Wimba learning strategy with PjBL model: How the effect student in excretory system concept?

Purwati Kuswarini Suprapto, Aji Riyanto*, Egi Nuryadin

Biology Education, Faculty of Teachers Training, and Education, Universitas Siliwangi, Indonesia

*Corresponding author: ajiriyanto1996@gmail.com

Abstract

This research aims to determine the effect of wimba learning strategies with PjBL (project-based learning) models toward student learning outcomes on the excretory system material. This research was conducted in September 2018 until September 2019. The research method used a true experiment with a population of all class XI in one of the State High School of Tasikmalaya City Indonesia, with eight classes with 288 students. The samples used were two classes taken by random cluster sampling, namely XI mathematics and science 1 (XIMS-1) class with 36 students (M=18, F=18) as a controller class and XI mathematics and science 4 class with 36 students (18 student male and 18 student female) as an experimental class. The research instrument was in the form of a multiple-choice written test totaling 30 questions. Based on the study results, data analysis using the ANCOVA test showed that the wimba learning strategy with the project-based learning model significantly improves students' understanding and analyzing concepts of the excretory system with p-value 0.002. These results are viewed from indicators of learning outcomes. The average score of N-Gain learning outcomes of students in the experimental class on the cognitive aspects of C1, C2, C4, and C5 have N-Gain better than the control class. This learning strategy was appropriate for learning biology that can make students more active in the learning process.

Keywords:
Excretory System
Learning Strategy
PjBL
Wimba

Article Info

Article History
Received: 25 September 2019
Revised: 26 June 2020
Accepted: 5 October 2020

Keywords:
Excretory System
Learning Strategy
PjBL
Wimba

© 2020 Universitas Negeri Jakarta. This is an open-access article under the CC-BY license (https://creativecommons.org/licenses/by/4.0)

INTRODUCTION

In the 2013 Curriculum, students are no longer the learning object, but students are the central learning (Djamahar, Ristanto, Sartono, Ichsan, & Muhlisin, 2018; Hairida, 2016). The 2013 curriculum emphasized exercising the students to their three core competencies, covering cognitive, affective, and psychomotor competence. Students work together to conduct research, apply logic and reasoning, and devise solutions to complex problems (Leasa, Sanabuky, Batlolona, & Enriquez, 2019; Öztürk & Korkmaz, 2019). The 2013 curriculum requires students to be active in the learning process, and the project-based learning (PjBL) model is one of them.

Project-Based Learning (PjBL) can increase students’ learning motivation, increase student activity, improve student skills, develop and practice communication skills in cooperative working groups, and give students opportunities to organize projects (Permana & Chamisijatin, 2018; Tsai, Shen, & Lin, 2014). The 2013 curriculum in implementation uses the scientific method; the scientific method emphasizes students’ activeness in constructing a concept in the learning process (Djamahar et al., 2018; Wahyu, 2017). In addition to choosing the right learning model, applying learning strategies applied by a teacher is very influential for their students.

Learning strategy is a learning activity that must be done by teachers and students so that learning objectives can be achieved effectively and efficiently (Rusman, 2016; Chiang, Fan, Liu, & Chen, 2016; Oghenevwede, 2019). A learning strategy is a learning activity that needs to be carried out by teachers and students to achieve learning objectives. Learning strategies are the methods chosen to convey subject matter in a particular learning environment, including the nature, scope, and sequence of activities that can provide learning experiences to students. Learning strategies can be interpreted as each activity chosen, which can provide students with facilities or assistance to achieve individual learning goals (Lai & Hwang, 2016; Özsevgeç, Artun, & Ünal, 2012). One of the learning strategies suitable to be combined with PjBL is the Wimba learning strategy because, in the learning process, through material and practicum delivery.

Wimba model learning strategies implemented in two stages, namely face to face learning and practicum. The approach used is deductive and inductive (Suprapto, Chaidir & Ali, 2019). Wimba model learning strategies are very suitable for using the scientific method. The scientific method itself is closely related to science. It is studied so that humans can understand the natural processes associated with life, besides science, require facts, and combine logic with imagination. The example is Biology (Suprapto et al., 2012). Wimba itself in the learning process is based on visuospatial. They are starting with making concept maps, making 2D drawings, 3D drawings, and then making concrete 3D. It can develop mastery of the material while presenting from 2D images, 3D images, and then to 3D Congkret (Suprapto et al., 2019; Suprapto, 2018).

Biology as a science has its uniqueness compared to other sciences (Ormanaç & Ören, 2011; Ristanto, Zubaidah, Amin, & Rohman, 2018; Styers, Van Zandt, & Hayden, 2018). Biological science products are a tangible collection of facts and concepts resulting from scientific processes (Goode & Halbritter, 2019; Inayah, Ristanto, Sigit, & Miarsyah, 2020; Sudjoko, 2001). In biology, imagination is necessary. Without imagination, it will be challenging to link each organ’s structure and function in the system. The imagination can then be presented by constructing a 3D image based on visuospatial (Ibrahim & Achmad, 2013). Spatial intelligence or visual-spatial intelligence is the ability that allows visualizing information and synthesizing data and concepts into visual or picture metaphor (Suprapto et al., 2012).

The ability of visuospatial representation is a person’s ability to understand and comprehend concepts through visual representation related to spatial learning and doing tasks (Dewiyanti & Kommers, 2005; Markowitz, Laha, Perone, Pea, & Bailenson, 2018; Suprapto, 2016). Therefore, during the learning process, visuospatial abilities are needed by students to
be able to help the process of absorbing material related to the system that occurs in the human body. In contrast, the process of imagination requires visuospatial abilities. To facilitate students to engage their visuospatial abilities to create their imagination when learning (Atikah et al., 2018; Dewiyanti & Kommers, 2005).

Based on an interview with a Biology teacher from one of the State High Schools in Tasikmalaya City, Indonesia, on 21 September 2018, the problem that arose in students in the learning process was the lack of students’ ability to imagine the material presented. For example, in the excretory system material in the formation of urine, students’ ability to imagine it so that more leverage needs to be assisted with pictures or videos will certainly reduce the students’ understanding of the material. Misunderstanding about the material will undoubtedly have an impact on the learning outcomes of students themselves (Yunanda, Susilo, & Ghofur, 2019; Zulfia, Susilo, & Listyorini, 2019). This research aimed to analyze the influence of the wimba learning strategy with the PjBL model in excretory system concepts.

METHODS
Research Design

The research method used is a real experiment. This method is considered promising because of the control class and the experimental class (Arikunto, 2013). The research method used a real experiment because it can control all external variables that affect the experiment (Sugiyono, 2017). The research design used in this study was the pre-test post-test control group design (Sugiyono, 2017). There are two groups chosen randomly in this design. Then, given a pre-test to determine the initial conditions, there is a difference between the experimental and control groups. Good pre-test results if the value of the experimental group is not significantly different. The arrangement of research patterns in a real experiment by Sugiyono (2017) can be seen in Table 1.

Table 1
Pretest-postest control group design

<table>
<thead>
<tr>
<th>Classes</th>
<th>Pretest</th>
<th>Treatment</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment</td>
<td>0₁</td>
<td>X₁</td>
<td>0₂</td>
</tr>
<tr>
<td>Control</td>
<td>0₂</td>
<td>X₂</td>
<td>0₄</td>
</tr>
</tbody>
</table>

Description:
- X₁: Wimba Learning Strategy with PjBL Model
- X₂: Cooperative Learning Strategy with PjBL Model
- 0₁: Pre-test of the experimental group
- 0₂: Post-test of the experimental group
- 0₄: Post-test of the control group

Population and Sample

This study's population was 288 eleven grade students in one of the state high schools relatively far from the center of Tasikmalaya City, Indonesia, in the 2018/2019 academic year. The sample in this study was taken using cluster random sampling technique. The steps taken by the author in sampling are doing the randomization process from eight population class (Table 2).

Table 2
Number of samples, each class

<table>
<thead>
<tr>
<th>Treatment Class</th>
<th>Class</th>
<th>Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment</td>
<td>XI mathematics and science 1 (XIMS-1)</td>
<td>36</td>
</tr>
<tr>
<td>Control</td>
<td>XI mathematics and science 1 (XIMS-4)</td>
<td>36</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>72</strong></td>
</tr>
</tbody>
</table>
Instrument

Based on the validity test results using Anates application, the research instruments used in this study were 30 multiple choice questions from 50 questions validated using Anates apps ver 4.0.9. Furthermore, the reliability test measured using Alpha Cronbach obtained a value of 0.89, which meant that the instruments were reliable. These instruments used to measure student learning outcomes based on Revised Bloom’s Taxonomy indicators, namely remembering, understanding, applying, analyzing, and evaluating. (Table 3).

Table 3
Learning output indicators in excretory system concept.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
<th>Number of questions</th>
<th>Sample of Question</th>
</tr>
</thead>
</table>
| Remembering  | Explain factual answers, test memory, and recognition                      | 12                  | The process of removing metabolic waste substances that are not useful for the body and excreted with urine, sweat, and respiratory air is called.  
  a. Secretion  
  b. Respiration  
  c. Excretion  
  d. Expiration  
  e. Reabsorption |
| Understanding| Translate, describe, interpret, or simplify.                                | 6                   | The following statements that are not related to the human excretory system are  
  a. The kidneys excrete urine  
  b. The lungs excrete water  
  c. The lungs secrete bile  
  d. The skin sweats  
  e. The liver secretes bile |
| Applying     | Understanding when to apply, why to apply, and recognizing patterns of application to new, unusual and different situations. | 8                   | If the urine has just been issued, the physical form that should be shown is…  
  a. Odorless and colorless  
  b. Colorless and odorless  
  c. Odorless and colorless  
  d. Smells and colors  
  e. Everything is correct |
| Analyzing    | Breaking down into sections, shapes and patterns                            | 20                  | The statement below which does not correspond to the above organs is…  
  a. Emits residual gases such as CO2 and H2O  
  b. Located in the abdominal cavity to the right under the diaphragm  
  c. Protected by a thin membrane called the hepatic capsuled.  
  d. Excreting bile, residual substances from the breakdown of damaged red blood cells  
  e. Antidote |
| Evaluating   | Based on the                                                                | 39                  | When our body temperature increases, |

10.21009/biosferjpb.v13n2.292-306 Suprapto et al E-ISSN: 2614-3984 295
<table>
<thead>
<tr>
<th>Criteria and stating why</th>
<th>the blood vessels in the skin will widen, the statement is</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Urine formation process</td>
<td></td>
</tr>
<tr>
<td>b. Metabolic process</td>
<td></td>
</tr>
<tr>
<td>c. Sweat formation process</td>
<td></td>
</tr>
<tr>
<td>d. Osmoregulation process</td>
<td></td>
</tr>
<tr>
<td>e. Augmentation Process</td>
<td></td>
</tr>
</tbody>
</table>

**Procedures**

Before excretory system learning was conducted, students in the experimental and control classes were given a pre-test to measure their initial ability. The experimental class was then taught using Wimba learning strategy with the PjBL model in the first, second, and third meetings. Students are assigned to make groups and design projects in the first meeting. Then students are assigned to present the progress of the project they made in the second meeting. And then, students present the final product they made in the third meeting. The application steps refer to Suprapto (2016), as indicated in Figure 1. On the other hand, the control class was taught using a cooperative learning strategy with a project-based learning model. The post-test of learning outcomes was then given to the experimental and control classes.

**Figure 1.** Wimba learning strategy.

**Data Analysis**

Data were analyzed using the prerequisite analysis and hypothesis test. The normality test was analyzed by the Kolmogorov-Smirnov test with a significance level of 5% or 0.05, and then for homogeneity test was analyzed by the Levene test with a significant level of 5% or 0.05, and then for hypothesis were analyzed using ANCOVA and showed that the significance level in the corrected model.
The normality test was analyzed by the Kolmogorov-Smirnov test with a significance level of 5% or 0.05. Data is normally distributed if the significant value or Asymp.Sig (2-tailed) value is more than 5% or 0.05. The data obtained in the experimental class (Table 4) that Asymp.Sig (2-tailed) values 0.200 (Pretest) and 0.076 (Posttest). While in the control class, the Asymp.Sig (2-tailed) values of 0.060 (Pretest) and 0.066 (Posttest) were obtained. Each data value in both classes is normally distributed because both classes’ data values have Asymp. Sig (2-tailed) is greater than the significance level of 5% or 0.05.

The homogeneity test was analyzed by the Levene test with a significant level of 5% or 0.05. Data is said to be homogeneity if the significance value or Asymp.Sig (2-tailed) value is more than 5% or 0.05. They tested the homogeneity of the data to measure the ability to think critically using SPSS version 23. Based on the results of the homogeneity test (Table 5), it can be concluded that the two data group which from the post-test score is homogeny.

### RESULTS AND DISCUSSION

The teacher gives a pre-test to measure how students understand the material to be learned in the first experimental class’s lesson. Then the teacher gives a video about the excretion system material that aims to stimulate students to find problems from the video that has been shown. After that teacher divides students into four groups and divides the width of student work and explains how the student worksheets are done, and at the end of the lesson, the teacher assigns students to make a concept map that will be presented at the next meeting.

At the second meeting, the teacher asked student representatives to present their concept maps in front of their friends. Then the teacher gives his comments on the concept map student has made. Besides that, the teacher also asked each group to present their product. Each group was assigned to make four products, namely 2D drawings and 3D drawings of excretory organs, and 3D from the 2D and 3D drawings they had made. Furthermore, at the third meeting, each group presented the products made by them and discussed each other's products about the products made between groups. Moreover, at the end of the lesson teacher gives conclusions about their products and ends with implementing the post-test.

Based on the results of the learning process of the experimental class using wimba learning strategies with project-based learning models, the output obtained in the form of 3D organs of the excretory system made by students (Figure 1). The teacher gives a pre-test to measure how students understand the material to be learned in the first experimental class’s lesson. Then the teacher gives a video about the excretion system material that aims to stimulate students to find problems from the video that has been shown. After that teacher divides students into four groups and divides the width of student work and explains how the

<table>
<thead>
<tr>
<th>Data</th>
<th>Asymp.Sig (2-tailed)</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest Experiment Class</td>
<td>0.200</td>
<td>Normal</td>
</tr>
<tr>
<td>Posttest Experiment Class</td>
<td>0.076</td>
<td>Normal</td>
</tr>
<tr>
<td>Pretest Control Class</td>
<td>0.060</td>
<td>Normal</td>
</tr>
<tr>
<td>Posttest Control Class</td>
<td>0.066</td>
<td>Normal</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>df1</th>
<th>df2</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.054</td>
<td>1</td>
<td>70</td>
<td>0.818</td>
</tr>
</tbody>
</table>

**Table 4**
The result of normality test

**Table 5**
The result of homogenity test
student worksheets are done, and at the end of the lesson, the teacher assigns students to make a concept map that will be presented at the next meeting.

At the second meeting, the teacher asked student representatives to present their concept maps in front of their friends. Then the teacher gives his comments on the concept map student has made. Besides that, the teacher also asked each group to present their product. Each group was assigned to make four products, namely 2D drawings and 3D drawings of excretory organs, and 3D from the 2D and 3D drawings they had made. Furthermore, at the third meeting, each group presented the products made by them and discussed each other's products about the products made between groups. Moreover, at the end of the lesson teacher gives conclusions about their products and ends with implementing the post-test.

Based on the results of the learning process of the experimental class using wimba learning strategies with project-based learning models, the output obtained in the form of 3D organs of the excretory system made by students (Figure 1).

Figure 2. Concrete 3D made by students regarding the excretory system organ; (a) liver, kidney, lung and skin organs made by groups 1, (b) liver, kidney, lung and skin organs made by groups 2.

Concrete 3D formation using wax is used to improve understanding of concepts and train students' spatial-visual abilities. Making 3D Concrete using wax can stimulate students to examine the extent of mastery of the concept, judging by the exact structure, shape, and location of the organ. Based on students' 3D Concrete results, there are still less delineated parts, such as lobes found in the lungs, kidney organs appear from within, and parts of the skin layer (Figure 2.a). Also, giving color to the organ's kidney and liver is still not quite right (Figure 2.b). However, based on the hypothesis test analysis, differences in students' learning outcomes before and after being given treatment using the wimba learning strategy with the project-based learning model.

Table 6
The result of hypothesis test

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>44,703^a</td>
<td>2</td>
<td>22,352</td>
<td>6,625</td>
<td>.002</td>
</tr>
<tr>
<td>Intercept</td>
<td>948,186</td>
<td>1</td>
<td>948,186</td>
<td>281,038</td>
<td>.000</td>
</tr>
<tr>
<td>Postest</td>
<td>17,814</td>
<td>1</td>
<td>17,814</td>
<td>5,280</td>
<td>.025</td>
</tr>
<tr>
<td>Strategi</td>
<td>40,242</td>
<td>1</td>
<td>40,242</td>
<td>11,928</td>
<td>.001</td>
</tr>
<tr>
<td>Error</td>
<td>232,797</td>
<td>69</td>
<td>3,374</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39198,000</td>
<td>72</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>277,500</td>
<td>71</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. R Squared = ,161 (Adjusted R Squared = ,137)
The hypothesis was analyzed using ANCOVA. All data analyzes were performed using SPSS for Windows version 23. The ANCOVA Test summary data analysis (Table 6) showed that the significance level in the corrected model was 0.002. Because the significance value is far below 0.05, then Ho is rejected. Based on this result, the Wimba Learning Strategy with Project-Based Learning Models significantly influences learning outcomes. Based on the next ANCOVA test (Table 6) obtained a significant value of 0.004 on learning outcomes, the conclusion of the hypothesis that can be rejected is Ho because of the results of a significant value of less than 0.005. This result shows that the wimba learning strategy with the project-based learning model can improve student learning outcomes in the material excretion system. The statement can be observed descriptively in the comparison of the average score of the pre-test, post-test, and N-gain learning outcomes of students in the experimental class and the control class (Figure 3).

![Figure 3](image-url)

**Figure 3.** The difference in increase Learning Outcomes of Students in Experiment and Control Classes

In comparing the average scores, the experimental class obtained learning outcomes of 0.52 using the Wimba learning strategy with a project-based learning model looks better than the control class that obtained learning outcomes of 0.39 using the cooperative learning strategy with the project-based model learning. These influences are due to the wimba learning strategy related to the ability to imagine information or knowledge that can then be presented by constructing visuospatial-based 3D images. One of the visuospatial abilities is obtained through groups (Dewiyanti & Kommers, 2005; Markowitz et al., 2018), so students can more actively discuss drawing 2D and 3D organs.

Visuospatial representation has a role in increasing students’ conceptual (Valai, Schmidt-Crawford, & Moore, 2019; Atikah et al, 2018). This development is due to the influence of PjBL. Students who are facilitated by Project Based Learning display better mastery of concepts compared to students who are facilitated by conventional learning, so the results learning of students who are facilitated by Project Based Learning is more improved than those not facilitated by Project Based Learning (Mahanal, 2010).

Wimba learning strategy with the PjBL model begins with observation through practical activities and the assignment of concept maps by compiling information about the material to
be studied. The step of making concept maps aims to compile the information received about the excretion system’s material to be studied so that students already understand the concept through the concept map they are making. Concept maps are two-dimensional hierarchy diagrams that reflect how knowledge is organized (Chiang et al., 2016; Davies, 2011; Kostova & Radoynovska, 2010). The concept map aims to get prior knowledge while strengthening students’ concepts or knowledge (Akyol, Sungur, & Tekkaya, 2010; Großmann & Wilde, 2019; Hadjichambis, Georgiou, Paraskeva-Hadjichambi, Kyza, & Mappouras, 2016; Suprapto, 2012). Concept maps are often used to assist in the clarification, consolidation, and strengthening of knowledge (Akyol et al., 2010; Hadjichambis et al., 2016). The concept map that has been made is then presented to check the extent of the reinforcement of the concept of knowledge and clarify the wrong concepts to students in the excretion system material. Based on the results of the concept map presentation, there are still misconceptions among students. Furthermore, to see the improvement of each Indicator of learning outcomes. The average N-Gain of students in the experimental class using the Wimba learning strategy with the project-based learning model and the control class using the cooperative learning strategy with the model PjBL is seen in Figure 4.

![Figure 4: The difference in the increase in indicators Learning Outcomes pre-test and posttest](image)

From comparing the average N-Gain on the aspect of indicators of student learning outcomes, Based on these pictures above, it can be concluded that the average score of N-Gain learning outcomes of students in the experimental class (the cognitive aspects of C1, C2, C4, and C5) better than the control class.

Model-VS with Inductive-Image (IG) treatment can develop Understanding (C2), in addition to the ability to remember (C1) and evaluate (C5) developed very well in the Inductive-Playdoh (IP) treatment. In contrast, the ability to apply develops from Deductive-Image (DG). The highest average N-Gain score in the experimental class is in the cognitive aspects of understanding (C2) and analyzing (C4). This aspect due to the assignment of a concept map that can improve students’ understanding of the concept (Lampert, Müllner, Pany, Scheuch, & Kiehn, 2020; Lancor, 2014). The initial learning process begins with practical activities by observing 2D images and 3D images of the excretory system or becomes one of the things that can improve students’ understanding. Moreover, the learning process that starts with practical activities will be easier to remember (Duda, Susilo, & Newcombe, 2019). Visual illustrating is involving the ability of information analysis and processing (Akyol et al., 2010; Hadjichambis et al., 2016). Thus, this learning model better improves in the higher level of the cognitive domain. It proved that the visuospatial representation support student to higher thinking ability as analyzing...
(Atikah, 2018; Hadjichambis et al., 2016).

The average N-Gain score in the experimental class has the lowest average score on the cognitive aspect of C3 that is applying. The control class has the lowest average score on the cognitive aspect of C1 that is remembering. The experimental class that uses Cooperative Learning Strategies with Project-Based Learning models gets the lowest N-Gain scores in C1 because students cannot remember the learning material in the learning process. Whereas in the experimental class, the low cognitive aspect of C3 is because students still lack in applying, applying concepts, and developing concepts. So, when drawing organs and forming organs with candles, there is still a wrong concept. From this, it can be concluded that with the Wimba Learning Strategy with PjBL, the results are significant and influential in improving the cognitive aspects of learning outcomes.

CONCLUSION

This study concludes that the Wimba Learning Strategy with PjBL Model influences students’ learning outcomes in the excretion system material in class XI, one of the State High Schools in the City of Tasikmalaya Indonesia Academic Year 2018/2019. The findings in this study indicate that the Wimba learning strategy with the PjBL Model significantly improves students’ ability to understand and analyze concepts. These findings are viewed from indicators of learning outcomes. The average score of N-Gain learning outcomes of students in the experimental class on the cognitive aspects of C1, C2, C4, and C5 have N-Gain better than the control class N-Gain. Nevertheless, it needs to be prepared to implement Wimba Learning Strategy with PjBL models so that teachers and students can maximize the learning steps to achieve the objectives in implementation.

ACKNOWLEDGMENT

The authors would like to convey our sincere gratitude to Mr. Anda Sujana as the school principal, Mrs. Tuti Hermawati, as a biology teacher, and students who are permitted to conduct the research.

REFERENCES


Öztürk, Ç., & Korkmaz, Ö. (2019). The effect of gamification activities on students’ academic achievements in social studies course, attitudes towards the course and cooperative learning skills. Participatory Educational Research, 7(1), 1–15. https://doi.org/10.17275/per.20.1.7.1


