The development of teaching materials use an inductive-based 7E learning cycle for elementary school students

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Abstract. The observation in the fourth grade of Elementary School (SDN 06 Lapai) Padang show that the teaching materials available in elementary schools have not helped students understand the subject matter. Students have not fully carried out activities on student worksheets. Students are not able to answer the questions given by the teacher, so the teacher has not been able to motivate students' initial knowledge. The teacher's view of students will determine the attitude in choosing the learning approach chosen by the teacher [1]. The approach shows the general way of looking at problems. An approach in learning has three bases, namely the basis of philosophy (based on principles and law), psychological basis (based on learning theory or students' mental development theory) and pedagogical basis (based on free and unstructured time periods in learning).

Inductive approach is one of the learning approaches that activates and motivates students to find concepts based on facts or phenomena so that concepts can be obtained from the material they have
learned. The stages of learning using an inductive model consisting of: (1) Formation of concepts, (2) interpretation of data, (3) application of principles [2].

Based on the observations of the fourth grade students at the Elementary School (SD Negeri 06 Lapai) in Padang, the average student learning outcomes were still low, still far below the minimum mastery criteria (KKM). Student mastery learning is presented in Table 1.

### Table 1. Student mastery learning

| Class | KKM | Mastery | Not mastery | Average |
|-------|-----|---------|-------------|---------|
| IV a  | 70  | 15      | 7 (31%)     | 66.2    |
|       |     |         | (68%)       |         |
| IV b  | 70  | 10      | 8 (43%)     | 67.8    |
|       |     |         | (56%)       |         |

Based on Table 1 it can be seen that student mastery learning is included in the low category. This indicates that students’ understanding in Natural Science learning is also low, even though learning media for Natural Sciences is available. Based on the above it is deemed necessary to conduct research based on the inductive approach with the aim of increasing student understanding, especially material that require skills in conducting experiment and their application in daily life so as to increase the activities and competencies of fourth grade elementary school students, especially learning outcomes.

One effort to improve student competence in science learning is to develop learning models using inductive 7E learning cycle. The 7E learning cycle model is a model that can guide students to actively acquire new knowledge with 7E (elicit, engage, explore, explain, elaborate, evaluate, and extend). Teaching materials using 7E learning cycle can help students understand the problems and phenomena they encounter in the environment. Learning using 7E learning cycle is able to explore students' ideas so that they are motivated to construct new knowledge. The 7E learning cycle can help students reason, think critically and creatively. The study aims to develop SD IV teaching materials using 7E inductive-based learning cycle that is valid, practical and effective.

### 2. Methods

Research use the Instructional Development Institute (IDI) model design which consist of three stages, namely define, develop, and evaluate [3]. The research phase consisted of: (1) conducting a preliminary survey, (2) compiling teaching materials (syllabus, lesson plan, module, and assessment) using an inductive 7E Learning Cycle, (3) validating teaching materials, (4) compiling research instruments, (5) conducting teaching materials and research instruments trials, (6) analyzing trial data, (7) conducting research by carrying out inductive-based 7E Learning Cycle, (8) giving post-tests, (9) analyzing data and interpreting results research. The research subjects are teaching materials. The research respondents were 21 fourth grade students at the Elementary School (SD Negeri 06 Lapai) in Padang. The research instruments were observation sheets, tests, and questionnaires on students' responses to the implementation of learning. The observation sheet is used in conducting the preliminary survey. Data were analyzed descriptively quantitatively. The effectiveness of a learning can be determined from two aspects, in terms of student learning activities and student learning outcomes. Activities are measured through observation of psychomotor skills sheet and learning outcomes are measured through concept understanding tests on subject matter.

### 3. Result and Discussion

#### 3.1. Define Stage

At the define stage students analyze and analyze subject matter. Student analysis includes aspects of quality such as interests, learning styles, and initial abilities possessed by students. Student analysis aims to find out the problems faced by students in the learning process. Students tend to be passive during the learning process, due to lack of communication in the form of question and answer between the teacher and students. Teacher centered learning conditions, less able to develop the ability of students
to find their own concepts. Students only accept material without digesting it first. As a result, student learning outcomes have not been satisfactory.

Material analysis aims to identify and arrange subject matter systematically. Material analysis includes identification, hierarchy and arrangement of concepts, originality, conceptuality related to the character of elementary students. The teaching material that was trial using the teaching material that developed was identifying various styles, including muscle style, electric force, magnetic force, gravitational force, and friction force.

3.2. Teaching materials use 7E based inductive learning cycle
At the develop stage, a prototype syllabus, lesson plan, teaching materials, module, and assessment using the Inductive 7E Learning Cycle model are designed. This teaching materials must be validated before being used.

3.2.1 Validity of teaching materials
Validity of teaching materials include four components of assessment, namely the feasibility of content, presentation, language, and graphics. Assessment conducted by five expert judgment. The result of teaching materials assessment for the four components was included the valid category, as in Table 2.

| Teaching Materials | Expert Judgment Value | Average |
|--------------------|-----------------------|---------|
| Syllabus           | DM 86 RM 87 US 92 RA 90 SW 93 | 89.5    |
| Lesson plan        | DM 86 RM 92 US 93 RA 90 SW 93 | 91      |
| Module             | DM 87 RM 93 US 95 RA 94 SW 93 | 92      |
| Assessment         | DM 87 RM 90 US 90 RA 94 SW 91 | 90.5    |

Based on Table 2 the results of the validity of teaching materials using inductive 7E Learning Cycle was include valid category. The average validation result of the teaching materials is 90.8 (valid category).

3.2.2 Practicality of Teaching Materials
The results of the evaluation of the implementation of teaching materials use an inductive 7E Learning Cycle model as shown in table 3.

| Responden | Score average | Category   |
|-----------|---------------|------------|
| Teacher   | 86.1          | Very practical |
| Student   | 88.7          | Very practical |

From Table 3 the average practicality teaching materials is 91.67 (very practical category). The results of the teacher response analysis show that the teaching materials use a 7E Learning Cycle that is developed practically (easy to use).

3.3. Effectiveness of teaching materials

3.3.1 Learning activity
Activities carried out by students during the learning of magnetic science material using Inductive-based 7E Learning Cycle are used as a reference in assessing learning activities as follows [4]: Step 1 elicit, the activity observed was visual activities, namely students observed each direction from the teacher, and emotional activities, namely assessing students' interest in learning. Step 2 is engaging, the activity observed is emotional activities that are students interested and interested in participating in learning. Step 3 is exploring, the activity observed is motor activities, namely students conduct experiments according to the material and instructions contained in the worksheet. Step 4 is explained, the activity observed is oral activities, namely student conduct group discussion activities, and ask questions
according to activities. Step 5 is elaborate, the activity observed is mental activities, namely students recall the material that has been studied. Step 6 is evaluate, the activities observed are writing activities i.e. students write answers on each question sheet. Step 7 is extend, the activity observed is mental activities, namely students connect material that has been studied with new concepts. The results of observations of each aspect of activities as in table 4.

| No | Activity | Session | Average |
|----|----------|---------|---------|
| 1  | Visual activities (VA) |         |         |
|    | Observe the direction of the teacher | 83 | 94 | 92 | 89.7 |
| 2  | Emotional activities (EA) |         |         |
|    | Students are interested in learning | 85 | 90 | 89 | 88.0 |
| 3  | Emotional activities (EA) |         |         |
|    | Students are interested in learning | 87 | 91 | 89 | 89.0 |
| 4  | Motor activities (MoA), |         |         |
|    | Students conduct experiments according to instructions | 73 | 88 | 88 | 83.0 |
| 5  | Oral activities (OA), |         |         |
|    | Conduct group discussion activities | 83 | 92 | 85 | 86.6 |
| 6  | Mental activities (MeA), |         |         |
|    | Recall the material that has been learned | 87 | 90 | 85 | 87.3 |
| 7  | Writing activities (WA), |         |         |
|    | Students write answers on the question sheet | 72 | 78 | 93 | 80.3 |
| 8  | Mental activities (MeA), |         |         |
|    | Connecting material that has been studied with new concepts | 82 | 83 | 91 | 85.3 |

In table 4 it can be seen that there are 8 types of student activities observed in learning activities. The highest activity is generated by step 1: elicit with activities of students observing each direction from the teacher, followed by Step 2 is engaging in student activities interested in learning, while writing activities on the activities of students writing answers on each question sheet get the lowest score. Based on the results of student activity analysis it can be stated that teaching materials effective to improve student competence.

3.3.2 Student learning outcome
Assessment of student learning outcomes is the stage of the evaluation phase. This phase aims to determine the effectiveness of teaching materials using inductive-based 7E Learning Cycle. Student learning outcomes are viewed from three domains as in table 5.

| Domain | Session | Average |
|--------|---------|---------|
| 1. Cognitif | 86.5 | 90.2 | 92.5 | 88.8 |
| 2. Psychomotor | 84.0 | 87.3 | 88.8 | 86.7 |
| 3. Affective | 77.8 | 86.9 | 88.8 | 84.5 |

Student learning completeness in the cognitive domain was 86 at session 1 and 94 at session 2 and 3. Based on the results of analysis of student learning outcomes it can be stated that teaching materials effective to improve student competence.

3.4. Discussion
The 7E Learning Cycle Model requires students to be able to convey ideas to find solutions to problems. The learning cycle learning model can help optimize communication skills, especially in the exploration
stage because at that stage students discuss in groups [5]. The conceptual explanation stage encourages students to explain abstract concepts [6]. Communication is done using language as a link between experience and logic. During the phase of explanation, the teacher can express scientific terms from the concepts obtained when students cannot explain it [7]. At this stage students are confident about the material they have learned. In the elaboration stage in 7E learning cycle familiarizes students with the deepening of the subject matter so that trained students arrange answers well and systematically. The elaboration stage can develop communication skills [8].

The results showed that the validity of teaching materials using inductive-based 7E Learning Cycle was categorized as valid. This indicates that teaching materials using inductive 7E Learning Cycle already use the syntax of the learning model systematically and clearly so that teachers and students easily use it. A good learning tool besides fulfilling the validity criteria is also practically used. The teaching materials were declared practical if they can be used easily by teachers and students in learning. The use of the 7E Learning cycle can facilitate students in learning because they directly interact with the environment to analyze the phenomena of social behavior so that they can understand teaching material well [9]. Students stated strongly agree that learning with the 7E learning model is more fun when accompanied by experiments, it can make students more active and motivated to learn subject matter because they can apply the theory directly [10].

A distinctive feature of the 7E Learning Cycle model is that every student learns the learning material that the teacher has prepared, individual learning outcomes are discussed in groups and all group members are jointly responsible for the overall answer. Students can play an active role in enhancing their understanding of the teaching material learned [11]. Various studies have found that the application of the 7E Learning Cycle model effectively improves student learning outcomes [12-16]. Student mastery learning has reached the set point, which is a minimum of 85%. This is because the student worksheet is easily understood by students. The student worksheet can be understood by student if the learning outcomes by student get maximum results [17].

Teaching materials using an inductive 7E Learning Cycle effectively improve student learning outcomes [18]. The student worksheet is a product of teaching materials. 7E Learning Cycle turns out to be effective in improving student learning outcomes [19]. Learning using an inductive 7E Learning Cycle involves the activities of students to discover the concept of subject matter. The knowledge can last longer if students are involved directly in the process of discovery and construct their own concepts or knowledge [20]. Students can construct their knowledge through interaction with objects, phenomena, experiences and their environment.

There are several things that cause student learning outcomes to increase, including the 7E Learning Cycle associated with events around students and combined with inductive skills to motivate students to be able to apply it in life. Inductive thinking skills and learning outcomes of elementary students after learning with inductive learning models have increased [21]. The use of the 7E Learning Cycle combined with inductive skills is able to improve students' thinking and creativity abilities to solve problems [22]. The application of the 7E Learning Cycle can improve the high-level thinking skills of elementary students [23].

The results of the study state that the character of students (curiosity, honesty, thoroughness, discipline, and responsibility) has increased from the first to the third meeting. At the third meeting all character criteria are in the category of becoming a habit. Through the application of character values in learning, students can feel the importance of learning and they will gain deep meaning for the material they are learning. The application of inductive thinking learning models based on science process skills is able to improve students' scientific attitudes. The application of inductive thinking learning models based on science process skills can increase student achievement motivation [24, 25].

4. Conclusion

Inductive-based teaching materials on magnetic material can be used as a reference and example for science teachers in designing teaching materials. The results showed that the validity of science teaching materials using inductive-based 7E Learning Cycle is categorized as valid. The practicality of teaching
materials was include very practical categories, based on teacher and student responses. Teaching materials include effective categories based on student activities and learning outcomes. Student activities in learning include very high categories. Learning outcomes of most students achieve minimum completeness criteria.

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