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## Implementation of an Integrated Guided Inquiry Learning Model in Generic Science Skills to Improve HOTS

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**Abstract:** This research aims to determine the effect of evaluation of prior knowledge and student worksheets on students' high order thinking skill (HOTS) expressed in the form of learning outcome evaluation using an integrated guided inquiry learning model of generic science skills. The research design used is a dual paradigm with two independent variables, namely evaluation of prior knowledge with student worksheets, and one dependent variable, namely learning outcome evaluation. This research was carried out at SMA Negeri 14 Medan in the 2022/2023 academic year with the research population being all students in class XI Science and the sample in the research was class XI Science 3 which was obtained through a purposive sampling technique. The instruments used in this research consisted of the evaluation of prior knowledge with learning outcome evaluation each have 30 questions and the student worksheets has 15 questions. The research results show that there is a significant influence between evaluation of prior knowledge and student worksheets on students' higher-order thinking skill. Apart from that, there are also differences in higher order thinking skill between students with low evaluation of prior knowledge and students with high evaluation of prior knowledge.

**Keywords:** Evaluation of Prior Knowledge; Student Worksheets; HOTS; Guided Inquiry Learning; Generic Science Skills

### INTRODUCTION

The development and progress of a nation is determined by the quality of its human resources. The quality of human resources is related to the quality of education. Based on data released by worldtop20.org, Indonesia's education ranking is 67th out of 203 countries. This shows that the quality of Indonesian education is still relatively low. One of the causes of the low quality of education in Indonesia today is the lack of

students' skill to think at a higher order (Jamil et al., 2021). In fact, the 21st century requires humans to have high order thinking skill, namely the skill to think critically, the skill to think creatively, and the skill to solve problems (Pratiwi et al., 2019).

The lack of students' skills in higher order thinking is caused by the tendency of teachers to still teach using the lecture method so that the learning process is teacher-centered, while students become passive (Hajrin et al., 2019). Students can only solve

limited problems. A learning process that does not actively involve students results in students being smart in theory, but unable to apply it in everyday life. This is because students are only directed to memorize without understanding the concepts of the knowledge they receive. One of the subjects at high school level that is not enough just to memorize, but requires in-depth understanding of concepts is chemistry (Susparini et al., 2016).

Chemistry as a branch of science requires the presentation of facts obtained not only based on theory, but can also be applied in the learning process so that students can construct new knowledge. Chemistry can be a forum or means for students to practice critical thinking skills, be creative and be able to solve problems where students relate them to everyday phenomena (Panggabean et al., 2022). However, in reality there are still many students who experience difficulties in learning chemistry (Sariati et al., 2020). They cannot connect abstract and complex chemical concepts. Apart from that, they also have difficulty solving chemistry problems that require logical and mathematical skills (Zakiyah et al., 2018).

The results of an interview with one of the chemistry teachers at SMA Negeri 14 Medan showed that students still experienced difficulties in solving calculation problems, especially calculating the change in reaction enthalpy in thermochemical materials. Students do not understand the concept of chemical calculations well so that when faced with questions related to calculating enthalpy changes in reactions, these students cannot solve them. One way that can be done to overcome this problem is to change the pattern of the learning process to be student-centered.

A student-centered learning process can be carried out through the development of various essential learning skills, such as effective oral communication, logical, critical, creative thinking, curiosity, mastery of information technology, independent learning, and personal and social development. This means that the

communication that takes place in the implementation of the student-centered learning process is not one-way, but must be interactive, reciprocal communication between teachers and students (Abdullah, 2017). Implementing a student-centered learning process requires an appropriate learning model to activate students.

Currently, there are many learning models designed to help the learning process become student-centered, such as problem-based learning models, project-based learning models, discovery learning, and guided inquiry learning models. The guided inquiry learning model emphasizes the process of discovering concepts and relationships between concepts. The guided inquiry model is suitable for learning chemistry. Students can play an active role and act like scientists in discovering chemical concepts (Malau & Juniar, 2020). In the guided inquiry learning model, students do not passively receive information from educators, but students must actively build their own knowledge (Parwati et al., 2020). This model requires students to construct the knowledge they gain into long-term memory (Hajrin et al., 2019).

In the learning process using the guided inquiry model, the teacher acts as a facilitator who guides and directs students to discover their own concepts (Imaculata et al., 2021). Meanwhile, students get the opportunity to solve problems given in groups to exchange information (Sumarni et al., 2017). The application of the guided inquiry learning model aims to enable students to freely and independently develop the concepts they learn (Puspitasari et al., 2019).

The guided inquiry learning model is less effective if applied to students who do not have above average intelligence. This is because the characteristics of the guided inquiry model learning process are that students solve problems and the main concepts relate to things they already know to form or build new knowledge (Puspitasari et al., 2019). In building this new knowledge, basic skills are needed from students. The

basic skills in question are generic science skills.

Generic science skills are basic skills that are general, flexible, and oriented as preparation for studying higher science. Generic science skills are needed to train students' scientific work so that students are able to understand concepts, solve problems scientifically, and are able to learn on their own effectively and efficiently (Rosidah et al., 2017). Generic science skills rely on understanding concepts and solving. Generic science skills are related to the guided inquiry learning model because this model accommodates students in practicing generic science skills through the learning stages (Iswatun et al., 2017). Generic science skills can also influence higher-order thinking abilities because they are key skills, core skills, and basic skills before using higher-order thinking skills (Izetbigovic et al., 2019).

One of the advantages of the guided inquiry learning model is that it has a positive influence on improving students' higher-order thinking skills. This is because in the learning process using the inquiry learning model there are various activities that involve high order thinking skills, such as formulating problems, proposing hypotheses and looking for answers to a problem and solving problems yourself (Fadillah et al., 2022). Students are also emphasized to search for and understand learning material independently, while teachers only act as facilitators and guides for students in understanding learning material. Guided inquiry learning is implemented so that students are free to develop the concepts they learn, not just limited to material that is recorded and memorized (Juniar et al., 2019).

Several previous studies have proven that the guided inquiry learning model can improve students' higher-level thinking abilities. Research conducted by Aini & Yonata (2020) with the research title "Implementation of a Guided Inquiry Learning Model on Chemical Equilibrium Material to Train Higher Order Thinking Skills" shows the results that the implementation of this learning model is

effective for training and improving high order thinking skills. This is marked by an increase in student learning outcomes. Similar results were also obtained by Uliya & Muchlis (2022), Meriyenti (2022), Maullidyawati & Hidayah (2022), Fenica et al. (2017), and Yarni (2020).

The implementation of the guided inquiry learning model is maximized by using learning tools. In this research, researchers will apply four learning tools that have been previously developed, namely Prior Knowledge Evaluation by Ambarita (2023), Teaching Materials by Aulia & Dibyantini (2023), Student Worksheets by Ad'dhalia & Sutiani (2023), and Evaluation of Learning Outcomes by Tobing (2023). Even though the learning tools have been developed and validated by experts, researchers still make modifications by correcting writing errors and adding several questions to the evaluation of prior knowledge and evaluation of learning outcomes.

Evaluation of students' prior knowledge is the starting point because it describes students' readiness to participate in the learning process. Suparni (in Azizah et al., 2021), prior knowledge are a collection of basic knowledge that is used as a requirement for further learning. Basically, prior knowledge are the cognitive capacities that students have from previous learning to the new learning process (Zulkarnain, 2020). Thus, it can be said that prior knowledge is a prerequisite that students must master before participating in a learning activity (Silitonga et al., 2022).

Furthermore, teaching materials and student worksheets are also an important part of the learning process. One effort that teachers can make to develop students' active learning is by using media in learning (Sutiani & Maisyarah, 2021). Teaching materials contain subject matter that is arranged systematically to represent concepts that lead students to achieve a competency, while student worksheets can increase student learning activities. Meanwhile, evaluation of learning outcomes is used to see or monitor

students' learning progress with predetermined standards and goals.

Based on the background description above, the author is interested in raising this problem by conducting a research entitled "Implementation of an Integrated Guided Inquiry Learning Model in Generic Science Skills to Improve HOTS".

## METHODS

This research was carried out at SMA Negeri 14 Medan with the research population being all classes XI Science and the research sample was XI Science 3 which was obtained through purposive sampling technique. The research design used is a dual paradigm with two independent variables, namely evaluation of prior knowledge with student worksheets, and one dependent variable, namely high order thinking skill expressed in the form of learning outcome evaluation. The instruments used in this research consisted of evaluation of prior knowledge with learning outcome evaluation with 30 questions each and student worksheets with 15 questions. The evaluation of prior knowledge question items are designed in the form of verbal and numerical knowledge, while the learning outcome evaluation question items are designed according to indicators of high order thinking skill.

The data in this research is in the form of evaluation of prior knowledge, student worksheets, and learning outcome evaluation data which were analyzed using statistical analysis. The statistical analysis used includes normality test, homogeneity test, multiple linear regression test and Independent Sample T-Test with the help of the SPSS version 25.0 program. The normality test is carried out to find out whether the data is normally distributed or not. The homogeneity test is carried out to determine whether the data is homogeneous or not. Meanwhile, hypothesis testing was carried out to determine whether there was a significant influence between students' prior knowledge and worksheets on high order thinking skills expressed in the form of evaluation of learning outcomes and

to determine whether there was a difference in high order thinking skills between students with low prior knowledge and students with high prior knowledge

## RESULT AND DISCUSSION

### A. RESULT

#### 1. Description of Research Data

Based on the research that has been conducted, the average prior knowledge evaluation data, student worksheets, and evaluation of learning outcomes obtained can be seen in Table 1.

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

Source	Meet 1	Meet 2	Meet 3
Prior knowledge evaluation	52.50	61.56	67.81
Student worksheets	72.50	72.50	73.12
Evaluation of learning outcomes	73.31	75.93	77.18

#### 2. Data Prerequisite Test

Research data prerequisite tests include; Normality tests and homogeneity tests were carried out using the SPSS 25.0 program. at a significance level of 5% (sig. 0.05). The normality test used is the Shapiro-Wilk test with the condition that the research data is normally distributed if sig. > 0.05. The results of the normality test of prior knowledge evaluation data, student worksheets, and evaluation of learning outcomes are presented in Table 2.

**Table 2.** Normality test

Source	Shapiro-Wilk Sig	Information
Prior knowledge evaluation	.342	Normal Data
Student worksheets	.084	Normal Data
Evaluation of learning outcomes	.092	Normal Data

Based on table 2, it can be seen that the significance values of the prior knowledge evaluation data, student worksheets, and evaluation of learning outcomes normality

tests are 0.342; 0.084; and 0.092. The results obtained show that the significance value is greater than 0.05 (sig. > 0.05). Thus, it can be concluded that the prior knowledge evaluation data, student worksheets, and evaluation of learning outcomes data are normally distributed.

After the normality test, the prior knowledge evaluation data, student worksheets, and evaluation of learning outcomes data homogeneity test was carried out using the Levene test at a significance level of 5% with the provision that if the sig. > 0.05 then the data is homogeneous. The results of the homogeneity test of the research data are shown in Table 3.

**Table 3.** Homogeneity test

Source	Levene Test Sig	Information
Prior knowledge evaluation	.288	Homogeneous
Student worksheets	.896	Homogeneous
Evaluation of learning outcomes	.052	Homogeneous

Based on table 3, it can be seen that the significance value of the the prior knowledge evaluation data, student worksheets, and evaluation of learning outcomes homogeneity tests is 0.288; 0.896; and 0.052. The results obtained show that the significance value is greater than 0.05 (sig. > 0.05). Thus, it can be concluded that the prior knowledge evaluation data, student worksheets, and evaluation of learning outcomes data are homogeneous.

### 3. Data Analysis

After all the data is normally distributed and homogeneous, a hypothesis test is carried out to answer the problem formulation. The hypothesis test carried out was a multiple linear regression test and an Independent Sample T-Test using the SPSS 25.0 program at a significance level of 5% (sig. 0.05).

#### 3.1. Multiple Linear Regression Test

A multiple linear regression test was carried out to determine whether there was a

significant influence between prior knowledge evaluation data, student worksheets, and evaluation of learning outcomes as an indicator of students' higher order thinking skills. The results of the multiple linear regression test analysis in this study are as follows.

##### a. Partial t Test

Based on the results of data processing, the sig value is obtained. Prior knowledge and student worksheets partial t-tests on evaluation of learning outcomes are 0.000 and 0.002. Because the sig. < 0.05, it can be concluded that prior knowledge evaluation and student worksheets partially have a significant effect on learning outcomes.

##### b. F Test

The F test was carried out with the aim of finding out whether there was an influence of the independent variables prior knowledge and student worksheets together on learning outcomes as the dependent variable. As for the sig. prior knowledge and student worksheets's F test for learning outcomes is 0.000. The results obtained show that the sig. smaller than 0.05, so it can be concluded that prior knowledge and student worksheets together have a significant effect on learning outcomes.

##### c. R<sup>2</sup> Test

The R<sup>2</sup> test was carried out to determine how much influence prior knowledge and student worksheets have on learning outcomes. The significance value of the R<sup>2</sup> prior knowledge and student worksheets tests on learning outcomes is 0.924. This means that the influence of prior knowledge and student worksheets on learning outcomes is 92.4%. Meanwhile, 7.6% is influenced by other variables. This variable can come from internal factors (interest and motivation to learn) or external factors, such as family, school, social environment and economic conditions.

#### 3.2. Independent Sample T-Test

The Independent Sample T-Test was carried out to determine whether there was a difference in learning outcomes between students with high prior knowledge and

students with low prior knowledge. The significance value of the Independent Sample T-Test is 0.000 (sig. < 0.05). Thus, it can be concluded that there is a difference in learning outcomes between students with high prior knowledge and students with low prior knowledge.

## **B. DISCUSSION**

The results obtained from the multiple linear regression test are in accordance with the statement made by Dochy (Payung et al., 2016) that prior knowledge has a significant contribution to student learning outcomes. Hikmah (2018) and Lestari (2017) also shows that students' prior knowledge has a positive and significant influence on student learning outcomes. Regarding the positive and significant influence of student worksheets on learning outcomes, it is supported by Putra (in Hastuti et al., 2023) which states that the use of student worksheets in the learning process can improve student learning outcomes. Research conducted by Mursalim & Rumbarak (2021) also shows that there is an increase in student learning outcomes by using student worksheets.

Furthermore, the significance value of the Independent Sample T-Test is 0.000 (sig. < 0.05). The results of the research show that there are differences in learning outcomes between students with high initial knowledge and students with low initial knowledge. This is in line with what Sholihah (in Hikmah, 2018) stated that there are differences in learning outcomes between students who have high initial knowledge and students who have low initial knowledge.

It is explained further in the research of Muammar et al. (2017) shows that the learning outcomes of students with high prior knowledge are better than students with low prior knowledge. Hasanuddin (2020) explains that the higher the level of prior knowledge a student has, the higher the learning outcomes the student will obtain. This is due to the high ability of students to discover and investigate concepts. Russffendi (in Lestari, 2017) also stated that student success in learning depends

on student readiness. One of these readiness is prior knowledge.

In this research, the evaluation of learning outcomes shows the value of students' high order thinking skills. The learning outcomes evaluation test questions are prepared based on indicators of high-order thinking skills, so that if the learning outcomes evaluation score is high then the student's high order thinking skills score is also high.

## **CONCLUSION**

Based on the results of the research and data analysis that has been carried out, it can be concluded that there is a significant influence between the evaluation of students' prior knowledge and worksheets on the evaluation of learning outcomes, both partially and simultaneously. The influence of evaluating students' prior knowledge and worksheets on evaluating learning outcomes is 92.4%, while 7.6% is influenced by other variables which can come from internal factors (interest and motivation to learn) or external factors, such as family environmental factors, school, social environment, and economic situation. Besides that, there are differences in the high-order thinking skills of students with low prior knowledge evaluations and students with high prior knowledge evaluations. Students with low prior knowledge evaluations generally have low higher order thinking skills. On the other hand, students with high prior knowledge evaluations generally have good higher order thinking skills as well.

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