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The Effect of Conceptual Understanding Procedures Learning Model on Students' Higher Level Thinking Skills

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ABSTRAK

Kegiatan pembelajaran cenderung berpusat pada guru dengan metode pembelajaran konvensional. Selain itu, indikator yang dilatih terbatas pada indikator C4 (analyzing). Hal ini berdampak pada kemampuan berpikir tingkat tinggi siswa. Penelitian ini bertujuan untuk menganalisis pengaruh model pembelajaran prosedur pemahaman konseptual terhadap keterampilan berpikir tingkat tinggi siswa. Penelitian ini menggunakan metode penelitian eksperimen semu dengan pendekatan penelitian kuantitatif. Jenis desain penelitian yang digunakan adalah non-equivalent control group design. Subyek dalam penelitian ini adalah siswa kelas IPA di SMA dengan populasi penelitian sebanyak 205 siswa. Teknik pengambilan sampel yang digunakan adalah cluster random sampling. Teknik pengumpulan data yang digunakan adalah tes uraian sebanyak 7 soal kemudian diukur dengan menggunakan uji t. Hasil penelitian menunjukkan bahwa model pembelajaran Conceptual Comprehension Procedure berpengaruh signifikan terhadap kemampuan berpikir tingkat tinggi siswa. Penelitian ini berimplikasi pada proses pembelajaran siswa sehingga dapat menjadi bahan evaluasi pembelajaran bagi guru untuk meningkatkan kualitas pembelajaran khususnya yang berkaitan dengan melatih kemampuan berpikir tingkat tinggi siswa.

ABSTRACT

Learning activities tend to be teacher-centered with conventional learning methods. In addition, the indicators trained are limited to C4 (analyzing) indicators. This has an impact on students' higher order thinking skills. This study aims to analyze the effect of the conceptual understanding procedures learning model on students' higher order thinking skills. This study uses a quasi-experimental research method with a quantitative research approach. The type of research design used is a non-equivalent control group design. The subjects in this study were students science class in senior high school with a study population of 205 students. The sampling technique used is cluster random sampling. The data collection technique used was a description test of 7 questions then measured using the t test. The results showed that the Conceptual Comprehension Procedure learning model had a significant effect on students' higher order thinking skills. This research has implications for the student learning process so that it can become an evaluation lesson for teachers to improve the quality of learning, especially with regard to training students' higher order thinking skills.

1. INTRODUCTION

Higher order thinking skills (HOTS) are one of the skills needed in the 21st century. These skills are interpreted as a comprehensive thinking process by describing information and making decisions in dealing with and solving complex problems (Fatimah et al., 2021; Rohim, 2019; Siregar et al., 2020) includes the ability to analyze, evaluate, and create (Dasilva et al., 2019; Ramadhan et al., 2019; Umami et al., 2021). Higher order thinking processes have the characteristics of logical, critical, evaluative, creative, and solutive thinking (Ichsan & Fatimah, 2022; Septiyani et al., 2020). In this study the HOTS indicators used refer to the Revised Bloom's Taxonomy, because these indicators are very consistent with the achievements of physics learning (Johansson, 2020; Saepuzaman et al., 2022). The Revised Bloom's Taxonomy is a level that regulates the most basic and essential cognitive processes to high-level critical and imaginative thinking

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which will later be used as a reference as the thinking skills that students want to achieve (Gul et al., 2020; Prakash & Litoriya, 2022). HOTS is a very important skill and must be owned by every student to face the challenges of the 21st century. However, in reality HOTS learning has not been taught optimally (Hasan et al., 2022; Saraswati & Agustika, 2020). So that students' HOTS in Indonesia is still relatively low at the national and international levels (Istiyono & Suyoso, 2019; Sarah et al., 2021)**.** According to previous study in general, Indonesian students' HOTS abilities are very low in: (1) integrating information; (2) generalize case by case; (3) formulating real-world problems into subject concepts; and (4) conduct investigations (Acesta, 2020).

Based on the preliminary studies that have been conducted at SMA Negeri 1 Mangunjaya it is known that physics learning activities are still not in accordance with the expected HOTS criteria. The observation results show several facts, namely: (1) physics learning activities tend to be teacher-centered; (2) the method used is still dominant using the conventional method, namely the lecture method without any activities that support HOTS learning; and (3) learning activities only focus on transferring knowledge from teacher to student, so it does not support the process of increasing student HOTS. The low HOTS-based learning is supported by an analysis of the results of the interviews, where the teacher only gave the highest HOTS-based questions on achievement C4 (analyzing). That is, there is a gap between the expected higher order thinking skills and the higher order thinking skills taught.

In an effort to overcome the above problems, it is necessary to apply appropriate learning processes to improve students' higher order thinking skills. One that is being pursued is to apply the Conceptual Understanding Procedures (CUPs) learning model. The CUPs learning model was initially used to support physics students in understanding mechanics material as well as highlight potential alternative conceptions for students in their first year at university (Carpendale & Cooper, 2021; Gita et al., 2018). The CUPs learning model is a type of constructivism and cooperative learning. Constructivism and cooperative learning types can direct student learning activities to build understanding gradually by working independently or in groups. Therefore, the CUPs learning model is at least able to develop students' abilities which include communication, collaboration, critical thinking and problem solving, as well as creativity and innovation.

The application of the CUPs learning model consists of three phases, namely: the individual work phase; group work phase; and the presentation phase of group work results (Amri et al., 2017; Sari et al., 2022). In the individual work phase, the teacher provides stimulus to students and students build their understanding independently by solving various problems on individual worksheets. In the group work phase, students create heterogeneous groups and discuss the problems given on the group worksheets. In the presentation phase of group work results, there is one group that presents the results of their group work and other groups will provide responses to reach a shared understanding that is in accordance with the actual concepts or facts. The results of previous research conducted stated that the CUPs learning model proved to be more effective in increasing HOTS with an effect size value of 0.3 which was included in the "moderate" improvement category (Saregar et al., 2016). In addition, other HOTS capabilities can be integrated with the CUPs learning model (Ahmad, 2022; Hidayah et al., 2021). Therefore, in this study the researchers integrated the CUPs learning model with higher order thinking skills.

This study aims to analyze the effect of the conceptual understanding procedures learning model on students' higher order thinking skills. Research on higher order thinking skills has its own uniqueness because these skills are very important skills for students to have. However, the achievement of students' higher order thinking skills is still relatively low. The application of the CUPs model as a type of constructivism and cooperative model is expected to help students master higher order thinking skills. The novelty of this study is that it focuses on a more in-depth process with a more diverse population and sample size. In addition, in this study the researchers used the concept of dynamic fluid physics which HOTS had never integrated with the CUPs learning model.

2. METHOD

This study uses a quantitative approach. The quantitative approach is an approach that involves a process of systematic and empirical investigation through statistical calculations of numerical data (Fauzi et al., 2018; Sastypratiwi & Nyoto, 2020; Sugiyono, 2018). The research method used was a quasi-experimental design with a non-equivalent control group. The design of this research design is shown in Table 1. The subjects of this study were students of class XI with a population of 205 students. This research was conducted at SMA Negeri 1 Mangunjaya for the 2021/2022 academic year. The sample used was class XI MIPA 4 as the experimental class and class XI MIPA 6 as the control class which were selected by cluster random sampling technique. The technique starts with creating clusters as needed, then selecting samples randomly (Bhardwaj, 2019; Firmansyah & Dede, 2022). The choice of this technique is based on the

limitations of studying each individual who is part of the study population simultaneously. The data collection technique used was a description test of 7 questions. The essay test questions are based on the development of HOTS indicators which include C4, C5, and C6 as shown in Table 2.

Table 1. Research Design

Cognitive Level	*Pretest*	Treatment	*Posttest*
Experiment Class	O_1	X	O_2
Control Class	O_3	-	O_4

Information:
O_1 : pretest for the experimental class
O_3 : pretest for the control class
X : giving treatment using the CUPs learning model
O_2 : posttest for the experimental class
O_4 : posttest for the control class

Table 2. HOTS Research Instrument Grid on Dynamic Fluid Materials

No.	Cognitive Level	Indicators of Competence Achievement
1	C4 (Analyze)	Analyzing Activities Problems Solving Studying the Problem
2	C5 (Evaluate)	Assess an Arguments Predicting Experimental Results
3	C6 (Create)	Designing Design Correcting an Action

Base on Table 2, the validity of the instrument was tested using the Product Moment Correlation Coefficient formula with a significant level of 5%. Instrument items are declared valid if they meet the $r_{count} \geq r_{table}$ value criteria. The results of the validity test are shown in Table 3.

Table 3. Instrument Validity Test Results

Questions Number	Questions Level	r_{count}	r_{table}	Conclusion
1	Analyzing Activities (C4)	0.5263	0.2586	Valid
2	Problem Solving (C4)	0.5831	0.2586	Valid
3	Studying Problems (C4)	0.5370	0.2586	Valid
4	Assess an Arguments (C5)	0.4353	0.2586	Valid
5	Predicting Experimental Results (C5)	0.7021	0.2586	Valid
6	Designing Design (C6)	0.7334	0.2586	Valid
7	Correcting an Action (C6)	0.6436	0.2586	Valid

Base on Table 3, the influence of the CUPs learning model is measured using the t test. The t test can be carried out with the condition that the research data is normally distributed and the research sample is homogeneous. In addition, to find out how high the increase in HOTS in each research sample, the normalized gain (N-gain) test was used. Hake explains further regarding the categories that can be assigned to the result of gain $\langle g \rangle$. The categories can be seen in Table 4.

Table 4. Category N-gain Score

N-gain Value	Category
$\langle g \rangle \geq 0{,}7$	High
$0{,}7 > \langle g \rangle \geq 0{,}3$	Medium
$0{,}3 < \langle g \rangle$	Low

3. RESULT AND DISCUSSION

Result

HOTS-based learning activities are carried out on dynamic fluid material in two meetings. The dynamic fluid material at the first meeting focused on discussing the principle of continuity and the material at the second meeting focused on discussing the Bernoulli principle. In this study, the C4 indicator is explained so that students are able to analyze activities, solve problems, and study a problem related to the

dynamic fluid concept. For the C5 indicator, students are trained to be able to assess an argument and predict experimental results related to dynamic fluid material. For indicator C6, students are trained to be able to designing design and correct an action related to dynamic fluid material. The descriptions of indicators C4, C5, and C6 will later be interpreted as learning objectives for each class as well as being indicators of research instruments (description test questions).

Based on the prerequisite tests including the data normality test and data homogeneity test, it is known that the experimental class and the control class have normally distributed data and the two samples have homogeneous variants. Therefore, hypothesis testing can be continued with the t test with the results shown in Table 5.

Table 5. t-Test Results

Data	Experiment Class	Control Class	Trust Level	t_{count}	t_{table}
N	34	34	99.5%	6.93	2.66
Average Score	13.97	9.71			
Standard Deviation	2.47	2.60			
Variance	6.09	6.76			

The confidence level used to test this hypothesis is 99.5%. Based on Table 5, it is known that the t_{count} analysis value is 6.93 while the t_{table} analysis value is 2.66. Based on the t test criteria, if the value of $t_{count} > t_{table}$, it can be concluded that the Conceptual Understanding Procedures (CUPs) learning model has a significant effect on students' higher order thinking skills. In addition, both the experimental class and the control class experienced an increase in higher order thinking skills. This increase is based on the normalized gain test results shown in Table 6.

Table 6. Normalized Gain (N-gain) Test Results

Results	Experiment Class	Control Class
Pretest Average	6.26	6.41
Posttest Average	13.97	9.71
Gain $\langle g \rangle$	0.35	0.15
Upgrade Category	Medium	Low

In general, the results of previous research have similarities with the results of this study, namely the CUPs learning model can improve students' higher order thinking skills. Based on Table 6 it is known that the experimental class with the CUPs learning model obtained a gain of 0.35 and was included in the moderate improvement category. For the control class with the Direct Instruction learning model, a gain of 0.15 is obtained and is included in the low increase category. The experimental class gain is 2.3 times greater than the control class gain.

In this study, the pretest and posttest were carried out in the experimental class and the control class. The pretest and posttest results are shown in Figure 1.

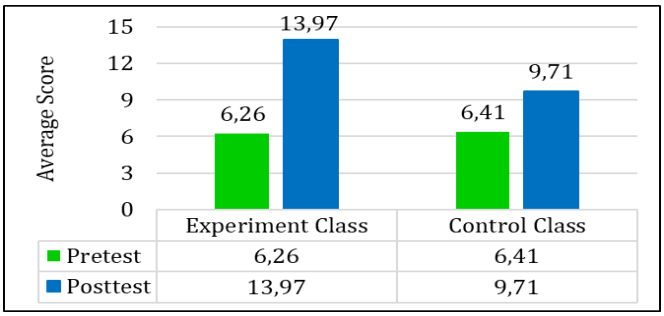

Figure 1. Mean Score of Pretest-Posttest Experiment Class and Control Class

Based on Figure 1, the results of the analysis of the average pretest and posttest scores of the experimental class and control class are shown. The results of the analysis show that the average pretest score obtained by the experimental class is 6.26. The average pretest score of the experimental class was lower than the average score of the control class pretest which got a score of 6.41. However, after being given treatment, it was found that the posttest average score of the experimental class increased to 13.97. The increase in the posttest average score of the experimental class was greater than the increase in the control class's posttest average score which obtained a score of 9.71.

If the pretest and posttest data for the experimental class are described further, a result is obtained where there is an increase in each indicator of higher order thinking skills (C4, C5, and C6) for the experimental class. The average pretest score for the C4 indicator was 2,02 and increased on the posttest average score to 2.93. For the C5 indicator, the average pretest score was 1,23 and increased in the posttest average score to 2.73. For the C6 indicator, there was an increase which initially got a pretest average score of 1,17 to 1,41 in the posttest average score after being given treatment. This can be seen in Figure 2.

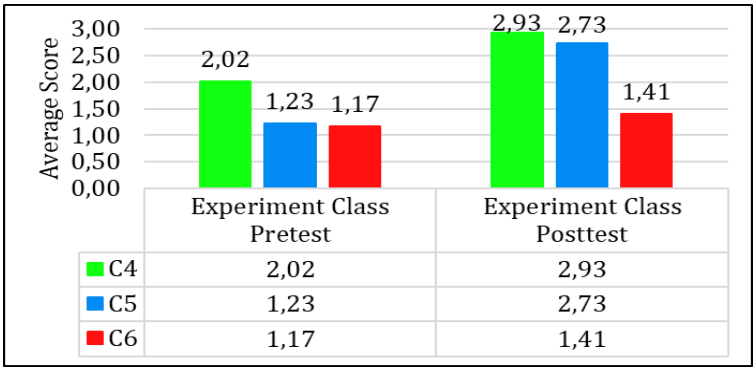

Figure 2. The Average HOTS Score for Each Indicator in the Experimental Class

Based on Figure 2 it is known that after being given treatment using the CUPs model, the average score of the C4 indicator posttest increased 1.5 times higher than the pretest average score. For the C5 indicator it increases 2.2 times and for the C6 indicator it increases 1.2 times. In this case the highest HOTS increase was achieved by indicator C5, followed by indicator C4, followed by indicator C6.

Discussion

The results of previous research conducted stated that the CUPs learning model proved to be more effective in increasing HOTS with an effect size value of 0.3 and included in the moderate improvement category (Saregar et al., 2016). In that study, Saregar, et al. using a saturated sample so that all members of the population are used as research samples, while in this study the researchers used a more diverse sample. The results of other studies state that the CUPs model has an effect on increasing high-level thinking skills in the medium improvement category (Gita et al., 2018). The research was conducted at the junior high school level, while this research was conducted at the high school level.

The reason for the C5 indicator experiencing the highest increase was because students' activities explored more of themselves in finding understanding in groups, namely in the group work phase and the group work presentation phase. This is considered sufficient to minimize difficulties in mastering HOTS, because group learning is seen as a good learning environment for actively developing knowledge and learning is fun. Fun learning will help students better understand the material provided by the teacher (Finnegan & Ginty, 2019; Ningsih, 2018).

Analysis related to the creating indicator (C6) which received the lowest increase in score because the C6 indicator is the peak indicator in the Revised Bloom's taxonomy (Ladin et al., 2021; Tulljanah & Amini, 2021), so the difficulty in achieving this indicator is even greater than the indicators below it. In addition, if learning is seen ideally, students are expected to be able to design designs and correct a problem that is presented. However, some students actually experienced difficulties in understanding the context of the problem given. If seen from the tendency of students to answer test questions, students still have difficulty in associating the questions presented with the concepts needed. This can be seen where some students finally answered the questions without being supported by the right answer solutions, even some students did not answer the questions given. In addition, C6 indicator training with the CUPs learning model was only carried out once, namely in the group work phase. This is different from indicators C4 and C5 which are carried out 2 times.

C6 indicator training is carried out in the group work phase, where students are asked to carry out experimental activities. In this activity it can be seen that most students have not optimally carried out experimental activities. The activity was not maximized because the students were not used to the treatment given. However, the low increase in the C6 indicator was not only experienced in this study. The C6 indicator is the highest and the most difficult indicator to improve, so the C6 indicator gets the smallest increase compared to the other indicators (Agustihana & Suparno, 2019; Widyaningsih et al., 2021). The low increase in the C6 indicator was also confirmed by the research analysis conducted where from 2013

to 2019 in general the C6 indicator was the HOTS indicator with the lowest increase compared to the indicators below it (Ratnasari et al., 2021).

The Conceptual Understanding Procedures (CUPs) learning model is able to increase HOTS in each indicator. The increase in student HOTS was caused by two factors. The first factor is the influence of the CUPs learning model on higher order thinking skills. The CUPs learning model has the characteristics of constructivism learning as expressed by previous study (Lestari et al., 2022; Yulianti et al., 2020). Constructivism-based learning can significantly improve students' higher order thinking skills (Heryani, 2023; Minarni & Napitupulu, 2020; Nurfadilah et al., 2021). Constructivism learning supports students in obtaining an understanding of the material independently. Constructivism learning has the characteristics of contextual, collaborative, metacognitive thinking, and facilitates problem solving so that students are able to develop higher order thinking skills (Saputro & Pakpahan, 2021; Sugrah, 2019). Constructivism learning is a relevant learning approach as a basic environment for training higher order thinking skills (Bisri, 2020; Sosibo, 2019).

The second factor, students are not required to complete all assignments individually because in the application of the CUPs model there are stages of learning that are carried out in groups (cooperative learning type). Cooperative learning can help increase the understanding of students with low academic abilities and students with high academic abilities (Jampel et al., 2018; Mayasari et al., 2022). This is because, in the CUPs model group work phase, students are grouped evenly with different abilities in each group (heterogeneous). Cooperative learning is a collaborative learning strategy to achieve common goals. According to previous study group learning, especially peer groups, has an effect on higher order thinking skills (Husodo et al., 2019). In general, cooperative learning is proven to improve higher order thinking skills (Slameto, 2018; Windasari & Cholily, 2021).

This research can contribute to improving students' conceptual understanding. By using a learning model that focuses on understanding concepts, students can develop a deeper understanding and acquire higher-order thinking skills. This study aims to evaluate the effect of learning models on students' higher-order thinking skills. If research finds that the learning model used is effective, this can provide recommendations to teachers and policy makers to adopt the model to develop students' higher order thinking skills. Limitations of this research may be carried out in a certain environment with a specific sample of students. Therefore, it is important to consider whether the results of this study can be applied generally to a wider population of students.

4. CONCLUSION

Based on the results of the research that has been described, it can be concluded that the Conceptual Understanding Procedures (CUPs) learning model has a significant effect on students' high-level thinking skills. Increasing higher order thinking skills with the CUPs learning model resulted in a moderate increase. This research has implications for processes that train students' higher order thinking skills, including the ability to analyze, evaluate, and create. This ability is necessary for students to support 21st century competencies. In addition, this research can be used as a reference that the CUPs learning model can be used as an alternative for teachers to improve students' higher order thinking skills. However, as a note, in this study there are still limitations that affect the results of the study. Therefore, the researcher suggests that teachers familiarize students with a constructivism approach and learning that is oriented towards higher order thinking skills. In addition, considering that the C6 indicator is the indicator with the lowest increase in HOTS, the teacher should pay more attention to the learning content for the C6 indicator so that the HOTS training for the C6 indicator can be maximized.

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