



The Effectiveness Of Using Student Worksheet Accompanied by Hybridization Kit On The Discovery Learning Model

Nanda Lista Putri, Erlina, Andi Ifriany

Department of Chemistry Education, facultr of Teacher Training and Education, Tanjungpura University, Pontianak, Indonesia

* Corresponding Author e-mail: andi.ifriani@fkip.untan.ac.id

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Abstract

Chemistry learning, especially the topic of hybridization, is often considered difficult by students because the concepts are abstract and cannot be clearly visualized through 2D textbook images. This study aims to determine the effectiveness of using Student Worksheets (LKPD) accompanied by a Hybridization Kit (Hy-KIT) through the Discovery Learning model. The research employed a quantitative approach with a quasi-experimental design. The sample (N=72) was selected using purposive sampling and consisted of a control class (36 students) that used conventional worksheets (LKS) and an experimental class (36 students) that used LKPD with Hy-KIT. The research method used was a quasi-experimental design with a Nonrandomized Control Pretest–Posttest design. Data were collected through validated essay-type pretest and posttest questions. The novelty of this study lies in the integration of the 3D Hy-KIT media, which provides a real visualization of orbital shapes, with the Discovery Learning model. This combination serves as an alternative learning tool to significantly enhance students' understanding of this abstract material. The results showed that both classes experienced improvement, but the experimental class demonstrated higher learning gains than the control class. The Effect Size (ES) calculation produced a value of 0.6, which falls into the medium category, indicating that the LKPD accompanied by Hy-KIT is effective in improving students' understanding of hybridization concepts.

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INTRODUCTION

Education plays an essential role in improving the quality of learning so that learning processes can take place effectively and support students' cognitive, skill, and attitude development. The effectiveness of learning is not only seen from the improvement in learning outcomes but also from students' active engagement. Therefore, teachers need to design learning that is appropriate, structured, and relevant to students' needs (Krismayanti & Mansurdin, 2023).

In chemistry learning, several materials are challenging for students due to their abstract nature, one of which is chemical hybridization. Many students struggle to visualize the direction of orbitals because learning tends to rely heavily on textbook images. Based on interviews with chemistry teachers at SMAN 11 Pontianak, the use of learning media in the classroom is still very limited. As a result, students tend to only memorize hybrid shapes without understanding how they are formed. Interviews with students also revealed the same issue: 2D images in textbooks do not provide sufficient support for visualizing orbital directions.

To address this problem, appropriate learning media is needed to help students visualize and understand abstract concepts. One possible media is Student Worksheets (LKPD) accompanied

by a Hybridization Kit (Hy-KIT). LKPD functions as a learning guide, while Hy-KIT is a 3D tool that helps students observe basic orbitals, excited orbitals, and hybrid orbitals directly (Lerian et al., 2022). With this media, learning becomes more visual, making hybridization concepts easier to understand. Learning becomes more effective when combined with the Discovery Learning model, which encourages students to actively search for and discover concepts through investigative activities. Through stages such as problem presentation, data collection, analysis, and drawing conclusions, students can gradually build their own understanding (Budiastuti et al., 2023).

Many factors influence learning outcomes, one of which is learning media. Therefore, the learning process must be adjusted to students' needs and characteristics to achieve optimal results. Only then can we determine whether learning is effective or not (Zaifullah et al., 2021). The effectiveness of learning media refers to how well the media helps students achieve learning objectives. Effectiveness can be measured through students' learning outcomes; if their results increase, the media is considered effective, and if not, then the media is considered ineffective (Cahyani & Brilian, 2020).

Student Worksheet (LKPD) and Hy-KIT are tools used to assist and facilitate teaching and learning activities, creating effective interactions between students and teachers (Muslimah, 2020). Hybridization is a concept in chemistry that explains how atomic orbitals mix to form new orbitals called hybrid orbitals. It is part of the Grade XI chemistry curriculum taught in the odd semester (Yerimadesi et al., 2017). Based on the information above, this research was conducted to determine whether Student Worksheets (LKPD) accompanied by a Hybridization Kit (Hy-KIT) are effective during the teaching and learning process to improve students' understanding of chemical hybridization material.

METHOD

This research was conducted in Grade XI Chemistry 1 and XI Chemistry 2 at SMAN 11 Pontianak, with 36 students in the control class and 36 in the experimental class. The sample was selected using purposive sampling, a technique in which the researcher chooses participants based on specific considerations.

This study used a quantitative approach with a quasi-experimental design. Quasi-Experimental Research is an experimental design conducted without random assignment but still involves group participation (Yogaswara et al., 2019). According to Cook & Campbell (1997), quasi-experiments apply treatments and measure their impacts on experimental units without random assignment to obtain comparisons from the treatment outcomes (Abraham & Supriyati, 2022).

The instruments used in this study included five essay questions and Student Worksheets (LKPD) accompanied by Hy-KIT, a teaching aid containing orbital direction models for hybridization material. Data collection used a test technique to measure students' learning outcomes on hybridization material. Tests were administered twice: before learning (pretest) and after learning (posttest). The test instrument consisted of five essay questions that had been validated beforehand to ensure appropriateness as a measurement tool.

RESULTS AND DISCUSSION

The results and discussions contain the results of research findings and their discussion scientifically. Write down scientific *findings* obtained from the research results that have been carried out but must be supported by adequate data. The scientific findings referred to here are not the data of the research results obtained.

These scientific findings must be explained scientifically including: What are the scientific findings obtained? Why does that happen? Why is the trend of such a variable? All these questions must be explained descriptively and scientifically and supported by adequate scientific basic phenomena if necessary. In addition, it should also be explained the comparison with the results of other researchers who are on almost the same topic. The results of the study and findings must be able to answer the research hypothesis in the introduction.

CONCLUSION

The research was conducted over 3 weeks with 6 meetings for each class (control and experimental) at SMAN 11 Pontianak. This school was selected due to students' limited understanding of hybridization and the absence of instructional media to help visualize orbital directions.

Table 1. Research Design for Pretest-Posttest

Group	Pretest	Treatment (X)	Posttest
Control	O ₁₁	X (LKPD & Hy-KIT)	O ₂₁
Experiment	O ₁₂	Y (LKS)	O ₂₂

(Prayitno & Ihsani, 2020)

Description :

O₁₁ = Pretest results for experimental class

O₁₂ = Pretest results for control class

X = Treatment using LKPD and Hy-KIT

Y = Treatment using LKS

O₂₁ = Posttest results for experimental class

O₂₂ = Posttest results for control class

The first stage before research was instrument validation. The instrument consisted of five essay questions. Validation was carried out by two experts in content, construct, and language. The validation calculation used Gregory's formula.

Table 2. 2x2 content validity cross-tabulation

Content validation	Validation 2		
	Less relevant (skor 3-4)	Very relevant (skor 1-2)	
Validation 1	Less relevant (skor 3-4)	(A)	(B)
	Very relevant (skor 1-2)	(C)	(D)

(Gregory, 2000).

Description :

V_i = Content validation

A = both experts agree

B = expert 1 agree, expert 2 disagrees

C = expert 1 disagree, expert 2 agree

D = both experts agree

Table 3. Content validity criteria

Content Validity	Category
0,80 – 1,00	Very high
0,60 – 0,79	high
0,40 – 0,59	medium
0,20 – 0,39	low
0,00 – 0,19	Very low

(Amir & Arsyad, 2015).

The validation results ranged from 0–1. The closer the value to 1, the better the content validity, indicating stronger agreement between experts. The validation results obtained from the experts are as follows:

Table 4. Expert validation criteria

Content validation		Validation 1	
		Less relevant (skor 3-4)	Very relevant (skor 1-2)
Validation 2	Less relevant (skor 3-4)	(0)	(0)
	Very relevant (skor 1-2)	(0)	(9)

$$Vi = \frac{D}{A+B+C+D} = \frac{9}{0+0+0+9} = \frac{9}{9} = 1$$

After instrument validation by both experts, the result was 1, indicating a very high score. After the instrument was validated, a pretest was conducted on the control/Chemistry 1 class on September 1, 2025, and on the experimental/Chemistry 2 class on September 1, 2025. The average score for the control class was 23.80, and the average score for the experimental class was 22.47. This can be seen in the diagram below:

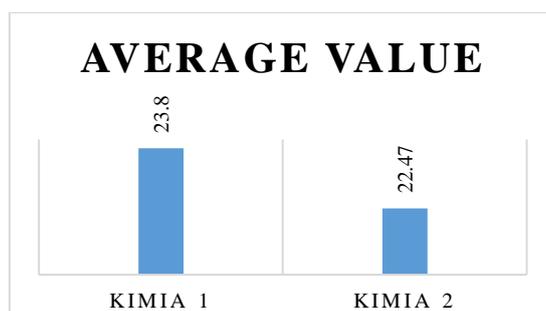


Figure 1. pretest diagram

The diagram above shows that both classes obtained low scores on the hybridization material. After a pretest was conducted to determine students' initial knowledge of the hybridization material, the next step was to apply the teaching media in the form of Student Worksheets (LKPD) accompanied by Hy-KIT in the experimental/chemistry 2 class during the hybridization learning process. This aimed to determine whether the teaching media was effective for use in the learning process. The effectiveness of the teaching media can be determined from the posttest results, which are calculated using the Effect Zise formula:

$$d = \frac{\bar{X}_B - \bar{X}_A}{SD_{pooled}}$$

While,

d = **Cohen's d** value (effect zise)

\bar{X}_a = Average of grup A (control class)

\bar{X}_β = Average of grup B (eksperiment class)

$SD_e d$ = combined standard deviation (*pooled standard deviation*)

After the effect zise (ES) is calculated, theresults are then categorized as shown in table 5.

Table 5. Effect size categories

Effect Size	Category
$0 \leq ES \leq 0,2$	low
$0,2 \leq ES \leq 0,8$	medium
$ES \geq 0,8$	high

(Cohen, 1988).

After the average pretest scores of both classes were obtained and the learning media (LKPD accompanied by Hy-KIT) had been applied to the experimental class, a posttest was then conducted to determine whether the learning media were effective when used during the learning process. The final scores from the posttest of the control and experimental classes can be seen in the table below.

Control class

Table 6. Average scores of the control class

	N	Minimum	Maximum	Average
pretest	36	0	50	23,80
posttest	36	10	85	60,56

From the comparison of the pretest and posttest results of the control class, there is an increase between the two scores, where the posttest score of 60.56 is higher than the pretest score of 23.80.

Experiment Class

Table 7. Average values of the experiment class

	N	Minimum	Maximum	Average
pretest	36	0	50	22,47
posttest	36	33	95	70,64

From the comparison of the pretest and posttest results of the experiment class, it shows an increase between the two values, where the posttest value of 70.64 is higher than the pretest value of 22.47. After the average posttest scores of the two classes are known, a normality test is first carried out on the two data.

Table 8. Posttest normality test table

		Tests of Normality					
		Kolmogorov-Smirnov ^a			Shapiro-Wilk		
class		Statistic	df	Sig.	Statistic	df	Sig.
score	posttest control	,122	36	,192	,963	36	,267
	posttest eksperiment	,125	36	,166	,938	36	,045

The normality test results in this study used the Kolmogorov-Smirnov formula with the condition that the results will be normally distributed when the sig score > 0,05 and the research results are declared normal with the sig results > 0,05.

The Effect Size test in this study was conducted to measure how effective the use of LKPD teaching media accompanied by Hy-KIT was in the learning process. So after knowing the average pretest score, posttest score, and after performing the normality test, the data will be calculated using the Effect Size formula as follows:

$$d = \frac{\bar{X}_B - \bar{X}_A}{SD_{pooled}} = \frac{70,64 - 60,65}{15,57} = 0,6$$

From the results of the Effect Size, the result is 0.6, which based on the classification of Effect Size according to Cohen, this result indicates the effectiveness of the media in the medium category. It can also be seen in the graph below which shows an increase from the pretest value to the posttest value and there are also differences between the control class value and the experimental class, where the experimental class value is higher than the control class.

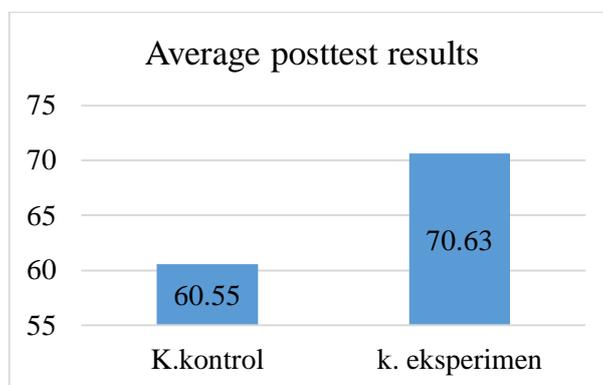


Figure 2. Posttest Diagram

CONCLUSION

Based on research conducted in class XI SMAN 11 Pontianak, the use of LKPD accompanied by Hy-KIT proved effective in helping students understand hybridization material. This can be seen from the increase in learning outcomes values in the experimental class which were higher than the control class after being given treatment. The Hy-KIT media provides a more real visualization of orbital shapes making abstract concepts easier for students to understand during the learning process.

RECOMMENDATIONS

Effect Size calculations yielded a value of 0.6 which is included in the medium category. This value indicates that the use of LKPD accompanied by Hy-KIT has a significant influence on improving student learning outcomes. Thus, this media is suitable for use as an alternative in chemistry learning, especially on abstract materials.

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