

Implementation of Student Worksheets (LKS) Using the Treffinger Model as A Guide For Self-Learning on Hydrocarbon Compound

Triliyansi Triliyansi*, Maya Erliza Anggraini, & Abudarin Abudarin

Chemistry Education Study Program, Faculty of Teacher Training and Education, University of Palangka Raya, Palangka Raya, Central Kalimantan 73112, Indonesia

*Corresponding author: triliyansi.12@gmail.com

Abstract: This study demonstrates the Treffinger model's impact on autonomous learning through Student Worksheets (LKS) concerning hydrocarbon compounds. Students showed a good understanding of hydrocarbons through problem-solving using the Treffinger model, achieving an average score of 79.56. Implementing the Treffinger model in learning activities significantly enhanced their knowledge about Hydrocarbons, achieving a coefficient of 84.46%. Treffinger's learning paradigm enhances student engagement, innovation, active participation, and a student-centred approach, augmenting motivation, problem-solving, and critical thinking skills.

Keywords: learning media, teaching strategy, chemistry teaching, learning model

INTRODUCTION

Chemistry is a science lesson that should be studied using an approach based on scientific methods, namely *the scientific* approach as mandated in the curriculum. One of the learning models that is relevant to scientific learning is the discovery learning model. The steps of *discovery learning* follow scientific learning steps, namely observing, questioning, gathering information, reasoning, and communicating. Selecting a learning strategy or model by a teacher or teacher is essential. The learning methods and models used are expected to positively impact the mastery of concepts to improve student learning outcomes, following their students' characteristics and conditions (Nasution, 2018).

One of the learning models recommended in the 2013 curriculum is *the discovery learning* model. The *discovery learning* model is a series of structured learning activities involving all students' abilities to search, find and systematically investigate, criticise, logicalize, and conclude the knowledge they find themselves (Hanfiah, 2009). The *discovery learning* model provides opportunities for students to think, develop ideas, find concepts and opinions, and play an active role during the learning process. The series of learning activities with this learning model involves all students' ability to search and investigate systematically, critically, logically, and analytically to formulate their own findings during the learning process (Putri et al., 2017).

The discovery learning *model* makes students remember concepts longer because data and information are found independently (Khasinah, 2021). *Discovery learning* is carried out through six stages. The initial stage is *stimulation*; at this stage, a phenomenon is presented that encourages students to think critically. The second stage is *the problem statement*, which is the stage of formulating a problem or question. The third stage *of data collection* is the data collection stage. The fourth stage of *data processing* is processing data to formulate findings or draw provisional conclusions. The sixth stage of *verification* is to validate the findings or knowledge obtained. The final stage of *discovery learning* is *generalisation*, which is drawing conclusions based on findings verified in the previous stage (Nugrahaeni, et al. 2017).

Previous research results show the success of applying the discovery learning model in several chemistry learning topics. The results of research conducted by Anisa et al. (2017) show that discovery learning has a significant influence on increasing students' motivation to learn and mastery of concepts. Based on their research results, Nugrahaeni et al. (2017) reported that the application of learning using *the discovery learning model* has proven to be effective in improving student learning outcomes and critical thinking skills of high school students. The results of Santika et al. (2017) stated that *the discovery learning model* is practical and effective and greatly influences students' flexible thinking skills in electrolyte and non-electrolyte solution materials.

The application of *the discovery learning model* requires a learning guide so that students can carry out learning activities effectively and efficiently, mainly if learning is carried out online. In online learning, students learn from home, and teachers teach from home online/online, using various available media or applications (Dewi and Sadjarto, 2021). Therefore, they need independent learning guides. The study guide can be packaged as a Student Worksheet (LKS). LKS are sheets that contain tasks that must be done by students (Majid, 2006). This activity sheet usually contains instructions and steps to complete the task. LKS contains various learning tasks that students must complete and functions as a tool to transfer knowledge and skills so that it can foster students' interest in following the learning process (Kurnianto, 2015). Widjajanti (2008) states that LKS is a practical learning guide to improve understanding of concepts.

LKS can be developed using one of the learning tool development models that previous researchers have widely used. Some examples of development models that are widely used in the development of learning tools are the Dick and Carey model (Muga et al., 2017; Ni'matullah, 2016; Afrida et al., 2014; Soeyono, 2014); Four-D model from Thiagarajan (Diani, 2015, Safitri et al., 2014); model ADDIE (Minarni et al., 2019; Satriawan & Rosmiati, 2017); Kemp model (Prahani et al., 2017; Kusumo, 2017).

Previous researchers have carried out several research on the development of LKS for discovery learning; for example, Setiadewi et al. (2015) developed LKS oriented to *the discovery learning model* (to improve students' creative thinking skills in biotechnology material grade XII high school. The limited trial results show that the LKS can potentially develop students' creative thinking skills. Research by Rahma et al. (2019) developed LKS with *a discovery learning model* on acid-base titration. The implementation test results revealed that using LKS can help students find and understand the concepts learned.

Unlike previous research, the LKS developed in this study is used for online learning on Hydrocarbon material. Guidelines in the form of instructions, directions, internal guidance, or LKS are packaged using an invitation sentence to avoid sentences that are commands. The LKS developed and used, in addition to being assessed for feasibility by experts and tested for readability, were also tested and implemented to determine the effectiveness of LKS in guiding *discovery learning activities*.

METHOD

The approach method used in this study is *quasi experiment* with a *Randomized Control Group Pretest-Posttest design* research design involving a sample of Class XI students from several high schools in Palangka Raya City in the 2022/2023 school year. The research design used in the study is a posttest-only control group design presented in Table 1.

Table 1. Pretest-Posttest Control Group Design

Sample	Pretest	Treatment	Posttest
A1	Q1	X1	Q2
B2	Q3	X2	Q4

Information:

A: Sample class randomly; B: Experimental sample class

Q1: Pretest the experimental class; Q2: Posttest class experiment

Q3: Pretest class control; Q4: Pretest the experimental class

The experimental class used the Treffinger model with the help of LKS media, and the sample was randomly used using the conventional model. The implementation of the pretest and post-test was carried out in both classes to find out the level of students' critical thinking ability in each sample. The data analysis technique in this study uses the "t" test, one of the statistical tests used to determine whether there is a significant difference between the two mean samples. However, homogeneity and normality tests are also carried out before data analysis. The normalisation test is used to find out whether the sample used in the study is normally distributed or not with the formula:

$$(X)^2 = \sum_{i=1}^k \frac{(f_0 - f_e)^2}{f_e}$$

With:

X²: Only Squares

f₀: frequency of observations

f_e: Expected frequency

If the distribution is normal, if X² (count ≤ X² (table)), the two data have a normal distribution; the next step is to carry out a homogeneity test so that the "t" test can be continued. The homogeneity test aims to see whether the two classes studied are homogeneous. The data of the PSTES results from both classes are compared with the F table; if the calculation is obtained F count ≤ F table, then the sample is said to have the same or homogeneous variant; on the other hand, F count ≥ Ftable, then the sample is said to be non-homogeneous. The hypothesis test was carried out after the data were normal and homogeneous by analysing the pretest and post-test of the experimental and control classes. The hypothesis is accepted ≥ t the table with the degree of value α = 0.05. If t counts ≥ t table means Ho is rejected; if t counts ≤ t table means Ho is accepted.

RESULTS AND DISCUSSION

LKS Validation Results

Two material experts and practitioners have validated the learning tools used previously tested on students to determine the feasibility of the LKS used. The results of the expert assessment are then calculated in the validity level of the LKS presented in Table 2.

Table 2. Results of Expert Validation of LKS

Assessment Aspects	Average	Criterion
Content eligibility	97.85	Excellent
Readability	97.78	Excellent
Linguistics	97.70	Excellent
Average aspect	97.75%	Excellent

The average score obtained from all aspects of $V = 3.92$ is in the excellent valid category. This means that the LKS is worthy of use in learning. The results of hypothesis testing are presented in Table 3.

Table 3. The results of hypothesis testing

Class	Mean	Standard Deviation	Minimum	Maximum	Manual	
					Calculation	t_{table}
Experiment	62	21.92	31	86	28.4	1.986
Control	40	12.86	19	68		

The data in the table shows a difference in critical thinking ability between the experimental class that uses the Treffinger model LKS and the control class that uses conventional. By paying attention to the higher mean value of the experimental class, it can be obtained that the use of the Treffinger model LKS in learning influences students' critical thinking skills.

Get a score

The N-Gain test was conducted to measure the increase in concept understanding in students in both classes of the research sample. The data of the N-Gain test results are presented in Table 4.

Table 4. Summary of N-Gain Test Results

Class	Average pretest score	Average posttest score	N-Gain	Category
Experiment	35	82	0,83	Good
Control	38	41	0,38	Keep

Data Table 4. It shows that the increase in the pretest and post-test scores of the experimental class is different from the increase in the pretest and post-test scores of the control class. This shows that the critical thinking ability of students in the classroom using the Treffinger model with LKS is greater than that of conventional classrooms.

Ability to carry out learning activities with the Treffinger Model LKS

Assessment of students' learning activity abilities includes problem focus, searching for information, problem-solving strategies and conclusions. The data on assessing critical thinking skills from cognitive and affective aspects are presented in Table 5.

Table 5. The ability of students to carry out learning activities

Assessment aspects	Experimental Classes		Control Classes	
	Value	Criterion	Value	Criterion
The focus of the problem	3,59	Good	2,82	Keep
Seeking information/Cooperation	4,01	Excellent	2,55	Keep
Problem-solving strategies	3,95	Good	3,05	Good
Conclusion	3,87	Good	3,05	Good
Ask	3,22	Good	2,64	Good
Convey ideas	3,38	Excellent	3,25	Good
Assess individual opinion ideas	3,82	Excellent	3,18	Good

The data showed that the comparison of students' critical thinking skills in the experimental class was higher than that of the control class.

Effectiveness of the Treffinger Model LKS

LKS that experts have validated are lent in chemistry learning in several high schools in Palangka Raya. Learning with the Treffinger model is carried out by students in class independently without the teacher's admiration throughout the learning process, and the teacher only delivers an introduction at the beginning and end of the lesson. The effectiveness of LKS is measured by the ability of students to carry out learning activities in each stage of the Treffinger learning process during learning. The results of the implementation test show that the Treffinger LKS is effective in sequentially guiding students during the learning process; the data is presented in Table 6.

Table 6. The effectiveness of the LKS guides students in their understanding of concepts

Material Concept	Average Score	Understanding of concepts	Criterion
Alkanes	84,26		Excellent
Alkenes	82,38		Excellent
Alkynes	79,78		Good
Isomers	74,56		Good
Carbon Compound Reaction	76,82		Good
Average	79,56		Good

LKS learning with *the discovery learning* model spurs students to actively ask questions, formulate provisional answers, conclude interrelated principles, and motivate students in learning by collecting information from various library sources, analysing results, and concluding. Some of these things make learning effective and can be considered an advantage of *the discovery learning* model compared to other learning models. The existence of a practical learning guide in the form of LKS is expected to enable students to carry out activities well at each stage of discovery learning so that they can construct and understand knowledge about hydrocarbon compounds. The effectiveness of LKS in improving students' mastery of concepts is measured by increasing the value of mastery of concepts before and after learning with the discovery learning model using a learning guide in the form of LKS. For this purpose, students are given pretests and post-tests to the subjects of the implementation test. The increase in mastery of concepts from the pretest to the post-test was calculated using *Normalised Gain (N-Gain)*.

The study results showed that after online learning with *the discovery learning* model using LKS *discovery learning*, the hydrolysis of salt mastery of students' concept mastery increased with an average *N-gain* of 0.83. Thus, it can be stated that the LKS developed in this study is efficacious in

improving students' mastery of concepts. This result is in line with the results of the research of Bogar et al. (2012), who stated that the training model that refers to a constructivist approach is more successful than traditional teaching methods that do not allow students to build the concepts they must master.

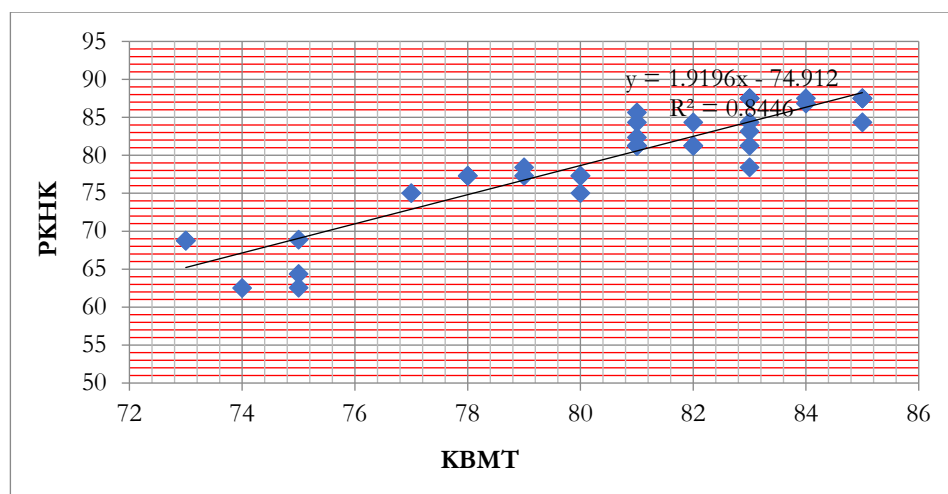


Figure 1. Learning Ability Curve using LKS Treffinger Model (KBMT) Vs Mastery of Hydrocarbon Concepts (PKH)

Increased mastery of the concept of hydrocarbon material above as a result of discovery learning activities guided by using LKS. In the learning process, students construct their knowledge through *discovery learning* activities. The *discovery learning LKS* is designed so that the rest can carry out activities in each stage of discovery learning. Based on the limited implementation test results, it is proven that the LKS is effective in guiding students to carry out *discovery learning* activities. The ability of students to carry out suitable discovery learning activities causes them to master concepts well. The results of this study are in line with the results of previous studies, including Diani (2016), Nugrahaeni et al. (2017) and Santika et al. (2017). The three studies showed the same results, namely that *discovery learning* guided using LKS was effective in improving thinking skills and mastery of concepts

CONCLUSIONS

This study's results show the influence of the Treffinger model on independent learning using Student Worksheets (LKS) on hydrocarbon compound materials. The ability of students to carry out learning activities using the Treffinger model LKS was classified as good (80.42). Students' understanding of Hydrocarbons with problem-solving using the Treffinger model was relatively good (average 79.56). The ability of students to carry out learning activities using the Treffinger model contributed positively to the mastery of the concept of Hydrocarbons with a coefficient derivation of 84.46%. This is because Treffinger's learning model provides more engaging, innovative, active, and student-centred learning to increase students' motivation, problem-solving, and critical thinking skills. However, this also depends on the LKS designed by the teacher. Further research is expected to be carried out on other chemical meters, accompanied by the expansion of sample parameters.

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