The use of the MR-SR based PIMCA learning model in eye as optical tools subject

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Abstract. The learning model has long been the focus in almost all research on physics education. Research was carried out on the physics learning model in the subject optical tool. The purpose of this study was to find out learning outcomes using the PIMCA learning model (Presentation, Idea Mapping, Conceptualization, and Assessment Formative) introduced and developed by Cosmas Poluakan. This research method uses the group pretest-posttest design. This research was conducted at the Manado State University Department of Physics with 24 students as respondents. The data collection instrument was a test. The research procedure started with the pre-test, followed by the implementation of physics learning according to the four steps of the PIMCA model, which ended with a post-test. The results of the data analysis gave an average of 43.75 before the test and 77.08 after the test. The results of this study show that student learning outcomes increase in optical eye subject. The results showed that the MR-SR-based PIMCA learning model was very effective in the physics learning process of eye as an optical tool subject.

1. Introduction
Learning has long been the focus in almost all physical education research. Students as aspiring physics teachers are expected to understand the concepts of physics well [1]. Multi-representation is the right medium to explain concepts in different ways [2]. According to Sonyono, the results obtained with representations such as tables, concept maps and analogies can improve the mastery of a concept [3]. Representation can make it easier for students to help build their own knowledge [4].

The purpose of this research was to determine the learning outcomes using MR-SR based PIMCA in ocular material as an optical instrument. Use of the PIMCA learning model, whereby the PIMCA model is a new learning model and a development model of the MOMBI learning model introduced and developed by Cosmas Poluakan, which is used together with the teaching and learning process based on MR-SR. Appropriate learning is required in physics and can direct students to learn actively and competently and to master a concept of physics in order to solve a problem. There is a problem where the students do not understand the concept of physics due to poor choice of learning models. Multimedia representation or the right tools to aid in conceptual understanding of multiple representations. In order for the learning objectives to be achieved, a teacher must use various semiotic sources so that they can be properly understood [5]. If the representation shows the same physics concept but uses a different format, it is a multiple representation [6]. Using semiotic representations in learning helps students improve their understanding of physics concepts [7].
The PIMCA [8] model is one of the alternatives being developed to improve problem solving skills based on multiple representations. The PIMCA method consists of four phases: (a) pre-setting, (b) idea mapping, (c) conceptualization, (d) assessment (formative). Where students' understanding of physics concepts increases after applying them to PIMCA model learning. Based on previous research by Derlina using a problem-based learning model for learning outcomes in optical geometry material [9] and current research, the MR-SR based PIMCA model in ocular material is used as an optical tool. Based on the results of the research, it can be seen that applying the MR-SR-based PIMCA model can improve mastery of physics concepts better than using a problem-based learning model for learning outcomes in comparison of optical material from the data where the understanding the concepts of physics increases after applying the PIMCA-based model. MR-SR while learning.

Vygotsky once said that the two main meanings of learning arise from social interaction and existing language and that learning makes us human [10]. Vygotsky's learning theory is one of all existing theories of social learning. The influence that Vygotsky has had on learning and teaching is very helpful and useful for teachers and researchers in understanding what best to do in learning development [11]. The ZPD explains the difference in the child's actual level of development that results from performance without support and the potential level that results from performance assistance [12]. Vygotsky's theory can be searched through the Zone of Proximal Development Theory and further from the Zone of Proximal Development Theory to the Activity Theory [13,14]. The MOMBI model is based on a situation, in when people are confronted with new learning material or new tasks, a mental model instructs the person to integrate into the existing willingness to know. Where mental models are not saved immediately. However, over time it is reconstructed into a scheme that is not learned.

In continuation of the application of the MOMBI model in physics learning, a new learning model has been developed which is a development model of MOMBI, but emphasizes the MR-SR-based teaching and learning process called the PIMCA learning model. If the MOMBI model is derived from the theory developed by Ulrike Hanke, namely the Mental Models theory, a new MR-SR-based learning model will be developed from the ZPD concept by Vygotsky.

The eye is a natural optical instrument that functions as the human sense of sight. The eye is the most important optical instrument, since no artificial optical instrument can appear without the eye. The developed human eye model is expected to explain (1) the type of image produced in the retina, (2) the accommodation of the lens of the eye, (3) myopic eye defects, and (4) hypermetropic eye defects [15].

2. Methods
This research was conducted on students with odd semesters of the 2020/2021 academic year at the Department of Physics Education at Manado State University. In this study, the design of the One Pretest-Posttest control group was used with the PIMCA learning model, which consists of four steps: 1. Presentation, 2. Idea mapping, 3. Conceptualization, 4. Formative assessment [7]. The PIMCA learning model consists of 4 steps, namely: (1) presentation. This is the step in which the learners receive initial information through the presentation of various forms of representation. This phase can be a combination of the proficiency steps and the prejudice of the MOMBI model: (2) idea mapping, which is the phase in which learners create concepts and build conceptual relationships based on information obtained from various forms of representation: (3) Conceptualization: In this phase, learners receive information and are supported by instructions from the teacher or lecturer, who acts as a resource and / or facilitator and / or tutor so that a framework can be created. At this stage, the mapping of immature ideas is corrected and incorporated into the correct concept so that later misunderstandings do not arise: (4) Formative assessment, the steps taken to ensure that the concept of knowledge created by the learner is correct. The formative assessment phase can act as a scaffold assessment. The formative assessment can serve as the basis for performing the diagnostics [7]. Student response data is reviewed, processed and analyzed. The results are shown in Figure 1.
3. Results and discussion

In this study with a test form evaluation. The test given consisted of questions before and after the test using the MR-SR-based PIMCA learning model. The pre-test questions were asked before the treatment, and after the pre-test was performed, the treatment was carried out, namely PIMCA learning. The questions were then asked after the test in order to compare the average value of the learning outcomes especially for eye material as an optical instrument before and after the treatment. Figure 1, the histogram values of the pre-test and the post-test show an increase in the post-test. Based on the processing and analysis of research data using the PIMCA model for prospective student teachers specializing in physics at the State University of Manado, it is shown that there are differences in the learning outcomes of physics after applying the PIMCA learning model based on multiple representations. With an average pretest value of 43.75 and an average posttest score of 77.08. The data normality test using SPSS 22 gave a significant value of 0.067. It can be concluded that the data is normally distributed.

4. Conclusion

This study uses an MR-SR-based PIMCA learning model. This study was conducted at the Physics Department at Manado State University with a total of 24 respondents. Via the eye material as an optical device. The results of the data analysis show that using the MR-SR based PIMCA model is very helpful in improving the understanding of physical concepts. It is also shown that the students' learning outcomes increase in the optical eye material. The results of the study show that the MR-SR-based PIMCA learning model is very effective in the learning process of the natural sciences, including biology, math, chemistry, engineering and especially physics.

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References

[1] Theasy Y, Wiyanto W and Sujarwata S 2017 Identifikasi Kesulitan Belajar Fisika Berdasarkan Kemampuan Multi Representasi Physics Communication 1(2) pp 1-5

[2] Ramlah R, Miriam S and Mahtari S 2018 Development of Multi Representation Based Cognitive Instrument on Newton Law Material Berk. Ilm. Pendidik. Fis. 6(3) pp 301-314

[3] Sunyono L, Yunita and Ibrahim 2015 Supporting Student in Learning with Multiple Representation to Improve Student Mental on Atomic Structure Concepts Science Education International 26(2) pp 104-125

[4] Tololiu C, Poluakan C, Mongan S W 2019 Use of representation of unit vector semiotic through Cartesian coordinate International Journal of Advanced Education Research

[5] Sukyadi D, Hermawan B, Dallyono R 2016 Transduction and Trans formation of Semiotic Resources in on English Classroom Malaysian Journal of ELT Research 12(1)

[6] Siswanto J, Susantini E and Jatmiko B 2018 March. Multi-representation based on scientific investigation for enhancing students’ representation skills In Journal of Physics: Conference Series 983 (1) p 012034 IOP Publishing

[7] Mondolang A H, Poluakan C, Mongan S W 2020 The Of Teaching Semiotic Vectors In The Introduction To Physics Journal of physics: Conference Series

[8] Poluakan C 2019 Model Assessment Formatif Kelas Berbasis Semiotic Resources Dalam Pembelajaran Fisika Proposal Penelitian DRPM Kemenristrkdikti

[9] Derlina D, Sihotang M I 2013 Pengaruh Model Pembelajaran Berbasis Masalah Terhadap Hasil Belajar Siswa Pada Materi pokok optic Geometri Kelas X SMA St. Yoseph Medan

[10] Clabaugh K G & Edd 2010 The Education Theory of Lev Vygotsky: A Multi-Dimensional Analysis (Newfoundations)

[11] Nurhalisa S 2018 Vygotsky’s Legacy on Teaching and Learning Writing as Social Proses (Institut Agama Islam Kendari)

[12] Shabani K 2010 Vygotsky’s Zone of Proximal Development: Instructional Implication and Teachers Professional Development 3 (4)

[13] Vygotsky L S 1986 Thought and Language (Trans, And Ed, A. Kozulin). (Cambridge, MA. MIT Press)

[14] Vygotsky L S 1986 Mind In Society: The Development of Higher Psychological Prosses, In M. Cole, V, John-Steiner, S, & E, Souberman (Eds). (Cambridge, MA: Harvard University Press)

[15] Mashudi A 2013 Pengembangan Media Model Mata Manusia untuk Meningkatkan Penguasaan Konsep Optik Jurnal Pendidikan IPA Indonesia 2(1)