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Implementation of an Integrated Problem Based Learning Model in Generic Science Skills in Thermochemical Material

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***Abstract*:** *This research aims to determine the effect of Prior Knowledge Evaluation, Student Worksheets on student learning outcomes using the Problem Based Learning Model Integrated Generic Science Skills on Thermochemical Material. This research was carried out at SMAN 2 Percut Sei Tuan in the 2022/2023 academic year, the research was designed using a dual paradigm with two independent variables, namely Prior Knowledge Evaluation and Student Worksheets and one dependent variable, namely Evaluation of Learning Outcomes. The population in this study was all class XI at SMAN 2 Percut Sei Tuan. The sample used class XI B as an experimental class taught with Prior Knowledge Evaluation, Student Worksheets and Evaluation of Learning Outcomes tools using the Generic Science Skills Integrated PBL Learning Model. Sampling was using purposive sampling technique. The instruments used in this research consisted of 25 Prior Knowledge Evaluation questions, 15 Student Worksheets questions and 28 Evaluation of Learning Outcomes in multiple choice form which had been developed by previous researchers. The results of this study that thereare significant influence between Prior Knowledge Evaluation and Student Worksheets on learning outcomes. There are differences in learning outcomes between students who have low Prior Knowledge Evaluation and high Prior Knowledge Evaluation.*

***Keywords*:** *PBL; generic science skills; prior knowledge evaluation; student worksheets; evaluation of learning outcomes*

INTRODUCTION

Education is one of the pillars of a country's development. The better the quality of education in the country, it can be concluded that the country has good quality (Amdayani et al., 2022). In Law No. 20 of 2003 concerning the Education System, it is stated that education is "a conscious and planned effort to create an atmosphere of learning and learning so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble morals and skills needed by himself and society (Pristiwanti et al., 2022) . In the world of education, there are several institutions that can rate the quality of education in a country, one of which is PISA.

PISA (The Program for International Student Assessment) is a program that measures children's performance in the areas

of mathematics, science and literacy abilities. In 2018 Indonesia was ranked 74th out of 79 countries in the reading category, while in the mathematics and science category it was ranked 73rd and 71st out of 79 countries. This shows that the quality of education in Indonesia still needs to be improved in order to increase the quality of education (Hewi & Shaleh, 2020).

In order to ensure the sustainability of education in Indonesia, the government is attempting to take strategic steps toward optimizing learning, specifically by implementing the curriculum. The curriculum plays an important role in developing learning designs and ideas that will serve as a guide in achieving educational goals. "Curriculum is a set of plans and arrangements regarding objectives, content and learning materials as well as methods used as guidelines for implementing learning activities to achieve certain educational goals," according to Law No. 20 of 2003 Chapter 1 Article 1. (Marpaung & Sitorus, 2024).

The development of the education curriculum in Indonesia has reached the development of the Independent Curriculum. The Independent Curriculum is education that is based on the nature of nature and the times, where each student has their own talents and interests. The idea of the essence of independent learning is to create a pleasant learning atmosphere without feeling burdened to achieve certain grades (Cholilah et al., 2023). The concept of an independent learning curriculum can shape students in thinking, learning to integrate literacy abilities, knowledge skills, skills and attitudes as well as mastery of technology (Manalu et al., 2022).

Chemistry is a branch of science that studies objects, their characteristics, structure, composition, and changes caused by interactions with other objects which are called chemical reactions (Situmorang et al., 2023). Chemistry is a part of natural science, which has abstract characteristics, which have two inseparable characteristics, namely, chemistry as a product and chemistry as a process. Chemistry as a product includes a collection of knowledge consisting of; facts, concepts and principles of chemistry, while chemistry as a process includes the skills and attitudes that students must have in developing knowledge. In understanding chemistry as a product, students experience many difficulties starting from understanding questions, writing what is known such as writing symbols, writing what is asked, writing formulas to reaching solutions or mathematical operations.

As we know, thermochemistry is a difficult material for students because it requires a strong understanding of concepts and calculations to solve problems in their learning. The challenge in learning thermochemistry is a lack of understanding of concepts like systems and environmental materials. Students also do not understand how to analyze Hess's law diagrams, and students lack sufficient basic mathematical operations (Rahmawati & Fikroh, 2022).

Based on the results of an interview with one of the chemistry teachers at SMAN 2 Percut Sei Tuan, class XI has used the independent curriculum. The learning models that have been used are the Inquiry model, Discovery Learning (DL), Problem Based Learning (PBL) and Project Based Learning (PJBL) in the learning process. The learning resources that have been used in chemistry learning are cellphones, learning videos and PPT. However, in the chemistry learning process the teacher never provides an evaluation of initial knowledge in the form of numerical and verbal reasoning questions integrated with Generic Science Skills which aims to determine students' learning readiness before the learning process begins. In Thermochemistry material, students experience difficulties in chemical equations, chemical calculations such as calculating enthalpy changes, bond energy because these students need to re-understand Lewis structures and students do not understand in analyzing legal diagrams because they have insufficient mathematical operations so that

student learning outcomes are low in thermochemical materials.

To improve student learning outcomes in Thermochemistry material, it is necessary to apply appropriate learning models to achieve the objectives of these learning activities. There are several learning models that can be applied, namely Problem Based Learning (PBL), Project Based Learning (PJBL), Inquiry Learning and Discovery Learning (DL). In this study, researchers used the PBL model. The PBL learning model can be said to be a learning process that challenges students to study in groups to find solutions to real world problems and then be required to solve these problems (Kristiana & Radia, 2021). The PBL model is a learning model that provides authentic experiences that encourage students to learn actively, construct knowledge, and integrate learning contexts at school and learning in real life naturally (Antara, 2022).

The problem-based learning model is student-centered. Problem-based learning allows students to conduct research, integrate theory and practice, and apply their knowledge and skills to generate an active solution to a problem. According to Permendikbud No. 22 of 2016, a problem-solving-based learning approach is strongly recommended for developing students' ability to generate contextual work both individually and in groups (Silitonga & Muchtar, 2023). One of the advantages of Problem- Based Learning, the learning paradigm is that it makes it easier for students to understand the ideas they are learning to overcome real-world challenges. So that the application of this model is expected to make students more focused in the learning process and improve student learning outcomes (Ramadhana & Sutiani, 2023).

When using the PBL model to teach, skills that are relevant to the learning model are required. One of the skills that can be used is generic science skills. The term "generic skills" refers to qualities and capabilities such as logical and analytical reasoning, problem solving, and intellectual curiosity, as well as effective communication, collaboration, and the ability to identify, access, and organize knowledge and information. KGS can be developed when students go through the process of learning chemistry, which includes learning various concepts and solving various scientific problems.

The Generic Science Skills integrated PBL model can help students develop learning independence in the classroom, allowing them to achieve their learning outcomes and objectives more effectively. Where learning outcomes are students' abilities acquired after learning activities (Dibyantini et al., 2021). Learning outcomes are a description of a student's progress or development during their studies, from when they first started participating in an educational program to when they ended their educational program. In the learning process, there are several things that influence student learning outcomes (Tambunan et al., 2024)

Learning outcomes are specific competencies or abilities that students acquire as a result of the teaching and learning process, and they include cognitive, affective, and psychomotor skills. The Generic Science Skills integrated PBL model is ideal for teaching chemistry. Chemistry education provides students with a direct and in-depth understanding of the natural world around them, which can be applied in everyday life from a broader developmental perspective and necessitates the presentation of facts that are not solely based on understandable concepts. These facts are better understood as products of thought when they are integrated directly into the student's learning process.

Based on the research results of (Langitasari et al., 2021) on the concept of atomic structure in class , it is known that students' generic science skills are rated low for the indicators of concept formation, logical framework, indirect observation, and causal law modeling, rated as moderate. Meanwhile, based on research by (Dibyantini

& Azaria, 2020), there is an influence of applying the Problem Based Learning model on students' generic science abilities. The average generic science ability of students after learning using the PBL model is high. Students' generic science abilities with an average N-gain in the high category in symbolic language (0.95), mathematical modeling with an average N-gain in the medium category (0.68), indirect observation with an average N-gain average in the medium category (0.57), and logical consistency with the average N-gain in the medium category (0.63).

In maximizing thermochemical learning, researchers will apply learning tools that have been developed previously. In this research, there are four learning tools that will be applied, namely; Initial Knowledge Evaluation in the form of numerical and verbal reasoning questions created by (Ambarita et al., 2024), Teaching Materials that have been integrated with Generic Science Skilss by (Aulia & Dibyantini, 2023) , Student Worksheets by (Ad'dhalia et al., 2023) and Evaluation of Learning Outcomes in the form of chemistry questions by (Tobing et al., 2023).

Initial ability is one of the internal factors that influence student learning achievement, and it is viewed as a relevant skill that is possessed when beginning to follow a lesson, implying that initial ability is a prerequisite that students must master before participating in a learning activity. The Prior Knowledge Evaluation intended in this study aims to measure students' initial abilities before learning begins (Silitonga et al., 2022). Where the form of evaluation of this initial ability is in the form of scholastic tests. Scholastic tests in the form of verbal reasoning and numerical reasoning items can be used as instruments to measure students' prior knowledge. Teaching materials are materials or learning materials that are produced systematically, which are used by students and students in the learning process. Learning materials or materials are basically the "content" of the curriculum, namely various subjects or fields of study with topics/subtopics and (Nuryasana & Desiningrum, 2020).

Learning materials are a collection of materials or learning substances that are organized coherently and systematically to present a complete picture of the competencies that students will acquire through learning activities. Teaching materials enable students to learn a competency coherently and systematically, allowing them to master all competencies cumulatively. For this reason, it is very important that educators have the competence to develop good learning materials according to the necessary requirements and needs, so that learning materials can be delivered well, and students also have good learning activities (Ritonga et al., 2022).

Learner worksheets are learning tools for students in carrying out learning activities. As for the benefits of using Student Worksheets during the learning process, students are able to understand concepts along with evaluations given by teachers in class and students are able to hone their abilities by working on evaluations that are equipped with instructions and work methods presented (Wahyuni & Zulyusri, 2023). Students Worksheets have four functions, namely: (1) as teaching materials that can minimize the role of educators while activating students more, (2) as teaching materials that make it easier for students to understand the material provided, (3) as teaching materials that are concise and rich in tasks to practice, and (4) facilitate the implementation of teaching to students (Novelia et al., 2017).

Evaluation of Learning Outcomes is a continuous process to determine and obtain decisions, to what extent various learning objectives have been achieved by students. The main benefit of evaluation is to improve the quality of learning and subsequently improve the quality of education. With the evaluation, students can find out the extent of

success that has been achieved during education (Akmalia et al., 2023).

Next, the researcher made modifications by correcting writing errors and adding questions to the initial ability test. Based on the description stated above, researchers are interested in conducting research entitled "Implementation of an Integrated Problem Based Learning Model of Generic Science Abilities in Thermochemical Materials"

METHODS

The research was designed using a dual paradigm. The population in this study was all class XI at SMAN 2 Percut Sei Tuan, while the research sample was class Sampling was carried out using purposive sampling technique. The instruments used in this research consisted of 25 Prior Knowledge Evaluation questions, 15 Student Worksheets questions and 28 Evaluation of Learning Outcomes questions in multiple choice form which had been developed by previous researchers.

The data obtained in this research is in the form of Prior Knowledge Evaluation, Student Worksheets and Evaluation of Learning Outcomes data. The statistical analyzes used include normality tests, homogeneity tests and hypothesis tests. The normality test is carried out to determine whether the data has a normal distribution or not. The normality test that the researcher used was the Shapiro Wilk test using SPSS 25.0 for Windows at a significance level of 5%. The homogeneity test aims to determine whether the data is homogeneous or not. The homogeneity test used by researchers is the Levene test. Hypothesis testing was carried out to determine whether or not there was a significant influence between Prior Knowledge Evaluation and student worksheets on learning outcomes and to determine whether or not there were differences in learning outcomes between low Prior Knowledge Evaluation and high Prior Knowledge Evaluation. The hypothesis tests used by researchers are multiple linear regression tests and Independent Sample t-tests.

RESULTS AND DISCUSSION

1. Normality and Homogeneity Test

Based on the research that has been carried out, the Prior Knowledge Evaluation, student worksheets and Evaluation of Learning Outcomes data obtained can be seen in table 1.

Table 1. Average prior knowledge student worksheets and evaluation learning outcomes

Score	Meet 1	Meet 2	Meet 3
Prior Knowledge Evaluation	79.16	74.16	78.33
Student Worksheets	78.33	74.44	78.88
Evaluation of Learning Outcomes	82.66	79.19	81

The normality test was analyzed using the SPSS version 25.0 program with the Shapiro Wilk test. Data from the normality test results can be seen below in table 2.

Table 2. Normality test results

Source	Shapiro Wilk Sig	Information
Prior Knowledge Evaluation	0.154	Normal Data
Student Worksheets	0.051	Normal Data
Evaluation of Learning Outcomes	0.067	Normal Data

Based on the results of the normality test above, it can be seen that the gainthe respective significance values are 0.154; 0.051 and 0.067. This shows that both data sets are greater than the significance level $\alpha>(0.05)$ so they can be classified as normally distributed.

Furthermore, after the data was normally distributed, a homogeneity test was carried out using the students' Prior Knowledge Evaluation, student worksheets and Evaluation of Learning Outcomes data which was carried out with the help of the

Levene test with the help of the SPSS version 25.0 program. Based on the results of homogeneity test data processing, the significance value is 0.905> 0.05. Therefore it can be concluded that the Prior Knowledge Evaluation, student worksheets and Evaluation of Learning Outcomes data are homogeneous.

2. Hypothesis testing

After it is known that the data is normally distributed and homogeneous, hypothesis testing can be carried out. The hypothesis test used is multiple linear regression test with the help of the SPSS version 25.0 program. The results of the multiple linear regression test analysis are as follows:

a. Coefficient of Determination Test

The magnitude of the regression/influence value (R) is 0.976 and the coefficient of determination (R square) is 0.953, which means that the influence of the independent variables (Evaluation of initial knowledge and student worksheets) on the dependent variable (Learning Outcomes) is 95,3%, while the remaining 4,7% is influenced by other variables.

b. F test

In the F test, a significant value of 0.000 < 0.05 is obtained, if the sig value < a (0.05), then H_0 is rejected and Ha is accepted. So the Prior Knowledge Evaluation and student worksheets variables together influence learning outcomes.

c. Partial t test

Based on the results of data processing the results showed that the Prior Knowledge Evaluation and student worksheets significance values were smaller than 0.05, namely 0.000 and 0.032. So it can be concluded that Ha is accepted and H0 is rejected. This means that Prior Knowledge Evaluation and student worksheets partially influence learning outcomes.

This is in line with research (Hikmah, 2018) also shows that students' prior knowledge has a positive and significant influence on student learning outcomes. Likewise, the results of research conducted by (Nofriyanti & Hardeli, 2023) regarding the influence of student worksheets on learning outcomes say that 95% of students are interested in using student worksheets based on the PBL model. The use of student worksheets provides opportunities for students to be active in the learning process so that when the student worksheets score obtained is high, they will get high learning outcomes and vice versa, when the student worksheets score obtained is low, the learning outcomes are low.

Next, the data obtained was analyzed using the Independent Sample t-Test hypothesis test with the help of the SPSS version 25.0 program. Based on the results of hypothesis testing data processing, learning outcomes obtained a sig value. (2-tailed) is 0.000>0.005 so it can be interpreted that there is a difference learning outcomes of students whose initial knowledge is classified as high versus students whose initial knowledge is relatively low.

This is in line with research (Ahmad, 2017) which states that there are differences in learning outcomes between students who have high initial knowledge and those who have low initial knowledge. Likewise with the results of research conducted by (Lindawati et al., 2021) and (Setiawan, 2017), which states that students who have high initial abilities will have high learning outcomes, whereas students who have low initial abilities may have poor learning outcomes because students have not mastered basic concepts as a reference for learning new material.

CONCLUSION

Based on the results of data processing, and hypothesis testing, it can be concluded. There is a significant influence between Prior Knowledge Evaluation and student worksheets on student learning outcomes. The amount of influence of Prior

Knowledge Evaluation and student worksheets on learning outcomes is 95.3%, while the remaining 4.7% is influenced by other variables. There are differences in the learning outcomes of students who have low Prior Knowledge Evaluation and high Prior Knowledge Evaluation. Where students who have high initial abilities, the learning outcomes obtained are high, otherwise students who have low initial abilities have low learning outcomes.

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