Enhancing students’ biological diversity learning outcomes through video assisted problem-based learning

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Abstract. Learning outcomes are abilities possessed by students after receiving their learning experiences. One way to improve students’ learning outcomes is by using video-assisted Problem Based Learning. This research aims to examine the increase in students’ learning outcomes by using video-assisted Problem Based Learning in biodiversity topic. This research used a quantitative approach. This study employed an experimental research method with a pretest-posttest control group design. The population of this study was 108 students from two public senior high schools in Banda Aceh, and they were selected by random sampling. Data about motivation was collected by distributing ARCS questionnaires while students’ learning outcomes were obtained through administering pretest and posttest in objective forms. The finding of this study suggested that students’ learning outcomes of the first high school are $Z_{\text{count}} > Z_{\text{table}}$ (2.437 > 1.96); whereas the students’ learning outcomes of the second-high school is $Z_{\text{count}} > Z_{\text{table}}$ (3.679 > 1.96). Thus, it is concluded that the implementation of video-assisted Problem Based Learning can enhance students’ learning outcomes on biodiversity topics at two public senior high schools in Banda Aceh.

1. Introduction
According to [1] success of someone’s learning is influenced by various factors. These factors are then divided into two, namely factors originating from students (internal factors) and factors originating from outside of students (external factors) including social and non-social environment as well as learning approach that is the way the teachers teach using the method, model, and learning media.

Teachers have important roles in determining the quality and quantity of learning. A good teacher must be able to master learning materials, have good teaching skills, and are able to create an interesting teaching atmosphere so that students are active during the teaching and learning process. Thus, biology teachers need to master biology materials more deeply with models and good teaching skills.

According to results of observational studies at public senior high schools in Banda Aceh, it was found that students’ learning outcomes on biology subject on biodiversity topic are relatively low which is below minimal completeness criteria where most of the students only obtain 55-65 meaning that the scores do not meet minimal completeness criteria. This condition will affect students’ achievements where most students do not meet the minimum completeness criteria that have been set (70), particularly on a biodiversity topic.
One way to achieve learning objectives is through using video and various learning models so that students can complete tasks or questions related to problems. One of the learning models that meet the criteria is a video-assisted Problem Based Learning model.

The use of media integrated with Problem Based Learning model in learning will use the problem as a focus to develop problem-solving skills, materials, and self-regulation. It will also make students take over responsibilities in their own learning in order to obtain wider benefits. Moreover, students can express and increase their abilities such as communication skills, group work, and problem-solving to understand concepts and material taught. In addition, the use of video in biology learning aims to attract students’ attention and interests to improve their learning outcomes.

The biodiversity topic is one of the biology topics taught in senior high schools. The topic discusses various types of biodiversity levels. It is difficult for students to distinguish the diversity level of living things around since teachers only teach through lectures which make students confused to imagine without looking directly at the problems that exist in the environment. The activity is expected to improve students’ learning outcomes by using video to achieve learning objectives.

Hence, researchers design a way through using media integrated with problem-based learning to improve students’ learning outcomes on biodiversity topics in two public high schools in Banda Aceh.

2. Method

The study applied an experimental method with a pretest-posttest control group design [2]. The design is illustrated in Table 1. The study was conducted in two public senior high schools in Banda Aceh from September to October 2018. The Population was all year 10 students in science program (298 students) from two public senior high schools in Banda Aceh. The sample used was random sampling. The research subjects were 108 students from 2 groups (control and experiment) of year 10 students in science program from each school.

| Group   | Pretest | Treatment | Posttest |
|---------|---------|-----------|----------|
| Experiment | O1      | X1        | O2       |
| Control   | O3      | X2        | O4       |

Description:

- $X_1$ = Learning with video assisted Problem Based Learning
- $X_2$ = Learning with conventional learning model
- $O_1$ = Pre-test score of experimental class
- $O_2$ = Post-test score of experimental class
- $O_3$ = Pre-test score of control class
- $O_4$ = Post-test score of control class.

Students were divided into two groups; a control group and an experimental group. The experimental group was taught using video-assisted problem-based learning while the control group was taught using a conventional learning model (lectures, discussions, questions, and answers) conducted according to syntaxes in Figure 1.

1. Introduce problems to students
2. Organize students to learn
3. Assist independent and group investigations
4. Complete students’ worksheets
5. Analyze and evaluate problem solving process

**Figure 1.** Stages of Problem Based Learning

The instrument of students’ learning outcomes was students’ written tests; an objective test regarding biodiversity topic which consists of 40 questions. The test was delivered before the learning process (pretest) and after the learning process (posttest). Data was collected through pretest and
posttest scores from control and experimental groups. Pretest and posttest scores were tabulated and counted *normalized gain* (*n* gain) using the formula from [3] as follows:

\[
N_{\text{Gain}} = \frac{\text{Posttest Score} - \text{Pretest Score}}{\text{Maximum Possible Score} - \text{Pretest Score}} \times 100
\]

The increase in students’ learning outcomes was assessed through counting *normalized gain* (*n* gain) while to compare the increase in students’ learning outcomes, two different tests were conducted using *Mann Whitney Test*.

3. **Result and Discussion**

3.1. **Students’ initial score**

Before starting a lesson, it is important to identify students’ initial knowledge through administering pretest. The results of students’ pretest in control and experimental classes can be seen in Table 2.

| School                  | Class | Average | Normality           | Homogeneity | Significance       |
|-------------------------|-------|---------|---------------------|-------------|--------------------|
| Senior High School 5    | Con   | 38.72   | X² score (9.410) > X² table (5.991) (Normal) | F_{hit} (1.16) < F_{tab} (2.07) | **Z_{score} (-0.070) > Z_{table} (1.96)** |
|                         | Exp   | 37.90   | X² score (1.448) < X² table (5.991) (Normal) | F_{hit} (1.02) < F_{tab} (1.82) | **Z_{score} (0.449) < Z_{table} (1.96)** |
| Senior High School 8    | Con   | 41.05   | X² score (11.58) > X² table (5.991) (Non normal) | F_{hit} (1.36) < F_{tab} (2.07) | **Z_{score} (2.437) > Z_{table} (1.96)** |
|                         | Exp   | 60.93   | X² score (3.316) < X² table (5.991) (Normal) | F_{hit} (1.76) < F_{tab} (1.82) | **Z_{score} (3.679) > Z_{table} (1.96)** |

* Normality Test, X² count < X² table  
** Homogeneity Test, F count < F table  
*** U Mann Whitney, large sample size (*Z_{hit} > Z_{table})*

Based on the pretest conducted in two public senior high schools in Banda Aceh (Table 1), it shows that H0 is accepted and Ha is rejected; in other words, students’ initial knowledge in experimental class and control class are similar. Next, an analysis of the average N gain score is performed to see the increase in students’ learning outcomes.

3.2. **Students’ final score**

The post-test is administered at the end of the teaching and learning process. The test is conducted to identify students’ level of understanding toward the materials that have been taught in the experimental and control class.

| School                  | Class | Average | Normality of   | Homogeneity | Significance       |
|-------------------------|-------|---------|----------------|-------------|--------------------|
| Senior High School 5    | Con   | 46.03   | X² hit (13.38) > X² tab (5.991) (Not Normal) | F_{hit} (1.80) < F_{tab} (2.07) | **Z_{hit} (2.437) > Z_{tab} (1.96)** |
|                         | Exp   | 60.28   | X² hit (0.696) < X² tab (5.991) (Normal) | F_{hit} (1.76) < F_{tab} (1.82) | **Z_{hit} (3.679) > Z_{tab} (1.96)** |
| Senior High School 8    | Con   | 41.05   | X² hit (11.58) > X² tab (5.991) (Tidak Normal) | F_{hit} (1.76) < F_{tab} (1.82) | **Z_{hit} (3.679) > Z_{tab} (1.96)** |
|                         | Exp   | 60.93   | X² hit (3.316) < X² tab (5.991) (Normal) | F_{hit} (1.76) < F_{tab} (1.82) | **Z_{hit} (3.679) > Z_{tab} (1.96)** |

* Normality Test, X² count < X² table  
** Homogeneity Test, F count < F table  
*** U Mann Whitney, large sample size (*Z_{hit} > Z_{tab})*
Based on the result of N Gain test conducted at two public senior high schools in Banda Aceh (Table 3), it reveals that H0 is rejected and Ha is accepted. The result indicates that there is a significant difference in students’ learning outcomes between the experimental and control class meaning that the use of video media integrated with Problem Based Learning can enhance students’ learning outcomes in the experimental group compared to students in control group who were taught using conventional learning on a biodiversity topic. The result of the posttest can be seen in Table 3.

The results obtained by students are strongly influenced by the learning process that has been conducted. The difference in the average N gain score of students’ learning outcomes shows that the achievement of students’ learning outcomes in the experimental class is better than the control class. This confirms that the problem-based learning model is more effective to use in the learning process. This is in line with [4] finding stating that PBL emphasizes learning more as a process that involves problem-solving and critical thinking in actual contexts. PBL also gives students the opportunity to learn broader things focusing on preparing students to become active and responsible citizens. Through PBL students also gain experience in dealing with realistic problems, and emphasize the use of communication, collaboration, and available resources to formulate ideas and develop reasoning skills.

Problem Based Learning has a strong effect on learning and achievement compared to other approaches where learning is not based on problem-solving. Students who were taught using the PBL model have shown better learning compared to students taught in the controlled classroom where problems are not the focus and students are not encouraged to use their prior knowledge [5]. This condition is certainly in accordance with the objectives of using the PBL model which will produce meaningful learning for students who learn to solve problems by perceiving all the knowledge and abilities they have. At least by using PBL students try to pursue the knowledge they need in order to make the learning process be more meaningful. This idea is supported by the previous study conducted by Samsulimi [6] arguing that Problem Based Learning model can improve students’ learning outcomes and motivation on the human digestive system topic for year 11 students.

The study revealed that the PBL model can enhance students’ learning outcomes in cognitive, affective, and psychomotor aspects [7]. Argued that there is a significant increase in the understanding of physics concepts among students who were taught using Problem Based Learning model-assisted video-based laboratory with an average score of 69.28. This shows that the average of students’ understanding of concepts is high; hence, the problem-based Learning model has a positive influence on students’ understanding of concepts and their learning outcomes [8].

Problem Based Learning is a learning model that requires students to work on problems to compile their own knowledge, develop inquiry and think higher, develop independence and confidence, and students use their skills such as working together in problem-solving. Furthermore, the syntax of the PBL model is: 1) Orientate students to learn, 2) Organize students to learn, 3) Help independent and group investigation, 4) Develop and present students’ work, 5) Analyse and evaluate the problem-solving process. Moreover, problems used in Problem Based Learning are problems experienced in the real world although individual abilities are demanded each student; however, in the learning process in Problem Based Learning students learn in a group to understand the problems, then students learn individually to obtain additional information related to problem-solving. Furthermore, teachers’ roles in problem-based learning are facilitators in the learning process. The strengths of problem-based learning model are being realistic with students’ lives the concept which is in accordance with students’ needs, developing students’ inquiry, students’ conceptual memory becomes strong, and developing problem-solving abilities.

The increase in students’ learning outcomes (see table 3) is strongly influenced by the implementation of Problem Based Learning model where the students are actively involved in finding information to find solutions to problems in accordance with the hypothesis. The students work in contextual problems; so, they have the opportunity to implement the concept to the real situation through analysing the facts or phenomena in real life. Students can work in groups to find solutions in solving problems to stimulate interaction and discussion in the learning process; therefore, it becomes
possible to increase students’ understanding through the explanation gained between students, students with learning resources, and students with teachers. Problem Based Learning requires students to identify problems, explore problems through questioning problems, then the students decide what to do to solve the problems.

Through video-assisted problem-based learning, students are involved in solving problems in groups. Students also obtain information regarding stages of problem-solving pattern beginning with problem orientation, analysis, plan, problem-solving, and structured assessment in each step of implementation in order to enhance students’ learning outcomes. In the teaching and learning process, students work on students’ worksheets and they are required to find their own concept regarding biodiversity topic.

Students plan what strategies will be used and how long will it take to solve problems such as designing how to solve problems, conducting group discussion in order to obtain solutions to various ideas, answers or questions through different point of views, gathering as many alternative solutions as possible through empirical data and facts, and evaluating the result of problems solving by presenting in groups in front of the class.

Through video-assisted problem-based learning, teachers act as facilitators and motivators to help students in problem-solving. Moreover, teachers give guidance in implementing discussion activities and the use of learning videos. Students are also given the opportunity to ask if they have difficulty. Thus, students can understand more easily the material taught which will improve their learning outcomes. The idea is similar to [9], opinion arguing that Problem Based Learning make students be independent learners in problem-solving.

Problem Based Learning model is effective to be integrated with other learning media since it supports the process of students’ initial development, brings up ideas in problem-solving and links between learning materials and problems in everyday life. One of the media is a video in which it is a media that can be used to convey learning messages. There are two complemented elements in the video, namely audio and visual element. Through audio element students are expected to be able to receive and understand the learning messages through listening; whereas, the visual element enables students to create learning messages through visualization. The combination of audio and visual elements tends to make students easy to remember and understand a lesson. Teachers can also create a high-quality learning process since the communication that occurs in the learning process is more effective [10].

The novelty of the use of video-assisted problem-based learning is the increase in students’ motivation and learning outcomes, interaction among students, and interaction between students and teachers which causes students to look more cheerful in class. In addition, the use of PBL is also integrated with video (audio-visual media) used to convey the message and stimulate thoughts, feelings, and students’ attention; therefore, teachers can create an attractive learning process identified through students’ interest in watching the videos. However, it is undeniable for students with weak thinking ability that they have difficulty in following the discussion and formulate problem solving.

The use of video in learning will give the opportunity for students to be more active and explore their abilities in problem-solving on biodiversity topic which will directly affect students’ learning outcomes. [11] that the use of video in learning has several advantages: it shows a mix of images and sound, is used repeatedly, is used as learning media in the classroom, and is used according to students’ level of understanding in mastering learning materials. Meanwhile, according to [12] video has several advantages and limitations: it is able to show certain movements; is repeated, and makes students be independent learners; whereas, the production of a video is costly; only a few people are able to operate it, and video equipment is required to operate a video. In addition, another weakness of video is it has one direction of communication that leads students to only watch the video. So, teachers need to consider these weaknesses when they use video in the classroom. However, since students can repeat and stop the video, therefore, teachers can stimulate students to discuss the content of the video.
which leads to an interactive teaching and learning process. Although it is costly and time-consuming to produce video; however, video is one of the attractive learning media.

By integrating video in the classroom, students can focus and pay attention to content, and increase their knowledge and interest in learning since video provides pictures and sound. It is in line with [13] which revealed that the use of well-designed teaching media can enhance students’ motivation and interest in learning as well as to increase their understanding of a topic.

The finding of this study is in line with [14] study that revealed that video-assisted problem-based learning can enhance mathematics teachers’ skills in teaching and using media and create a better classroom environment, therefore, it enhances the quality of education. According to [15], the use of thematic interactive video-based instruction can promote students to get involved in seeking information and explore a new idea. Furthermore, in the experimental class, students’ post-test and motivation scores are better than the control group. Another study was conducted [16], on using interactive video in an e-learning system. The study suggested that students who learn through interactive video have better scores and levels of student satisfaction than those who do not use interactive video. It indicates that it is crucial to integrate interactive video in an e-learning system.

The findings of this study support [17]. the study that showed that the use of video-assisted problem-based learning can increase students’ learning achievement and their attention toward the teaching and learning process. In addition, students have a better understanding of a topic. Another study was conducted by [18] which revealed that Problem Based Learning model can enhance senior high school students’ achievement of human digestive system learning.

4. Conclusion
It is concluded that the use of video-assisted problem-based learning can increase students’ achievement in learning Biology at two public senior high schools in Banda Aceh.

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