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Research Article

CLDW: Worksheet Application for Developing Science Generic Skills and Learning Outcomes

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Abstract

The purpose of this study was to analyze the effect of the application of the CLDW worksheet on science generic skills and learning outcomes. This quasi-experimental study used a nonrandomized control group pretest-posttest design and involved all tenth graders from a secondary school in Banjarmasin, Indonesia. The sample consisted of 113 students who were divided into 2 different classes. The experimental class was taught using CLDW, while the control class was taught by biology teachers using conventional worksheets. A rubric was used to assess students' answers and the results were analyzed using Mancova. Findings showthe use of CLDW significantly affects the dependent variable, namely learning outcomes and students' generic science skills after controlling for the initial abilities of students. Based on the results of the wilks lambda which has a df of 107,000 with a sig value of 0.00 (<0.005). Based on the results of the study, it can be concluded that CLDW can close the gap of generic science skills in character abilities between students in urban and suburban areas.

Keywords

CLDW, worksheets, learning, science generic skills, biology

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Introduction

Information and Communication Technology (ICT) is in the field of education after the determination of distance learning. Such as distance models to e-learning or & blended learning models which offer new options in the delivery of learning. The use of e-learning must be supported in a positive attitude in accepting technology and its application (Putra, Akrim, & Dalle, 2020). One of the uses of e-learning is to use the Digital Wetland Literacy Culture (CLDW). CLDW is a learning application in the form of e-learning which contains teaching materials, learning photos/videos, student worksheets (LKPD), learning materials and questions related to the potential of the local environment, namely the wetland environment in the South Kalimantan region. The LKPD CLDW is structured systematically and contextually by the surrounding community. One of the goals of using LKPD is to present learning concepts so that it will make students more comfortable with concepts that are already available (Putra & Ekasari, 2018). LKPD is used by educators or teachers to support the learning process so that the learning objectives are achieved. The LKPD function used in schools contains practice questions that train students in cognitive abilities (Fuadati & Wilujeng, 2019), but in CLDW LKPD using interactive multimedia will help students in learning biology besides that LKPD can be used by students when doing simulations/practices.
Generic science skills are skills that can be used to learn various concepts and solve various science problems, especially biological concepts. The indicators consist of direct observation, indirect observation, awareness of scale, symbolic language, logical framework, logical inference, causal law, mathematical modeling and the ability to build concepts (Brotosiswoyo, 2001). In fact, not all indicators of generic science skills are met, especially in every learning process (Saptorini, 2008), so it is necessary to use interactive media such as videos and illustrations to maximize learning, the use of interactive multimedia is a factor that can improve students' generic science skills to the level of achievement and influence the acquisition of optimal cognitive learning outcomes (Farid & Leny, 2017).
In addition, learning outcomes refer to success in the standard test used (Mayer & Hurd, 2009) so that improving learning outcomes is related to students' cognitive mastery. Learning outcomes and generic science skills are shown in written tests that are interrelated with learning materials in class X SMA, so that the relationship between learning outcomes and students' generic science skills can be improved by implementing learning that is in accordance with the demands of technology, one of which is by using CLDW which is included in learning management systems. Therefore, there needs to be an effort made by the teacher so that the learning outcomes and generic science skills of students can be measured objectively and effectively in learning biology.

Method

This study uses a quasi-experimental model *nonrandomized control group pretest-posttest* (Goddard & Melville, 2004). Research design presented in Table 1. The independent variables of this research are CLDW LKPD Biology SMA, while the dependent variables of this research are learning outcomes, generic science skills and students' character. Meanwhile, in the study, the variable (covariance) was used, namely the initial ability of students before learning was carried out using CLDW.

Table 1
Quasi Experimental Research Design

Group	Pre-test	Treatment	Posttest
Experiment	O	X	O
Control	O	C	O

Research Set

This research was conducted in March-August 2021 at SMA/MA in South Kalimantan. Learning is carried out on 4 biology learning materials in class X SMA/MA. This research was carried out in class X MIA as many as 2 classes of 5 SMA in the even semester of the 2020/2021 academic year.

The data collection process at the school was carried out for 3 months. The meeting was held 4 times for each class. The population in this study were all students of class X from 6 SMA/MA with a total of 113 students who were divided into 2 experimental classes and 2 control classes.
The experimental class was taught using CLDW, while the control class was taught by biology teachers using conventional worksheets. Students in the experimental class are equipped with CLDW according to the prepared application, each containing 4 learning activities. Learning activity 1 with CLDW-LKPD on Ecology, learning 2 about Animals, learning 3 about Population Structure, and learning 4 about Environmental Change. The stages of completing the LKPD are adjusted to the learning syntax that raises the indicators of generic science skills and adapts to the learning objectives. The test uses mancova which consists of covariance, namely the initial knowledge of students, the dependent variable in the form of generic science skills and learning outcomes.

Results and Discussion

Results

a. The normality of the data associated with the multivariate normal distribution is an extension of the univariate normal distribution. In multivariate analysis, the assumption of normal multivariate is to ensure that the data used are normally distributed. The test results are presented in Table 2.

Table 2
Test results

Tests of Normality						
	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistics	df	Sig.	Statistics	df	Sig.
Learning outcomes	.103	113	.005	967	113	007
Science generic skills	.108	113	.003	965	113	.005
a. Lilliefors Significance Correction						

In the normality test above, the significance value of the Shapiro-Wilks test is more than the sig value, so the sample used in this study came from a normally distributed population.

b. Covariance matrix homogeneity test used on the dependent variable matrix between classes must be homogeneous. Based on the tests carried out using the Box's M test as presented in Table 3. The sig value is 0.103 which means that the three dependent variables have the same covariance variance matrix in the existing groups (occupations).

Table 3
Test results using Box's M test

Box's Test of Equality of Covariance Matricesa	
Box's M	10,877
F	1,759
df1	6
df2	80641.014
Sig.	.103
Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.	
a. Design: Intercept + TREATMENT + INITIAL CAPABILITY + TREATMENT * INITIAL CAPABILITY	

c. The homogeneity test of the variance equation related to the covariance requirements of all inter-class dependent variables must be homogeneous. The homogeneity of variance test was carried out using Levene's test with both results <0.05 thus proving that there was the same variance matrix, which is further presented in Table 4.

Table 4
Levene test results

	F	df1	df2	Sig.
Student learning outcomes	3.396	1	224	.068
Science generic skills	1,879	1	224	.173

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a. Design: Intercept + TREATMENT + INITIAL ABILITY + TREATMENT * INITIAL ABILITY

d. The similarity of the slope between treatments (Homogeneity of Regression Slopes)
At this stage depending on the decision criteria rejected if p_{value} the regression coefficient < a and H_0 is accepted if p_{value} the regression coefficient > a or in other words there is a similarity in the slope of the group (treatment), while the data can be shown in Table 5.

Table 5
The results of the similarity of the slope between treatments

Tests of Between-Subjects Effects						
Treatment * initial ability	**Dependent Variable**	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**sig**
	Student learning outcomes	1304.876	1	1304.876	3.930	.050
	Science generic skills	77.463	1	77.463	.469	.495

Based on the results in Table 5, it can be seen that the interaction between treatment and initial ability has a significance of 0.50 and 0.408, it is concluded that H_0 is accepted so that the treatment has the same regression slope.

e. Mancova Test

After the prerequisite test has been carried out, it is continued using the Mankova test as presented in Table 6. Controlling the students' initial abilities aims to explain the relationship and relationship to the dependent variable.

Table 6
Mancova test results on the variable

Effect		Value	F	Hypothesis df	df error	Sig.
Intercept	Pillai's Trace	.818	159,836b	3,000	107,000	.000
	Wilks' Lambda	.182	159,836b	3,000	107,000	.000
	Hotelling's Trace	4.481	159,836b	3,000	107,000	.000
	Roy's Largest Root	4.481	159,836b	3,000	107,000	.000
Treatment	Pillai's Trace	.165	7.056b	3,000	107,000	.000
	Wilks' Lambda	.835	7.056b	3,000	107,000	.000
	Hotelling's Trace	.198	7.056b	3,000	107,000	.000
	Roy's Largest Root	.198	7.056b	3,000	107,000	.000
Initial ability	Pillai's Trace	.084	3.266b	3,000	107,000	.024
	Wilks' Lambda	.916	3.266b	3,000	107,000	.024
	Hotelling's Trace	.092	3.266b	3,000	107,000	.024
	Roy's Largest Root	.092	3.266b	3,000	107,000	.024
Treatment initial ability	*Pillai's Trace	.039	1.444b	3,000	107,000	.234
	Wilks' Lambda	.961	1.444b	3,000	107,000	.234
	Hotelling's Trace	.040	1.444b	3,000	107,000	.234
	Roy's Largest Root	.040	1.444b	3,000	107,000	.234

a. Design: intercept + treatment + initial ability + treatment * initial ability
b. Exact statistics

Based on Table 6, it is known that through controlling students' initial abilities, the use of CLDW LKPD significantly affects the dependent variable in the form of learning outcomes and generic science skills. Decision making is based on the Wilks lambda column having a df of 107,000 with a sig value of 0.00 (<0.005). Meanwhile, to test the effect of each factor on the dependent variable, univariate data can be used by comparing the CLDW LKPD with the control class and the experimental class. The explanation of the Test of Between Subject Effect table can be seen in Table 7.

Table 7
Univariate on the dependent variable

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Student learning outcomes	12008.026a	3	4002,675	12.056	.000
	Science generic skills	15979.127b	3	5326.376	32,270	.000
Intercept	Student learning outcomes	40846,746	1	40846,746	123.025	.000
	Science generic skills	58056,455	1	58056,455	351,739	.000
Treatment	Student learning outcomes	4191,336	1	4191,336	12,624	.001
	Science generic skills	1453,338	1	1453,338	8.805	.004
Treatment * initial ability	Student learning outcomes	1304.876	1	1304.876	3.930	.050
	Science generic skills	77.463	1	77.463	.469	.495
Error	Student learning outcomes	36190.205	109	332.020		
	Science generic skills	17991,067	109	165,056		
Total	Student learning outcomes	532800,000	113			
	Science generic skills	519096.000	113			
Corrected Total	Student learning outcomes	48198.230	112			
	Science generic skills	33970.195	112			

a. R Squared = .249 (Adjusted R Squared = .228)
b. R Squared = .470 (Adjusted R Squared = .456)

Based on the value of the F test in the table above, it states the relationship between differences in learning outcomes in the class with treatment and control. Learning outcomes have an F value of 12.624 with a significance of 0.01 so that there is a significant difference in learning outcomes between the experimental class using CLDW and the control class significantly. The value of R adjusted square for learning outcomes is 22.8%.
In addition, the difference in treatment between the control and experimental classes affects the generic science skills of students, this can be seen from the F value of 8.805 with a significance of 0.04. The value of R adjusted square for science generic skills is 45.6%.

Discussion

Based on the test using Mancova, it is known that the use of CLDW LKPD significantly affects the dependent variable on students, namely learning outcomes and generic science skills starting with controlling the students' initial abilities.
The initial ability of students is measured before learning is carried out by giving a test containing material that will be given in class on the next material. In this process, it is possible to determine

the initial ability level of students to the depth of the material being taught. Control of initial abilities is important in influencing students when they get new information so that it is included in cognitive tests which play an important role in school programs (Davis et al., 2007). Initial ability related to prerequisite knowledge to take part in learning (Aliyah, Yuhana, & Santosa, 2019) so that the initial ability of students as a covariate can be used as a controller to the extent of the differences between the dependent variables.

Based on the average in both classes, it shows that the treatment class has a higher average value and is categorized as very good than the control class which has a lower average value. Each student has different generic science skills because the characteristics of these students are also different. Students who tend to be more active and respond to each material explained will have a better understanding of the material being taught. The use of LKPD based on generic science skills contains sheets that contain brief material, learning objectives, instructions on how to work on questions, and several questions that students must answer (Putra & Ekasari, 2018).

Learning outcomes are based on indicators set in learning, cognitive learning outcomes are part of the academic achievement test which aims to assess the achievement of graduate competency standards in certain subjects. HThe learning outcomes that have been achieved show their relationship with the ability to realize, understand and master a series of various forms of student activities (Putra & Hidayat, 2019). It meansIn learning, an important process is needed to understand concepts and construct knowledge (Utami et al., 2017).

The relationship between the dependent variable, namely generic science skills and student learning outcomes, shows various perspectives, such as from the cognitive domain, there is a strong relationship between science generic skills in both the experimental and control classes (Martiningsih, Situmorang, & Hastuti, 2018). In addition, the percentage of generic science skills increased followed by an increase in cognitive learning outcomes when implemented using a virtual laboratory in high school learning (Risna, Hamid, & Winarti, 2017). This is in accordance with the data from the test results between variables using the LKPD CLDW that significantly affects the dependent variable, namely generic science skills and learning outcomes by controlling the initial abilities of students. This is based on the wilks lambda column having a df of 107,000 with a sig value of 0.00 (<0.005). In addition, the univariate test shows that the F test value for the relationship between treatment differences and learning outcomes has an F value of 12.624 with a significance of 0.00 which means that there are differences in learning outcomes between the control class and the experimental class. Meanwhile, there are also differences in generic science skills in the two classes, which is indicated by the F score of 8805 with a significance of 0.04.

Things that support the use of CLDW LKPD affect the dependent variable, including content that is in accordance with learning objectives. The LKPD section consists of guiding questions that are presented in the form of open ended, namely by building open questions and the use of guiding questions. Procedurally, LKPD is a step-by-step problem-solving guide through discourse and discussion to strengthen the material learned (Putera, 2016).

The selection of CLDW supporting learning activities is arranged according to learning objectives such as in the quiz section, learning videos that are integrated with the YouTube platform with interesting audio and visuals, especially learning videos increase the attractiveness of learning (Harendra, Karyanto, & Muzzazinah, 2021). In addition, learning resources in the form of videos, websites and images on CLDW LKPD are a form of multimedia. Multimedia can be used to visualize a concept that cannot be observed directly as one of the generic indicators of science (Agustin, 2013). The use of multimedia involving animation and instruction is clearly relevant in the implementation of biology learning (Tsui & Treagust, 2013).

The implementation of learning is in accordance with the specified activities, and a clear time for collecting assignments can focus learning, especially in implementing online learning. Good learning implementation is one of the determinants of learning (Sholihan, 2021). In addition, learning can be equipped with chatrooms as learning assistance to facilitate more flexible and clear communication between teachers and students. This can hone communication skills even though it is not done face-to-face with students. Communication related to learning can be done by presenting the results of the discussion, answering questions and writing down the lesson with the final result of the discussion (Utami, 2019).

In addition, CLDW LKPD makes it easier for students to adapt to learning, because CLDW can be accessed repeatedly by students, this is known from the high accessibility of CLDW and is well structured and systematic. This is supported by the results of the statement by Putra and Hidayat (2019) that these activities can be reduced by giving students sufficient freedom or responsibility to carry out tasks and experiments and find their own work, but the teacher must also provide positive reinforcement when the result is correct and negative reinforcement when the result is incorrect. In addition, the use of learning methods, and the place in online learning affects learning satisfaction (Sadikin & Hamidah, 2020).

Based on the Mancova test, it is known that the value of R adjusted square in the univariate results of the two dependent variables is different. The value of R adjusted square for learning outcomes is 22.8%, while R adjusted for science generic skills is 45.6%. The adjusted R value means that the use of CLDW LKPD contributes 22.8% in improving learning outcomes, while the use of CLDW LKPD contributes 45.6% to the aspect of generic science skills during Biology learning. In learning there are other influences that can increase the results of the two dependent variables. Factors that influence online learning are a combination of internal and external factors so that the success of e-learning is important to analyze empirically (Zhang & Goel, 2011). Students who have these skills are in the skilled category, then the learning outcomes of knowledge and attitudes are also aligned or follow (Putra & Hidayat, 2019). The use of generic science skills in the learning process is adjusted to the material and learning process so that it is in accordance with the characteristics of students, then in terms of content has been completed according to the needs of students. Based on the results of the study, the use of CLDW can close the gap of generic science skills in learning outcomes between students.

Conclusion

Based on the discussion, it can be concluded that the use of CLDW significantly affects the dependent variable, namely learning outcomes and generic science skills of students after controlling for students' initial abilities. Based on the wilks lambda column which has a df of 107,000 with a sig value of 0.00 (<0.005). R adjusted shows that CLDW LKPD contributes 22.8% in improving learning outcomes while in the aspect of science generic skills, CLDW LKPD contributes 45.6% in increasing science generic skills. Further analysis of its influence should also add dependent variables related to external and internal learning factors or a combination of both.

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