

学位論文の要旨 (論文の内容の要旨)
Summary of the Dissertation (Summary of Dissertation Contents)

論 文 題 目

Dissertation title

The Effectiveness of Computer Simulations for Improving Indonesian Junior High School Students' Conceptual Understanding of Light and Optical Instruments

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Conceptual understanding is one of the competencies in the science education curriculum in Indonesia. This competency is a part of the science graduation standard indicated in Ministry of Education and Culture (MoEC) article number 20, the year 2016. Thus, conceptual understanding is needed by students for learning science successfully. However, students' conceptual understanding in Indonesia is low. According to Trends in International Mathematics and Science Study (TIMSS) in 2015, there were only 32% in the overall of Indonesian students who had the correct answer for a question that demands conceptual understanding ability on science. One of the factors that affect students' conceptual understanding is misconceptions. Misconceptions have occurred if the students' understanding of a concept differs from the scientific concept.

Previous studies on improving conceptual understanding suggested that the first step towards an effective learning process is to identify the misconceptions and employ effective teaching methods to overcome the misconceptions. One of the teaching methods to overcome students' misconceptions is using computer simulations in the learning process. Thus, the main objectives of this research were to investigate the effectiveness of computer simulations to improve students' conceptual understanding and to overcome students' misconceptions about light and optical instrument concepts.

Before investigating the effectiveness of computer simulations, this research was started by developing a two-tier multiple-choice test (TTMCT) to assess students' conceptual understanding as well as to investigate students' misconceptions of light and optical instrument concepts. The result from this test was twenty-two students' misconceptions about light and optical instrument concepts. These misconceptions were used to develop computer simulations about light and optical instrument concepts. The computer simulations programs were reviewed by six science teachers to obtain comments and suggestions for further improvement using a set of questionnaires, which consisted of 10 item questions with a 5-point Likert scale.

The sample of this study consisted of 264 junior high school students in 8th grade from three public schools in Semarang city, Central Java Province, Indonesia. For this study, the sample was divided into two groups, the experimental and control group. For the experimental group (130 students), the learning process of light and optical instrument concepts was taught using the computer simulations. For the control group (134 students), the same concept was taught using science textbooks.

This study used a quasi-experimental design involving experimental and control groups. TTMCT measured students' conceptual understanding of light and optical instrument concepts. The TTMCT was administered to both the control and experimental group, first in the initial meeting before instructions and second in the seventh meeting after completing the instructions.

When the post-test scores were compared by means of the t-test to ascertain the effect of the computer simulations on the students' conceptual understanding, it was found that there was a statistically significant difference between the control and experimental groups [$M_{exp} = 48.61$, $SD_{exp} = 14.58$, $M_{con} = 36.66$, $SD_{con} = 12.7$, $t = 7.099$, $sig < 0.05$]. The results showed that computer simulations have a positive effect on students' conceptual understanding.

In conclusion, the computer simulations were found to improve students' conceptual understanding of the light and optical instrument concepts and had contributed to the higher achievement of the experimental group. The findings in this study showed that computer simulation is an effective teaching method to improve students' conceptual understanding and overcome their misconceptions about light and optical instrument concepts.

備考 論文の要旨はA 4判用紙を使用し、4,000字以内とする。ただし、英文の場合は1,500語以内とする。

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