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How can HOTS for Vocational High School Students be Enhanced through the Problem-Based Learning model?

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ABSTRACT

Problem-based learning (PBL) aims to enhance students' engagement, creativity, and technological proficiency by offering them autonomous learning experiences. The comprehensive approach to PBL entails acquiring knowledge through collaborative project work and using real-life experiences. This method has demonstrated its ability to foster both academic and soft skills. The study aims to examine the role of a scientific-based problem-based learning model (PBL) in improving the higher-order thinking skills (HOTS) of students in vocational high schools. The study employed a quantitative approach with a quasi-experimental method, with a total of 56 students in both experimental and control classes. The data was analyzed using the t-test and the n-gain test. The results of the study show that (1) the scientifically based problem-based learning model is effective in improving higher-order thinking skills in vocational high school students; (2) the knowledge transfer indicators in experimental classes have the highest scores, critical thinking indicators in medium categories, and problem-solving indicators in medium categories. In conclusion, PBL greatly contributed to improving students' 21st-century skills.

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1. INTRODUCTION

Higher order thinking skills, commonly referred to as HOTS, encompass the ability to think critically, creatively, and be able to solve problems that are categorized as cognitive processes in analyzing, evaluating, and creating (Ballakrishnan & Mohamad, 2020). Mastering problem-solving skills requires students to face global challenges so that they are able and ready to compete in the future (Vettleson, 2010). Problem-solving skills are one of the skills currently needed by students so that they can solve their increasingly complex problems in everyday life (Yavuz et al., 2010). Students are enjoined to first process any novel information independently and critically that can culminate in knowledge and provide a solution to a problem (Saptono et al., 2020). When students are directed to be able to think independently and critically, they are targeted to have high-level thinking skills (Antasari, 2018). The ability to think critically is one of the indicators that students have a high level of thinking ability (Kurniawati et al., 2019). The role of the teacher is required to integrate HOTS among students. Therefore, teachers must be able to improve their skills to apply HOTS continuously in order to produce students who are capable of thinking at a high level (Ponniah et al., 2019). Higher order thinking skills in students require both internal and external support, one of which is through the application of a problem-based learning model (Tajudin & Chinnappan, 2016).

During the era of industry 4.0, companies require individuals to possess academic excellence and strong soft skills in order to secure employment in the business industry (Fareri et al., 2020; Ranasurya & Herath, 2020). As a result, educators are being forced to adapt and explore novel instructional and learning methodologies to incorporate in the classroom, enabling students to acquire both academic knowledge and interpersonal skills (Saechan, 2021; Sapan et al., 2020). Thus, institutions should adopt a learning approach that incorporates technology that aligns with students' needs. For an individual to effectively address problems, they must possess both critical thinking and creativity. However, in order to actively participate and collaborate with others, collaboration and communication skills are essential. The field of education must equip the upcoming generation to stay abreast of current trends and even play an active role in the forthcoming growth phase.

Project-based learning (PBL) is a teaching and learning strategy that aligns with the curriculum and 21st-century education. It offers self-directed learning opportunities to enhance students' involvement, innovation, and proficiency in technology. The comprehensive approach to problem-based learning (PBL) entails acquiring knowledge through collaborative project work and using real-life experiences. This method has been demonstrated to effectively foster both academic and soft skills (Sapan et al., 2020). The essence of this approach is to evaluate the proficiency of students in addressing challenges faced in their actual experiences (Zen et al., 2022). Several academic fields have adopted Problem-Based Learning (PBL) in educational institutions to facilitate students' acquisition of specific subjects by simulating real-life scenarios. PBL inspires students to engage in investigation, problem-solving, and decision-making processes (Nur Shafiekah et al., 2019; Ulrich, 2016). Essentially, Problem-Based Learning (PBL) combines students' existing knowledge and actions in the learning process (Bhagi, 2017; Yamil, 2022). Instead of relying on traditional paper tests or written exams to assess students, PBL encourages them to apply their past knowledge to tackle real-world challenges. Moreover, PBL is acknowledged for its capacity to foster social and emotional growth while also aiding pupils in gaining a deeper comprehension of their education. Problem-Based Learning (PBL) has the potential to enhance students' proficiency in English and their soft skills, as supported by Trisdiono et al. (2019).

The problem-based learning model is a teaching and learning approach first introduced by McMaster University Medical School in the late 1960s in Canada (Demirel & Dağyar, 2016). Problem-based learning is a learning model that provides contextual problems into the classroom, so it can stimulate students to learn (Narmaditya et al., 2018). The learning model starts with a problem to be solved, and the problem is designed in such a way that students can learn independently to acquire new knowledge before they can solve the problem (Surya & Syahputra, 2017).

The ability to think critically, an exemplar among the HOTS indicators that students in the 21st century must have, can be invoked through school learning (Miterianifa et al., 2020). HOTS skills are esteemed to be one of the most important learning outcomes (Seventika et al., 2018). Developing the HOTS skills of students today is very important as an educational goal and at the same time promoting the quality and self-development of students (Larsson, 2017). Every educational institution strives to teach its students critical thinking (Seventika et al., 2018). To this end, activities that can develop HOTS skills are needed so that students can apply their skills in everyday life so that they are ready to face global milieu (Miterianifa et al., 2020). As elucidated by Collin Jerome, problem-based learning can be used to improve students' HOTS (Jerome et al., 2017).

Therefore, this research was conducted to examine how the application of a problem-based learning model in vocational high school students works. Specifically, this study aims to analyze the effectiveness of problem-based broadening in improving the HOTS of vocational high school students. The insights gained from this research are crucial to teachers' educators, curriculum developers, and those involved in planning and implementing improvements and innovations in education. Furthermore, this research can contribute to the much-needed literature on the development of teaching thinking in Indonesia.

2. METHODS

The research methodology employed in this study is quasi-experimental. This study follows a pretest and posttest control group design. The experimental group received treatment involving the use of Problem-Based Learning (PBL) instruction, while the control group did not get this treatment and instead employed the standard model of instruction. The study's design is illustrated in Figure 1.

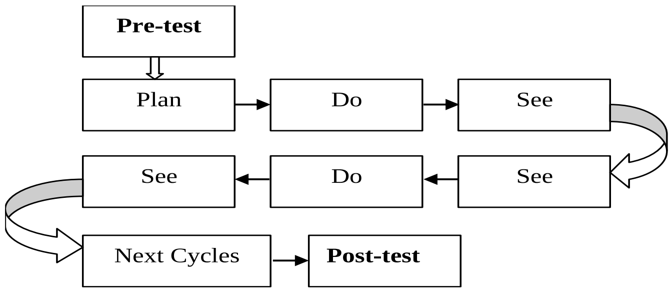

Figure 1. Research design

The study was carried out at Vocational High School (Sekolah Menengah Kejuruan/ SMK) PGRI 1 Pakisaji from March 23 to June 29, 2023. The study focuses on the student population of the X class at SMK PGRI Pakisaji. The population is presumed to possess nearly identical traits. In this study, the researchers employ a sampling method wherein they select classes taught by themselves through a voting process. One class is designated as the experimental group, while another class serves as the control group. There were a total of 56 students, with 28 in the experimental class and 28 in the control class. This study employed data collection methodologies that involved the administration of tests. During the experimental phase, it was necessary to conduct an analysis assumption test and an average similarity test. The assumptions consist of a normality test, a homogeneity test, and an efficacy test for each test class. The similarity tests involved calculating the average score before the test and the average score after the exam. The data analysis for this exam was conducted using SPSS software version 25.

3. FINDINGS AND DISCUSSION

The outcomes of the descriptive study employing inferential statistics, facilitated by SPSS, to assess the efficacy of the PBL model in enhancing the Higher Order Thinking Skills (HOTS) of Economics and Business students at SMK PGRI Pakisaji are presented below.

3.1 Results of the pretest in the experimental and control classes

The pretest data is used to find out the initial ability of students to think at the higher order thinking skills or before being given a certain treatment. The results of the score analysis of students in the experimental and control classes are depicted in Figure 2.

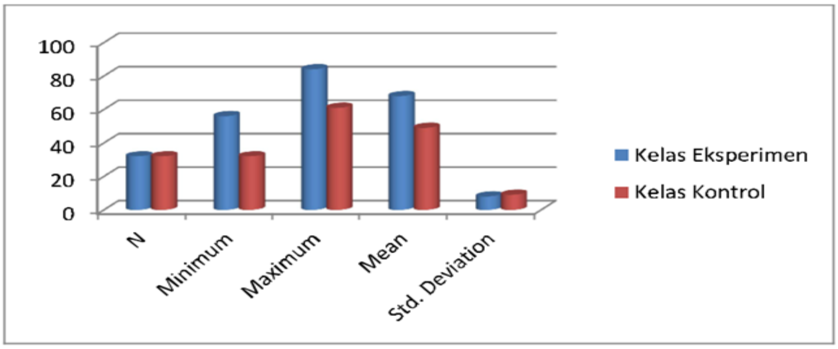

Figure 2. Results of the pretest in the experimental and control classes

According to the findings of the descriptive analysis, the initial proficiency of students in higher-order thinking (HOTS) in both the experimental and control classes indicates that the average scores are not statistically distinct. This is demonstrated in the graph, where the minimum and maximum values of the two classes exhibit similar outcomes. This indicates that the aptitudes of students in the control group and the experimental group are comparable. The findings of this descriptive analysis are further reinforced by the results of the analysis employing parametric statistical tests, namely the independent sample t-test. The purpose of this initial ability difference test is to ascertain whether the control group and the experimental group possess equivalent beginning abilities. The homogeneity test confirmed that the pretest scores of both groups were similar. The decision to employ the t-test relied on the assumption that the data had equal variances, as indicated by Equal Variances Assumed (EVA). The t-test analysis yielded a p-value of 0.738, which is greater than the significance level of 0.05. Therefore, it may be inferred that the null hypothesis (H_0) is accepted and the alternative hypothesis (H_1) is rejected. This implies that there is no discernible disparity in the average pretest score between the experimental group and the control group, indicating that both classes had equivalent initial skills.

3.2 Results of the posttest in the experimental and control classes

The posttest data is used to determine students' abilities in higher-order thinking skills (HOTS) after given the treatment. The results of the analysis are presented in Figure 3.

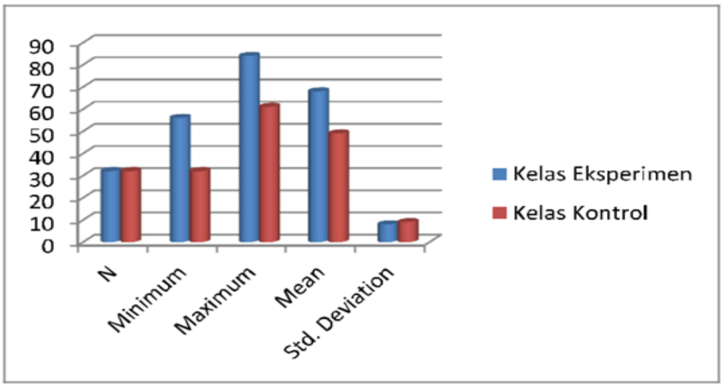

Figure 3. Result of the posttest in the experimental and control classes

The descriptive analysis revealed a significant improvement in the pupils' higher-order thinking skills following the implementation of the treatment. The experimental group was instructed using the problem-based learning (PBL) model, while the control group was taught using the lecture learning model. The results indicate a notable disparity in the degree of cognitive capacity between the control group and the experimental group. This is evidenced by achieving the highest results in both courses, which are notably distinct. Consequently, the PBL learning style is more advantageous for enhancing students' proficiency in higher-order thinking skills (HOTS).

The results of this descriptive analysis are strengthened by the results of the independent sample t-test with the assumption that both variances are homogeneous (equal variance assumed) with a significance level of 5% to find out the differences in the posttest results. Based on the test results, where p-value = 0.000 < α = 0.05, H0 is rejected and Ha is accepted, it can be concluded that students' higher-order thinking skills using the PBL learning model are significantly better than students using learning in lecturing.

3.3 Effectiveness Test

The efficacy assessment was conducted in both the experimental class and the control class. This examination intends to assess the extent to which the PBL learning model and lecture learning models are helpful in enhancing the higher-order thinking skills of SMK students. The analysis results indicate that the PBL learning model significantly enhances high-level thinking skills in SMK Business Economics learning. This is supported by a z-value of -6.584 and an r-value of 0.823, both falling within the large category. The PBL learning model accounts for 67.7% of the observed effect (r2). The PBL learning paradigm has the capacity to enhance higher-order thinking abilities (HOTS) among SMK students, particularly in business economics subjects, by a significant margin of 67.7%.

Discussion

The PBL learning model emphasises students' cognitive abilities by integrating concepts acquired from diverse sources to solve problems in a meaningful manner, serving as an initial step for further investigations (Demirel & Dağyar, 2016; Hermann et al., 2021; Kurniawati et al., 2019; Surya & Syahputra, 2017). This aligns with research findings indicating that students' higher-order cognitive abilities are greater in the experimental class utilising the Problem-Based Learning (PBL) model compared to the control class employing lecture-based instruction (Antasari, 2018; Ballakrishnan & Mohamad, 2020; Narmaditya et al., 2018; Saptono et al., 2020). The PBL paradigm has a significant impact on enhancing students' abilities to collaborate and engage in high-level cognitive processes. The distinction resides in the educational process that takes place within the classroom, where traditional classrooms tend to emphasise the function of the researcher more prominently. In the experimental class, students are expected to actively participate in the learning process (Heong et al., 2011; Yavuz et al., 2010).

During the learning activities in the experimental class, the students were provided with worksheets containing the various stages of the PBL learning model at each meeting. These learning stages and modules are designed to effectively stimulate students' development of higher-order thinking skills (HOTS). Meanwhile, on the other hand, learning activities in the control class. An expository learning model was employed to deliver the instruction through lectures. This learning process is characterised by unidirectional communication since students solely engage in listening, note-taking, and completing tasks provided by the researchers. Consequently, the researchers do not have the opportunity to get feedback on the students' learning progress. Throughout the learning process using the PBL paradigm, the majority of students exhibited strong motivation to learn, actively engaged in problem-solving, participated in group discussions, and sought assistance from their peers rather of relying on the teacher for guidance.

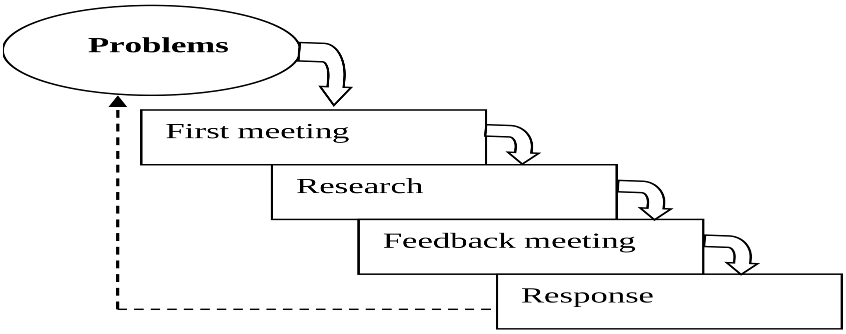

Figure 4. Stage of PBL Learning Model

The level of student engagement in the experimental class is believed to enhance the mean score of higher-order cognitive abilities. The development of Higher Order Thinking capabilities (HOTS) is crucial for the comprehensive enhancement of critical, systematic, logical, relevant, analytical, evaluative, and creative thinking abilities. It also fosters problem-solving and decision-making capabilities in an honest, confident, responsible, and independent manner (Sakti, 2019). The researchers categorised PBL learning into multiple stages. The initial phase is the orientation step, commencing with the researchers' elucidation of the PBL learning paradigm and providing directions on how to utilise the Student Worksheets. Currently, the students' familiarity with the preceding or necessary information remains limited. Indeed, in order to successfully attain the learning objectives through the utilisation of this Problem-Based Learning (PBL) approach, it is imperative that the students possess a solid foundational comprehension of the subject matter.

The subsequent phase entails the process of organising. At this juncture, the students were tasked with delineating and arranging difficulties that have been previously recognised. By implementing the PBL learning paradigm, the students acquired the ability to recall prior knowledge and demonstrate independent comprehension of the instructions provided in the worksheets. During this phase of implementation, it was observed that there was a notable enhancement in both the enthusiasm and aptitude of pupils for learning. The kids demonstrated their enthusiasm for studying by diligently completing the worksheet on economic difficulties and scarcity.

In the third stage, namely guiding individual and group investigations, the students were required to investigate the problems presented in the worksheets to find solutions to the problems. At this stage, the researchers helped students understand the problem, helped them collect information from various valid references, and asked questions that can lead them to think critically when solving problems. The next stage was developing and presenting the work. At this stage, the students presented the results of the thoughts that have been formulated both individually and in groups and exchanged opinions about the results of the investigations that have been carried out with their group mates. The fifth stage is to analyze and evaluate the results of problem-solving. At this stage, the students reviewed the results of the problem solving that has been done in the previous stage, which were the result of a collaboration of personal opinions with the results of exchanging opinions with their group mates.

On the other hand, if further analyzed, the PBL learning model focuses on improving three indicators of higher-order thinking skills (HOTS), namely knowledge transfer, critical thinking, and problem solving. In the knowledge transfer indicator, the activities carried out by students were to apply the knowledge and abilities that have been developed in learning in new contexts. Based on the calculations made on the transfer of knowledge indicator for the experimental class, a score of 0.71 was obtained in the high category. This is because students in the experimental class are better able to analyze, evaluate, create, or find solutions. In addition, the students in the experimental class are used to orienting themselves to problems, so they find it easier to analyze, evaluate, create, or find solutions to problems in questions.

In critical thinking indicators, the activities carried out by the students are to develop the ability to make wise judgments and criticize something using logical and scientific reasons. One of the learning objectives is to make the students able to express arguments, reflect, and make the right decisions. Based on calculations made on critical thinking indicators (critical thinking), the students got a score of 0.68 in the medium category. From the value obtained, it can be seen that the ability to think critically (critical thinking) is because students understand problems that make it easier for them to think more critically.

Meanwhile, the student activities enhanced their capacity to recognise and resolve difficulties by employing non-automatic solutions, as indicated by the problem-solving indicators. By possessing this capability, students would have the capacity to resolve issues and operate with greater efficiency. The problem-solving indicator received the lowest score among the other indicators, specifically 0.66, based on calculations. This is due to pupils' diminished capacity to effectively identify the optimal resolution to the issue of economic challenges and limited resources.

The results of this study are in line with the results of research studies by Asyari et al. (2016), Enda & Odabaşi (2009), and Soyadı (2015), showing that the PBL learning model is more able to improve students' higher-order thinking skills, or HOTS. This can be seen from the average posttest average obtained by students in the experimental class, which was higher than that of students in the control class. The experimental class that applied the PBL learning model obtained an average posttest score of 68.25, and the control class got only 49.47.

4. CONCLUSION

The PBL learning model is more capable of improving students' higher-order thinking skills, or HOTS. This can be seen from the fact that the posttest average obtained by the students in the experimental class is higher than that obtained by the students in the control class. The experimental class that applied the PBL learning model has an average posttest score of 68.25, or 98.23%, while the control class has a score of 49.47, or 40.22%. The present study only examines the role of a scientific-based PBL in improving students' higher-order thinking skills (HOTS). It is recommended that the next researcher investigate the effect of technology-enhanced PBL on secondary and senior high school students to fill the research gap in this study.

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