Implementation of the Problem-Solving Learning Model in Improving Student Learning Outcomes on Chemical Equilibrium Matter at Senior High School

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	This research project is concerned with the difficulties that students encounter when attempting to comprehend complex chemical equilibrium material. The objective of this research is to investigate the influence of the problem-solving learning model on student learning outcomes at MA YADARO Moyot Sakra East Lombok. The research method employed is quantitative, with a quasi-experimental design and data analysis conducted through a one-way ANOVA test. The findings of the study indicate that the problem-solving learning model has a beneficial impact on learning outcomes, enhances students' comprehension of chemical equilibrium problems, and serves as an effective strategy for fostering students' interest in learning. The findings of this study indicate that the implementation of this model can enhance the efficacy of learning processes pertaining to abstract concepts. **Keywords:** Problem-Solving, Chemical Balance, Implementation of Model, Learning Output, MA YADARO

Introduction

In the context of managing the process of teaching and learning activities, a number of challenges frequently emerge in the classroom setting. Such difficulties may manifest as a lack of interactivity in the learning process, with the focus remaining on the teacher. The prevailing pedagogical approach tends to be conventional, which can result in diminished motivation to learn among students. This phenomenon was observed at the MA Yadaro school. The findings of the observational study conducted at MA Yadaro School indicate that the learning process is uninspiring. In accordance with Dare's learning cone theory (Zubaidah, 2010: 3), the act of learning renders students in a passive state, with a mere 50% probability of recalling the material. However, if the learning is perceived as active by the students, the tendency is to recall the material studied at a rate of approximately 70% to 90%. In this case, the majority of students have not achieved the minimum completion criteria (KKM) set for the course. A lack of creativity on the part of teachers in the use of learning models can result in a tendency towards monotony in the learning process. This may preclude students from having the opportunity to engage actively in exploring their abilities and potential, and thus the results obtained may not yet reflect their abilities in

understanding concepts taught in class. One such learning model that can facilitate active student engagement in the learning process is the problem-solving model.

The Problem-solving learning model employs open-ended problem-solving to facilitate student comprehension. As Wijaya (2008) posits, problem-solving constitutes a series of learning activities that prioritize the scientific process of problem-solving. In accordance with Slameto (2015, p. 407), problem-solving entails the identification of a solution to a given problem, which may entail the discovery of patterns, rules, or algorithms. In light of the various perspectives that have been articulated, it can be posited that problem-solving represents a pedagogical approach that is predicated on the examination of problems with a view to identifying solutions or responses. It can be reasonably deduced, therefore, that the implementation of a problem-solving learning model may prove an efficacious approach to enhancing student learning outcomes. The aforementioned problem-solving learning model has the potential to enhance cognitive learning outcomes and students' comprehension abilities.

In light of the suboptimal learning outcomes observed among students in the MA Yadaro class, this research aims to ascertain the efficacy of implementing a problem-solving learning model in enhancing the cognitive learning outcomes of class XI Science students with regard to chemical equilibrium material.

As Sudirman posits, the problem-solving method represents a pedagogical approach wherein the problem itself serves as the initial point of discussion, upon which students engage in the analysis and synthesis of information with the objective of identifying solutions or answers. In his 2016 work, Shoimin (2016: 23) defines a learning model as "a conceptual framework that describes systematic and planned procedures in organizing learning experiences to achieve certain learning goals and functions as a guide for learning designers and teachers in planning teaching and learning activities." In other words, the learning model furnishes a framework and direction for educators to utilize in their pedagogical endeavors.

In the journal Educational Technology Research and Development (2018), Jonassen defines problem-solving as a cognitive process that involves the identification of problems, the analysis of alternative solutions, and the decision-making required to achieve desired outcomes. He posits that problem-solving is the capacity to develop sophisticated and analytical strategies to surmount ambiguous or unstructured scenarios.

The benefits of problem-solving processes This concept was articulated by Djamarah (2010, p. 92) as follows: This model has the potential to enhance the utility of educational experiences within the classroom by situating them within the context of the real-world

challenges and opportunities faced by students. Problem-solving activities can facilitate the development of greater flexibility in students' ability to address a range of problems, both individual and group-based. This learning model prompts students to engage in more profound and expansive cognitive processes when confronted with problems and learning activities. Furthermore, students may adopt a more structured and systematic approach to problem-solving in all aspects of their lives.

The aforementioned opinions collectively indicate that the problem-solving learning model is an effective pedagogical approach that facilitates students' engagement in a comprehensive learning process, encompassing the formulation of problems, analysis, data collection, and conclusion formulation. This model enables students to derive meaning more readily from their educational experiences. The steps or syntax of problem-solving learning are carried out in accordance with the principles set forth by John Dewey (Priansa, 2017, p. 232).

The study of chemical equilibrium encompasses a vast array of concepts that necessitate logical reasoning to be fully comprehended and effectively applied. The capacity for logical thinking is a crucial skill in the process of problem-solving. Chemical equilibrium is defined as a state in which both the reactants and products are present in concentrations that exhibit no further tendency to change over time. In general, chemical reactions can be classified into two categories with regard to equilibrium. Chemical equilibrium can be classified into two distinct categories: static equilibrium and dynamic equilibrium. Static equilibrium is defined as a state in which all forces acting on an object are in equilibrium, that is, no net force is produced. In a state of equilibrium, the scale needle is in a fixed, unchanging position, indicating that the mass displayed on the left and right sides is identical. This can be analogous to equilibrium conditions in chemistry. The term "chemical equilibrium" is used to indicate that the reaction rates on either side of the equation are equal. It should be noted that chemical equilibrium is a dynamic process, unlike the static or stationary nature of a mass scale. The objective of this study is to gain an understanding of equilibrium reactions in chemical reactions.

Chemical reactions are classified into two categories based on the nature of their progression: one-way reactions and two-way reactions. The following is an explanation of the aforementioned reactions: a. Unidirectional/Irreversible/Irreversible Reaction It is likely that you have previously observed or participated in a burning process involving paper. In such an instance, the paper will undergo a series of chemical changes, resulting in the formation of black and gray ash. Indeed, the paper will undergo a color change, initially

appearing black and then gray. It would be beneficial to ascertain whether it is possible for ashes to return to paper. It is not possible to achieve this outcome. The combustion of paper is an exothermic reaction that occurs in a single direction and is therefore irreversible.

The following section outlines a series of steps and strategies that can be employed in the context of learning chemical equilibrium through a problem-solving approach. These include: the clarification of the problem, the facilitation of brainstorming sessions, the collection of ideas and information, the discussion of potential solutions, the presentation of solutions, and the reflection on the process. It is established that chemical equilibrium materials possess distinctive properties or characteristics.

The following characteristics are associated with chemical equilibrium material: theoretical, numerical, computational, and analytical. This problem-solving learning model has the potential to enhance students' engagement, make the learning material more appealing, and facilitate a structured and systematic approach to learning. Accordingly, this problem-solving learning model has the potential to enhance student learning outcomes.

The characteristics of the material will determine the most appropriate method for solving chemical equilibrium problems. The results of research conducted by the author during the odd semester of the 2017/2018 academic year at SMA YPK Oikoumania Manokwari are presented herewith. The research employs a quantitative methodology, with a single class designated as the experimental class, specifically X4 at SMA YPK Oikoumene Manokwari. This research is a descriptive, pre-experimental study that employs a single variable: the efficacy of the Problem-Solving model on the learning outcomes of class X4 students at SMA YPK Oikoumene Manokwari on the subject of chemical bonds. The application of the problem-solving learning model by students resulted in an 88.23% success rate in achieving the minimum criteria for class completion. This is because when learning is implemented using the Problem-Solving model, students are able to discover concepts in chemical bond material from the provided reading material. Furthermore, students are able to be involved in the teaching and learning process, as evidenced by the research conducted in 2022 at SMKN 3 Jambi City on thermochemical materials. This research is of the correlational, quantitative variety. The sample was selected through the use of a simple random sampling technique, whereby the selection was made by drawing lots. The research instrument is an observation sheet comprising two sections: an observation sheet on the implementation of the problem-solving model and students' critical thinking abilities, and a posttest of student learning outcomes.

The findings of the research study indicate a correlation between the implementation of the problem-solving model and students' critical thinking abilities. The contribution of this research is to demonstrate the relationship between two variables: the use of problem-solving models and students' critical thinking skills. The following represents a synthesis of recent research in this field: The findings of this research demonstrate a notable correlation between problem-solving learning models and the development of critical thinking skills. It is therefore recommended that this model be employed in the learning process.

Research Method

This research employs a quantitative research design with quasi-experimental elements. A pretest-posttest control group design was employed to evaluate the efficacy of the model problem-solving learning approach in the experimental class, relative to conventional learning models in the control class. This involved administering a pretest to ascertain students' initial abilities and a posttest to assess their final abilities.

Results and Discussion

Validity testing is conducted through the administration of expert validation tests and subsequent trials with students. Upon analysis of the SPSS version 20 program, it was determined that 19 of the 20 items exhibited a statistically significant correlation at the 0.05 level. Conversely, one item failed to meet the requisite validity standards, as its correlation value fell below the 0.05 threshold, rendering it invalid.

The pretest is conducted as an initial phase in the data collection process, with the objective of assessing the participants' initial comprehension of the material prior to the implementation of any specialised instruction or learning activities. The objective of this pretest is to ascertain the participant's initial level of comprehension and preparedness to engage with the material to be studied, as well as to identify their specific learning requirements.

Table 4.1 Recapitulation of Pre-test Results in Experimental Classes and Control Classes

Class	Students	Minimum Results	Maximum Results	Score Total	Average Score
Eksperiment	19	25	55	740	38,94737
Control	19	20	65	880	46,31579

As illustrated in the table above, the mean pretest score for the experimental class was 38.94. In the control group, the lowest pretest score was 20, while the highest score was 65. The mean pretest score for the control class was 46.31, with a total score of 880 and a total of 19 students.

Table 4.2 Recapitulation of Post-Test Results in Experimental Classes and Control Classes

Class	Students	Minimum Results	Maximum Results	Score Total	Average Score
Experiment	19	80	100	1675	88.15789
Control	19	55	70	1225	64.47368

As illustrated in the table above, the mean posttest score for the experimental class was 88.15789. In contrast, the posttest score for the control class was 64.47368.

A more pronounced enhancement in post-test outcomes within the experimental cohort relative to the control cohort suggests that the pedagogical approach or intervention implemented within the experimental setting is more efficacious in enhancing students' abilities. Therefore, the implementation of an intervention in the experimental class has been demonstrated to yield superior learning outcomes in comparison to the conventional methods employed in the control class.

The one-way ANOVA test is employed for the purpose of comparing the means of two distinct groups derived from two separate samples. The statistical test employed is the one-way ANOVA. Prior to conducting the One-Way ANOVA test, it is essential to perform a population normality test as a prerequisite, as well as a population variance homogeneity test to ascertain the appropriate ANOVA test to be employed. The hypothesis is tested using a two-sample comparison test, namely a one-way ANOVA, with a significance level of 0.05. A significance level of 0.050 or greater indicates that the two classes have balanced means. The results of the average difference test are presented in the following table.

The results of the ANOVA test indicated that the F value was 136.517 with a p-value of 0.001. Given that the p-value is less than 0.05, the null hypothesis (H $_0$) is rejected. It can thus be concluded that there are statistically significant differences between the mean values in the groups. The findings of this study suggest that the problem-solving learning model is an effective approach for enhancing student learning outcomes in chemical equilibrium material for class XI MA YADARO. The efficacy of the problem-solving learning model is evident when the learning outcomes of students who were taught using this approach are compared to those of

students who were taught using the conventional learning model. The results of the hypothesis testing, conducted using the ANOVA test at a significance level of 5%, revealed that the calculated F value (136.517) was greater than the F table (4.113). This indicates a statistically significant difference between the student learning outcomes of the experimental group and the control group. Furthermore, the value of 0.01 is smaller than the 0.05 significance level, suggesting that the learning outcomes in the experimental class, which employed the problem-solving learning model, are effective in enhancing student learning outcomes.

The data indicates that the mean post-test score for the experimental group utilizing the problem-solving model is superior to that of the control group. This evidence indicates that the problem-solving learning model is effective in enhancing students' comprehension of problem-solving techniques in the context of chemical equilibrium. The efficacy of this model in enhancing learning outcomes is corroborated by constructivist learning theory, which posits that students demonstrate superior comprehension of concepts when they are actively engaged in devising solutions to given problems.

In addition to enhancing academic performance, the Problem-solving model also affects student engagement in the classroom. The data collected through observation indicates that students in the experimental group demonstrated greater levels of engagement in questioning, discussion, and the application of concepts to problem-solving tasks. This activity has a beneficial impact on the students' learning outcomes, as students who are more actively engaged in the learning process tend to demonstrate a more profound comprehension of the material being taught. This is in accordance with Piaget's theory of cognitive development, which posits that learning is an active process involving students in the exploration and construction of knowledge.

The findings of this research are consistent with those of previous studies, which indicate that the Problem-solving learning model is an effective approach for enhancing student learning outcomes, particularly in subject matter that necessitates an understanding of fundamental concepts and the ability to apply theoretical knowledge, such as chemical equilibrium.

Conclusion

The findings of this study indicate that the Problem-Solving learning model has the potential to serve as an efficacious alternative learning model for enhancing student learning outcomes, particularly in the context of chemical equilibrium. It is recommended that

educators integrate this model into their lesson planning to enhance student engagement and improve learning outcomes.

The implementation of the problem-solving model is also influenced by several supporting factors, including teacher readiness for implementing this model, student motivation, and the availability of adequate learning facilities. However, several obstacles must also be considered, including limited time and the tendency of some students to still depend on the teacher to solve problems. It is therefore evident that students must be encouraged to develop their learning independence in order to implement this learning model effectively, and that they require good time management skills in order to do so.

Moreover, the findings of this study can serve as a point of reference for subsequent research endeavors aimed at investigating the applicability of the problem-solving model across diverse materials and contexts.

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