning Outcome**

| Cognitive Learning Outcome | Total Students | Passed | %   |
|----------------------------|----------------|--------|-----|
| Product                    | 29             | 25     | 86.2|
| Process                    | 29             | 26     | 89.7|

Based on Table 5, there are 86.2% of students who pass the passing grade for cognitive learning outcome of product and there are 89.7% of students who pass the passing grade for cognitive learning outcome of process.
Learning outcomes can achieve passing grade because the instrument used has been validated. Test instruments should be valid and reliable to decrease mistakes in measurement process [13]. Inquiry-based lesson plan device can improve student competence, because inquiry syntax could accommodate spiritual, social, knowledge, and skill competency [14]. The analysis results of critical thinking skills are presented in Table 6.

**Table 6. The Results of Critical Thinking Skills**

| Indicators                  | Average (%) | Category    |
|-----------------------------|-------------|-------------|
| Formulate the problems      | 86,4        | Very Good   |
| Formulate the hypotheses    | 80,8        | Good        |
| Do observation              | 86,5        | Very Good   |
| Collect the data            | 81,8        | Good        |
| Analyze the data            | 86,9        | Very Good   |
| Formulate the conclusions   | 87,4        | Very Good   |

Based on Table 6, critical thinking skill of students categorized good and very good as found by the previous research also report that teaching sets based on inquiry based learning can improve critical thinking skill [12,15]. Critical thinking skills become one of learning device effectiveness [16]. Students’ critical thinking skills include formulate the problems, formulate the hypotheses, collect the data, analyze the data, and make conclusion are in good category [16].

### 4. Conclusion

The result of development research concluded that the teaching sets based on inquiry based learning were feasible to use in biology learning. This was supported by the data collected during the study, namely the lesson plan device validity from the expert’s assessment, the practicality which categorized as good and very good, and the effectiveness of the lesson plan device which can increase the cognitive learning outcome and critical thinking skill.

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