Implementation of the PIMCA model to learning convex mirror

by Jeane Tumangkeng

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Abstract. Learning in the 4.0 era requires various learning models, one of which is the MR-SR based PIMCA learning model (Presentation, Idea Mapping, Conceptualization, Assessment Formative) which presents the same concept in several formats. This study aims to determine the increase in student learning outcomes before and after implementing the MR-SR based PIMCA learning model introduced and developed by Cosmas Poluakan. The research method used of One group pre-test post-test design. This research of conducted in the Department of Physics, State University of Manado, with 29 student respondents. The research process begins with problem formulation, management, analysis of data, and conclusion. The results of the data analysis showed that the average score before the test of 20,69 and the average score after the test is 72,41. With a maximum value of 75, a gain of 0.9 is obtained. This means that there is an increase in learning outcomes in the high category because g > 0,7. The results of this study indicate that the MR-SR based PIMCA learning model can improve student learning outcomes in mastery of physics concepts.

Introduction

Physics is both a process and a product. Process is a procedure for finding physical products (facts, concepts, principles, theories or laws) which is carried out through rarities [1]. Era 4.0 learning requires various learning models, one of which is the MR-SR-based PIMCA (Presentation, Idea Mapping, Conceptualization, Assessment Formative) learning model which re-presents the same concept in several formats. The difficulty that helps students in problem management using mathematics in physics, comes from the mathematical knowledge that students need to handle problems or students already have relevant but imprecise mathematical knowledge [2].

To improve student learning outcomes, the use of learning models is very important. By using the PIMCA learning model, which is an MR-SR based model which will be applied to the learning process with 4 steps of PIMCA intervention which is a development model from MOMBI, in the Poluakan research proposal [3] namely; (1) presentation, (2) mapping ideas, (3) conceptualization, (4) formative assessment. Representation is the process of forming, abstraction, and demonstrating physical knowledge. Thus representation can be interpreted as a learning process that can be done from mental development that is in a person [3]. Therefore, in presenting images to determine the properties of the convex mirror image correctly, it can help students solve problems procedurally and systematically. Image representation can help students in learning during the learning process [4]. Physics often involves physical modeling in real life that uses external representations from concrete to abstract:

pictures, diagrams, words, graphs or equations [5]. Multiple representation (MR) is a model that represents the same concept in several different formats. Some forms of representation in ordinary physics are words, pictures, diagrams, graphs, computer simulations, mathematical equations and so on [6,7]. Many studies show that multiple representations can aid learning in learning and building concepts and solving problems, assisting in problem solving, and helping to address problems. Various studies on several representations show that representation is very important to be applied in learning. With some explanations of the problem above, a study will be carried out "The application of the MR-SR-based PIMCA learning model to the learning outcomes of physics education study program students with convex mirror material".

In Vygotsky's theory of learning, "mistakes" are very important because they can help shape future learning. Based on Vygotsky's perspective, "a concept appears in learning in the form of complex school interactions that aim to solve problems. For Vygotsky needed learning and aspects of the development process especially for humans, and psychological functions. In other words, learning makes us real humans. Vygotsky said that the two main meanings of learning occur through social interaction and language [8]. In physics, a student-centered learning model is needed that directs students to be actively involved in the thinking process and involves activities to acquire knowledge. In order to develop reasoning skills to master the concept of physics in solving problems. Supporting methods for understanding ideas in physics and for solving problems and managing mass are carried out using the MR (Multi Representation) method.

The MR-based learning model is PIMCA. PIMCA is a new learning model which is a model development of MOMBI [written] on the MR-SR-based teaching and learning process developed from Vygotsky's ZPD concept. The PIMCA learning model consists of 4 steps, namely: 1) Presentation, namely the step in which learners (students) get initial information through the presentation of various forms of representation. These stages can be joined from the provocation and preconception steps of the MOMBI model, 2) Idea Mapping, which is the stage where learners construct concepts and build concepts based on information received from various form representations. At the concept stage that the learners build, it may not be mature. 3) Conceptualization, which is the stage where learners receive information and assist assistance from teachers / lecturers who assist 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 true concept, then misconceptions are not built. 4) Formative assessment, the steps to ensure that the concept of knowledge constructed by the learner is correct. The formative assessment stage can serve as a scaffolding assessment. Formative assessment can be used as a basis for conducting diagnostics.

Methods

The research method used is the experimental method One group pretest-posttest design. This research was conducted in the Department of Physics, State University of Manado, with 29 student respondents. The learning process uses the PIMCA model. Which consists of 4 interventions, namely: Presentation, Idea Mapping, Conceptualization, and Assessment Formative. The learning model is taken from the DRPM master research procedure. The research data were obtained from an instrument in the form of an MR-SR based test that had been tested and validated. The following histogram is a summary of the results of the students' pretest and posttest answers.

3. Results and discussion

From the results of research conducted on even semester students majoring in physics education, Manado State University, it can be seen that the average learning outcomes are quite significant. The average student learning outcomes in the convex mirror material can be seen in this histogram:

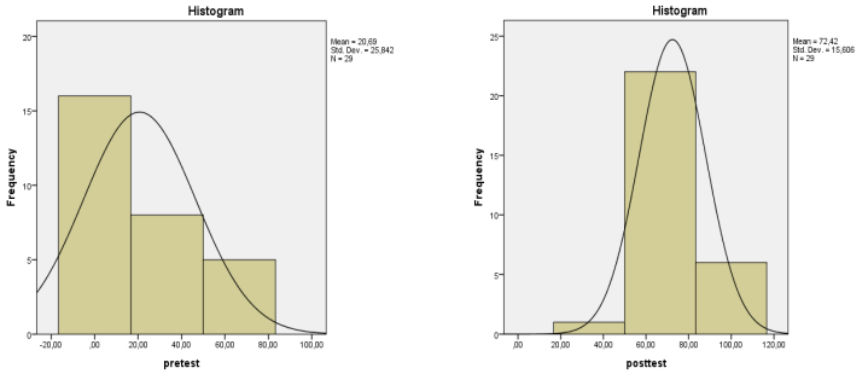

Figure 1. Histogram pretest-posttest.

This study applies the PIMCA learning model. In this study, 4 interventions were carried out, namely Presentation, Mapping of Ideas, Conceptualization, and Formative Assessment. This study used 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. Based on the results of preliminary data, students have not been able to determine the nature of the image on the convex mirror. Judging from the histogram image, the average pretest score was 20.69, the average post-test score was 72.41. With a maximum value of 75 to get a gain of 0.9. The application of MR-SR-based PIMCA learning models in several studies shows that multi-representation based learning and semiotic resources can produce student learning outcomes, especially in mastery of physics concepts [9–11]. Based on the description above, students can understand the concept of physics in the convex mirror material by applying the PIMCA learning model based on several representations and semiotic sources.

At the beginning of the study, the study provided pretest questions that used several representations and semiotic resources about the concept of physics in particular in determining the nature of the image on the convex mirror then applied the initial stage of the PIMCA model, namely presentation, at this stage the researcher conducted and displayed videos related to the learning objectives has been included on the learning device. Then the idea mapping stage is the stage where students construct concepts and build concepts based on the information received from the information and videos that have been accessed. Conceptualization stage, which is the stage where students receive information and provide assistance from researchers. At this stage, the mapping of immature ideas is corrected and constructed into a true concept, then misconceptions are not built. The formative assessment stage, namely the stage to ensure that the concept of knowledge constructed by students is correct where the researcher presents the convex mirror material. The application of the PIMCA model, students can also prove the results of their knowledge, so that students can understand the concept of physics in a convex mirror that has already understood.

4. Conclusion

Based on research that has been conducted on 29 student respondents to prospective physics education teachers at Manado State University on convex mirror learning, especially in determining the properties of the image on the convex mirror from the average student learning outcomes is better after applying the PIMCA model based on MR-SR compared to student learning outcomes before applying the MR-SR-based PIMCA learning model. Thus it can be ignored that through MR-SR-based PIMCA treatment it can improve student learning outcomes in mastery of physics concepts.

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References

[1] Indrawati 2011 Pengaruh analisis gambar demonstrasi pada pembelajaran fisika dan pengetahuan atas prosedural American semester awal mahasiswa calon guru fisika *J. saintifika* **5**
[2] Tuminaro J 2004 A cognitive framework for analyzing and describing introductory students' use and understanding of mathematics in physics
[3] Poluakan C 2020 *Model Assesmen Formatif Kelas Berbasis Semiotic Resources Dalam Pembelajaran Fisika*
[4] Kurnaz M A and Arslan A S 2014 Effectiveness of multiple representations for learning energy concepts: Case of Turkey *Procedia-Social Behav. Sci.* **116** 627–32
[5] Gilbert J K 2010 The role of visual representations in the learning and teaching of science: An introduction *Asia-Pacific Forum on Science Learning and Teaching* vol 11 (The Education University of Hong Kong, Department of Science and …) pp 1–19
[6] Kohl P B, Rosengrant D and Finkelstein N D 2007 Strongly and weakly directed approaches to teaching multiple representation use in physics *Phys. Rev. Spec. Top. Educ. Res.* **3** 10108
[7] Toding Y, Poluakan C and Mandolang A 2019 The application of multiple representations in vector addition
[8] Clabaugh G K 2010 The educational theory of Lev Vygotsky: A multi-dimensional analysis *New Found.* 1–18
[9] Mondolang A H, Poluakan C and Mongan S W 2020 The use of teaching semiotic vectors in the introduction to physics *Journal of Physics: Conference Series* vol 1572 (IOP Publishing) p 12086
[10] Meltzer D E 2007 Multiple representations in physics education: Recent developments and questions for future work *a workshop at the University of Jyväskylä*
[11] Tololiu C, Poluakan C and Mongan S W 2019 Use of representation of unit vector semiotics hrough Cartesian coordinate

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