PIMCA learning models to improve student learning outcomes in optic magnifying glass tool

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Abstract. The research was carried out on the students of physics education Faculty mathematics and science Manado state university with a total of 28 students as respondents. The purpose of this study was to determine the increase in student learning outcomes on the autik lup material using the PIMCA learning model. The research instrument used was a test. The research process started with the pre-test, continued with the implementation of physics learning according to the 4 steps of the PIMCA model and ended with a post-test. The results showed that the mean value before the test was 27.86 and the mean value after the test was 75. The results showed that the MR-SR-based PIMCA learning model can improve student learning outcomes to properly understand concepts of physics, especially in the subject of magnifying glass tool.

1. Introduction
Most of educational studies describe the causes of low student learning outcomes, one of which is the selection of the learning model used. This study uses an MR-SR-based PIMCA learning model on the Optical Lup Tool material. PIMCA is a new learning model which is a development model from MOMBI introduced and developed by Cosmas Poluakan but refined in the MR-SR-based teaching and learning process developed from the ZPD Vygotsky concept with DRPM Master Research 2020/2021 "Classroom-Based Formative Resource Assessment Model Semiotics in Learning Physics". In physics, a student-centered learning model is needed that directs students to be actively involved in the thought process and involves the acquisition of knowledge in order to foster reasoning skills to master the concepts of physics in solving problems. The method that supports understanding ideas in physics and for solving problems and solving problems is the MR (Multi Representation) method. According to Hubber and friends learning using multiple representations can help students overcome difficulties in understanding concepts and students can build conceptual understanding based on the use of representations [1]. According to Sunyono learning using multiple representations is more effective in understanding a concept [2]. Physics often involves physical modeling in real life that uses external representations of concrete to abstract forms: pictures, diagrams, words, graphs, or equations. Abstract topics are needed to understand science [3]. According to Gilbert [4], Toding [5] Multiple representation (MR) is a model that restates the same concept in several different formats. Image representation can help students in the teaching and learning process [6,7]. According to Poluakan C and Mondolang "Semiotic resources (SR) is a term used in social semiotics and other disciplines for families in manufacturing facilities means" [8,9].

[1] [2] [3] [4] [5] [6] [7] [8] [9]
Previous research using the Time-based Mind Mapping type cooperative learning model on optical instrument material [10], had problems in improving learning outcomes on optical loop instrument material. The purpose of this study was to see the improvement of student learning outcomes in autik lup material using the PIMCA learning model (presentation, idea mapping, conceptualization, and formative assessment) introduced and developed by Cosmas Poluakan.

PIMCA is a new learning model which i’s a development model from MOMBI which was introduced and developed by Cosmas Poluakan but refined in the MR-SR-based teaching and learning process developed from the Vygotsky ZPD concept with DRPRM Master Research 2020/2021 "Semiotic Resource-Based Class Formative Assessment Model In Physics Learning, Vygotsky's influence has been implanted in the scientific work of many scholars in many ways of developing and developing learning [11–14]. For Vygotsky Learning is necessary and is an aspect of the development process, especially for humans, and psychological functions. In other words, learning makes us real human beings. Vygotsky said that the two main meanings of learning occur through social and language interactions [15]. According to Vygotsky, a person's abilities can be divided into two levels, namely the level of actual development and the level of potential development [16].

Because in physics a student-centered learning model is needed that directs students to be actively involved in the thinking process, Cosmas Poluakan developed a MOMBI learning model called PIMCA. The PIMCA learning model consists of 4 steps, namely: (1) Presentation, namely the learning stage of obtaining initial information through the presentation of various forms of representation. This stage can be a combination of provocation steps and preconception of the MOMBI model; (2) Mapping ideas in stages where lessons construct concepts and construct conceptual lines based on information received from various forms of representation. At the concept stage, the learner's concepts may not be difficult; (3) Conceptualization, namely the learning stages of receiving information and providing assistance from teachers / lecturers who function as resource persons and / or facilitators and / or tutors, so that the scaffolding function can take place. At this stage, the mapping of immature ideas is corrected and constructed into a correct concept, so no misconceptions are built; (4) Formative assessment, namely steps to ensure that the concept of knowledge constructed by learning is correct. The formative assessment stage can serve as a scaffold assessment. The formative assessment can be used as a basis for making a diagnosis.

Lup is an optical instrument consisting of a convex lens that is used to see small objects appear clearer or larger than their actual size. According to Buenche and Eugene (206: 255 "a magnifying glass / loop is a converging (centered) lens that is used to form a strong, enlarged, virtual image of an object placed within its focal point. Convex lens in a circle forms a virtual image enlarged from an object placed between the focus point (f) and the center point of the lens.

2. Methods
The method used in this study is the One Group Pretest-Postest Design. The research was conducted on students of the Physics Education Study Program of Faculty mathematics and science Manado state university with a total of 28 students as respondents. The research instrument used was a test.

The research procedure started from the pretest, continued with the implementation of physics learning following the 4 steps of the PIMCA model and ended with the posttest. The average pretest and posttest values can be seen in the histogram below:
3. Results and discussion
The data was conducted on students of the physics education program of Faculty mathematics and science Manado state university. This study applies the PIMCA learning model. In this study, 4 interventions were carried out, namely Presentation, Mapping of Ideas, Conceptualization, and Formative Assessment. Research that uses a preliminary test to see the initial ability, then given treatment, namely the application of the PIMCA model. The research was conducted when the learning process took place and adjusted the students' learning schedule. The goal to be achieved in this research is to see improvement
Learning outcomes are taken based on the pre-test and post-test results on the lup optical instrument material. Judging from the results of research before being given PIMCA treatment, students have not been able to order shadows with maximum accommodation and shadows with eyes with minimal accommodation on the optical loop device material, according to Poluakan many students incorrectly answer the image ordering process because students do not understand the concept magnifying glass [17]. Students have low comprehension skills and many misconceptions about light propagation, light refraction [18].

After the research was held pretest data obtained from 5 items given to 28 research respondents. Based on the results of the pretest that were processed using the help of the SPSS Version 22 program, the total score was 780, the mean value was 27.86 with a standard deviation of 11.339, the media value was 20.00 and mode 20, the level of data distribution (variance) was 128,571 with a maximum value 60 and a minimum value of 20. Meanwhile, the posttest data were obtained from the questions given to 28 research respondents. Based on the results of the pretest which were processed using SPSS version 22, the total score was 2100, the mean value was 75.00 with a standard deviation of 10.364, the media value was 80.00 and the mode 80, the level of distribution data (variance) was 107.407 with a maximum value of 100 and a minimum value of 60.

The results of research in the experimental class on optical loop instrument material by applying the MR-SR-based PIMCA learning model in the physics education study program generally show a positive effect which states that the application of this learning model to improve student learning outcomes on optical loop instrument material. This is indicated by the average posttest results of the experimental class with a score of 75.00 higher than the average pretest results with a score of 27.86. From the results of descriptive analysis, it is obtained t_count = 15.985 > t_table = 1.703 so that rejecting H0 and accepting H1, it can be concluded that the average value of the posttest results, especially the Lup optical instrument material taught by applying the MR-SR-based PIMCA learning model is higher than the average value pretest before being given PIMCA treatment.

Based on the analysis of research data using the MR-SR-based PIMCA learning model, it shows that the increase in scores from pretest to posttest is higher when compared to the results of previous studies using the Mind Mapping-based Time-based cooperative learning model on optical instrument material [10]. The PIMCA learning model can be a reference for teachers and students as a model of choice in the learning process.

4. Conclusion
Based on the results of research that has been carried out on students of the physics education program of Faculty mathematics and science Manado state university. The research instrument used was a test. The results showed that the pretest mean score was 27.86 and the post-test mean score was 75. The results showed that the MR-SR-based PIMCA learning model could improve student learning outcomes in understanding physics concepts correctly, especially in optical instrument material Lup. Learning by following the steps of the PIMCA learning model (presentation, idea mapping, conceptualization, and formative assessment) can improve students' understanding of the optical loop instrument concept effectively and efficiently.

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