Development of PIMCA learning model on magnetic field

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Abstract. Research on physics learning on magnetic field has been carried with the PIMCA Learning Model (Presentation, Idea Mapping, Conceptualization, Formative Assessment introduced by Cosmas Poluakan). The research objective was to develop a PIMCA learning model based on Multiple Representation-Semiotic Resources. This research and development with reference to the 10 steps of developing the Dick and Carey model. This research was conducted in the Physics Education department of Manado State University, with 30 student teachers candidate as respondents. The research procedure starts from the development step by doing the validity of the expert test and then doing trials in small groups and large groups with pre-test and post-test. The results showed that the validity of the expert test got an average value of 3.28 so that the learning model was in the very good category and was worthy to be disseminated. In the small group trial results, the pre-test mean score was 0.2 and the post-test mean score was 2.2. Whereas for the large group the results of the pre-test and post-test trials were 0.7 and 2.5. In the student response, 46.6% chose very good, 40% chose were good, and 13.4% chose were quite good. The results of this research indicate that the PIMCA learning model is suitable for use as a learning model that can help students understand the concept of magnetic fields. 6% chose very good, 40% chose were good, and 13.4% chose were quite good. The results of this research indicate that the PIMCA learning model is suitable for use as a learning model that can help students understand the concept of magnetic fields.

1. Introduction
The development of learning models is one way to improve the quality of education. This research is related to develop a PIMCA learning model Based on MR-SR in magnetic field. PIMCA was introduced by Cosmas Poluakan is a development of the MOMBI learning model which emphasized more on learning based on Multiple Representation Semiotic Resources. Representation is a scientific process that explains or describes the same concept in different formats including verbal, graphical and numeric formats. Prior knowledge can determine which is used to complement, understand interpret, and develop representations in learning. PIMCA learning model Based on MR-SR is divided into 4 stages (1) presentation; (2) idea mapping; (3) conceptualization; (4) assessment formative [1-7]. The research objective was to develop a PIMCA learning model based on Multiple Representation-Semiotic Resources.

Learning is a systematic process in each component which is very important in realizing the success of a learning process [8]. Using multi-representation semiotic learning resources, learners will find ways to understand and solve problems with the help of pictures, animations, videos and so on. PIMCA is a
new learning model which is a development of the MOMBI model which emphasizes the MR-SR-based teaching and learning process developed from Vygotsky’s ZPD concept. The MR-SR-based PIMCA learning model, which consists of 4 steps, namely: (1) Presentation, which is the step where learners get initial information through the presentation of various forms of representation. This stage is a combination of the provocation and preconception stages. (2) Idea Mapping, namely the stage where learners construct concepts and build a conceptual fabric based on information received from various forms of representation. (3) Conceptualization, which is the stage where learners receive information accompanied by instructions from the teacher / lecturer who functions as a resource and / or facilitator and / or tutor. At this stage, the immature idea mapping is corrected and constructed into the correct concept so that misconceptions are not built, (4) formative assessment, namely the stage to ensure that the concept of knowledge constructed by the learner is correct. The formative assessment stage can be used as a basis for conducting diagnostics.

2. Theoretical framework

Vygotsky has a different explanation for cognitive theory. According to Vygotsky's aspect of the existence of the Proximal Development Zone (ZPD), a person's cognitive development is divided into the level of actual development and the level of potential development [9]. According to Vygotsky, describes a very important concept, the Zone of Proximal Development (ZPD). Vygotsky's notion of the zone of proximal development suggested a teaching approach, namely Scaffolding. Scaffolding is assistance or support for a child from someone who is more competent with the intention that the child is able to work on tasks or questions that have a higher level of complexity than at the level of cognitive development. In addition, children's cognitive development is closey related to self-regulation. Self-regulation is an individual learning process that stimulate their minds to achieve their learning goals [10-11]. According to Elena, she describes the current view of self-regulation and how that view is The Vygotsky approach provides an additional dimension to the discussion. Such an approach provides an important framework for developing interventions to help children who are self-regulating and provides important insights for teachers [12]. So that self-regulation is used as the ability to take action to achieve learning targets with various strategies in the areas of cognitive, behavioral, and affection.

Vygotsky defines ZPD (Zone of Proximal Development) as the distance between actual development as determined by an independent problem and the level of potential development determined through problem management under adult guidance or cooperation with more capable colleagues. ZPD is used to describe the level of development of students or actual and the next level that can be achieved [13].

In the learning design process, many factors must be considered. These factors are closely related and influence each other to some extent. These factors need to be organized into instructional design steps. Effective teaching is teaching that allows students to acquire certain skills, knowledge and attitudes [12-14].

3. Methods

The research was conducted at the Department of Physics, Manado State University. The respondents were 30 students of the Physics education study program. The research method used in this research is the Research and Development (R&D) following to the Dick and Carey model which includes 10 stages. At the beginning of the development, the expert test stage was carried out by a team of experts / experts and then two assessments were carried out, namely the pre-test which was carried out before the development of the learning model and the post-test was carried out after the development of the learning model by following the 4 stages of PIMCA learning (Presentation, Idea Mapping, Conceptualization, and Assessment Formative) for students divided into small groups and large groups.

Validity by a team of experts / experts conducting the analyzed assessment using the Passing Grade (P) which is the average score from the results of the expert's assessment and adjusted to the criteria for the assessment aspects.
Table 1. Category of instrument score.

| NO. | Interval          | Category |
|-----|-------------------|----------|
| 1.  | $3.25 \leq P \leq 4.0$ | Very good |
| 2.  | $2.5 \leq P \leq 3.4$ | Good     |
| 3.  | $1.75 \leq P \leq 2.4$ | Enough   |
| 4.  | $0 \leq P \leq 1.75$  | Less     |

In learning activities, small groups consisting of 10 students results of the study can be seen in figure 1.

**Figure 1.** Histogram pretest and posttest small group.

In the large group trial consisting of 20 students the average scores of the pretest and posttest can be seen in table 3.

**Figure 2.** Histogram pretest and posttest large group.

4. **Discussion**

Based on the results of the research carried out, the validity by the team of experts / experts carried out the assessment which was analysed based on the assessment score reached 3.28 so that the learning model was included in the very good criteria and deserved to be disseminated.

From the results of research conducted on students majoring in physics, State University of Manado in semester 5, there was an increase in the average learning outcome which can be seen in table 2 and
The results of the small group trial showed an average pre-test score of 0.2 and an average value. posttest 2.2 and trials in large groups obtained the average pretest and posttest values were 0.7 and 2.5. The results of this study are relevant to the research conducted by Irawati and Subaidi show that there is an increase in student activity and learning outcomes after being applied to Multi-representation [15], the results of research from Toding et al. that after the application of representation on vector material there is an increase in the average Average student learning outcomes [7], research conducted by Nasrullah [17] describes that the semiotic resources approach can motivate students to participate in learning activities and can stimulate students to conserve context, understand the meaning of symbols and use them, and communicate from the informal stage to formal. The progress found was the students' ability to abstract by constructing and using symbols as part of a plan to solve problems [14]. In addition, students are also asked for responses when they have participated in the PIMCA model of learning. It can be seen that 46.6% gave very good responses, 40% responded well and 13.4% gave good enough responses and no one gave a bad response.

5. Conclusion
This study uses an MR-SR based PIMCA learning model. Based on the results of research, the development stage for expert testing can be trusted for small groups and large groups. The results of the small group test showed an average increase from 0.2 to 2.2 and for the large group an average increase of 0.7 and 2.5. Students response when they had participated in the PIMCA model of learning, it was seen that 46.6% responded very well, 40% responded well and 13.4% responded quite well and none gave a bad response. The PIMCA learning model is very well used in the learning process, and can be a reference for teachers in the learning process. PIMCA is a simple learning model used for learning physics and also for other scientific concepts.

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