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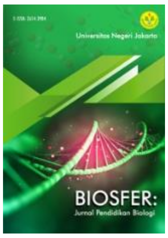

Evoking the four dimensions of student knowledge in ecosystem: effectiveness of real object, web, and blended learning

Anwar Musyaddad*, **Slamet Suyanto**

Biology Education, Faculty of Mathematics and Natural Science, Universitas Negeri Yogyakarta, Indonesia

* Corresponding author: anwarmusyaddad10.2017@student.uny.ac.id

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This research aims to identify whether there was a significant difference in influence between learning media based on real object, web, and blended learning on student knowledge dimension, which covers factual, conceptual, procedural, and metacognitive knowledge on ecosystem material. It was a quasi-experiment with a pretest-posttest comparison group design. The population in this study was all students of class X MIA in SMA N 1 Bantul and SMA N 2 Bantul, Indonesia. The sample in this study used three experimental classes that were randomly selected using cluster random sampling techniques. The data were collected using tests of factual, conceptual, procedural, and metacognitive knowledge and student's metacognitive questionnaire. These data were then analyzed using the Multivariate Analysis of Variants test. The results demonstrated that: (1) learning media based on real object, web and blended learning affect the student's factual, conceptual, procedural and metacognitive knowledge, (2) there was a significant difference in effectiveness between learning media based on real object, web and blended learning on students' factual, conceptual and metacognitive knowledge, (3) there was no significant difference in effectiveness between learning media based on real object, web and blended learning on students' procedural knowledge. Based on this, it can be recommended that biology learning media based on the real object and blended learning can be applied by the teacher to improve students' factual, conceptual, and metacognitive knowledge.

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INTRODUCTION

The implementation of the 2013 curriculum in Indonesia aims to improve the system and quality of Indonesia's education, with the hope of increasing students' knowledge and skills so they can compete with other countries. Therefore in the 2013 curriculum, students are required to master several skills and knowledge, including factual, conceptual, procedural, and metacognitive knowledge. In biology learning, factual, and conceptual knowledge are the basis of general biological knowledge. Students will more easily understand the material in the form of facts because students can make observations directly about the material being studied so that they have good factual knowledge, but not with their conceptual, procedural, and metacognitive knowledge. Factual knowledge is essential for students when learning various sciences or when solving problems in the learning process, such as revealing the truth of a statement with facts (Anderson & Krathwohl, 2017). Factual knowledge is related to a true statement because it matches the real situation.

According to Anderson & Krathwohl (2017), conceptual knowledge is knowledge about schemes, models, or theories explicit and implicit in different cognitive psychological models. Conceptual knowledge is obtained through interaction from Two Directions, which invites interpretation and is read from reality with the results of thought (Beydoğan & Hayran, 2015). Procedural knowledge is the ability of students to predict, design, make a hypothesis, and arrange the steps of observation or investigation (Star & Stylianides, 2013). Metacognitive knowledge is part of knowledge related to various tasks, goals, actions, and cognitive experiences (Flavell, 1979). Metacognition is a type of knowledge and special abilities that develop with personal experience and learning outcomes in school (Stewart, Cooper, & Moulding, 2007). Metacognition is very important for learning success because it allows individuals to manage their cognitive skills and to determine weaknesses that can be corrected by designing new cognitive skills (Aktağ, Şemşek, & Tuzcuoğlu, 2017). Metacognitive knowledge can control and stimulate students to know how to learn, to determine a good learning strategy for him (Bars & Oral, 2017; Darmawan, Brasilita, Zubaidah, & Saptasari, 2018; Lestari, Ristanto, & Miarsyah, 2019; Pratama, 2018; Rahman et al., 2018)

The ecosystem is a population of plants and animals that interact each other in a particular area and with abiotic components in the area (Bigss et al., 2004). Learning on ecosystem material includes the components of the ecosystem, such as biotic components consisting of living things and abiotic components consisting of non-living things. Besides, in learning biology, especially in the matter of ecosystems, students are expected to learn directly in the field, so students can know firsthand how ecosystems are formed and know the types of interactions in the ecosystem. Ecosystem material in learning biology studies various life phenomena that exist around humans. However, in its implementation, the teacher has not connected the biological material learned with the environment that is around the students (Marwanto, Seribulan, & Isfaeni, 2014).

Learning on ecosystem material is often only in the form of theory through textbooks, students do not directly learn the environment in which the ecosystem is formed. In fact, by doing learning directly to the environment, students can know various types of ecosystem components and can directly interact with these components. Thus they get a hands-on learning experience that will make their science processing abilities better — being able to link the material being studied with the conditions in the environment. For this reason, appropriate learning media are needed so that the learning process of biology in ecosystem material can be more meaningful for students so that the factual, conceptual, procedural, and metacognitive knowledge of students can be increased.

In the ecosystem material, there are many concepts that students must learn well; this can be done by students learning directly where the ecosystem is located or through learning resources found on the internet. By studying the object of the ecosystem directly in the field, students will quickly find out the facts about what they learned. Then they can strengthen these facts with a variety of concepts that they can find on the internet, starting from the process of observing, collecting data, observing so they can know what they are learning, and can determine how they learn it so that their metacognitive knowledge will be better honed.

One of the learning media that can be used is real object-based learning. Real object learning is a learning activity that is directly related to the object or learning media. According to Sudjana & Rivai (2017), the use of real objects in the learning process will make it easier for students to conduct observations and conduct investigations about what they learn. Learning by using real objects not only brings learning objects into the classroom but can also be through direct observation in the student learning environment. Learning that is designed outside the classroom by utilizing the surrounding environment can stimulate children's creativity and increase their enthusiasm for learning (Kiewra & Veselack, 2016). Also, it can take advantage of online-based learning by using web-based learning or blended learning.

The development of information technology and science is followed by the growth of the use and utilization of the internet. Therefore the use of the internet in the field of education must continue to be optimally developed through internet-integrated learning activities (Ardiansyah & Diella, 2017; Bagci & Celik, 2018; Putri & Aznam, 2019). Web-based learning is learning by utilizing the internet to find learning materials and learning resources that are available on various sites available on the internet (Mumpuni & Nurpratiwiningsih, 2016). Web-based learning is learning by utilizing the internet to find learning materials and learning resources that are available on various sites available on the internet. Web-based learning is a learning activity with website assistance; the website acts as a provider of learning resources (Anderson, 2007; Sofia, 2016). Web-based learning provides a wealth of information in various formats and is the primary medium for learning in both formal or informal learning (Kammerer, Brand-Gruwel, & Jarodzka, 2018). According to Clark & Mayer (2011), the website is an instruction that is presented and delivered through digital devices such as personal computers, laptops, cellphones, or smartphones shown as a means of supporting teaching and learning activities. Meanwhile, learning based on blended learning is learning that is both offline and online.

Blended learning is an innovative concept of traditional learning in the classroom and ICT-supported learning that includes face-to-face offline learning in the classroom and online learning (Hariadi, 2015; Lalima & Lata Dangwal, 2017; Ozmen, Tepe, & Tuzun, 2018). Blended learning is the integration of both conventional and modern teaching and learning processes, and has changed the teaching-learning culture from teacher-centered to student-centered. Online learning through blended learning or web-based can give students much knowledge because it can explore various learning resources. Those who utilize online-based interactive media will get the chance to get new knowledge faster (Gurubatham, 2013). Also, online-based learning by utilizing the use of ICT can train learning independence, and students can deepen the concepts they have learned (Supandi, Kusumaningsih, & Aryanto, 2016). Based on these descriptions, this study aims to find out the most effective learning media for increasing factual, conceptual, procedural, and metacognitive knowledge of students on ecosystem material. This will be very useful for teachers in determining learning media that is suitable for the learning objectives to be achieved, especially those related to factual, conceptual, procedural, and metacognitive knowledge.

METHODS

Research Design

This research was conducted with a quasi-experimental method with a pretest-posttest comparison group design. This study used three experimental groups without using a control group. The first experimental group was treated using real object-based learning, the second experimental group was treated using web-based learning, and the third experimental group was treated using blended learning. The design of this study can be seen in Table 1.

Tabel 1
The Pretest-Posttest Comparison Group Design

Pretest	Treatment	Posttest
Y_{1-1}	X_A	Y_{2-1}
Y_{1-2}	X_B	Y_{2-2}
Y_{1-3}	X_C	Y_{2-3}

Note:
Y_{1-1} = Pretest of experimental group 1
Y_{1-2} = Pretest of experimental group 2
Y_{1-3} = Pretest of experimental group 3
X_A = Learning media based on real object
X_B = Learning media based on web
X_C = Learning media based on blended learning
Y_{2-1} = Posttest of experimental group 1
Y_{2-2} = Posttest of experimental group 2
Y_{2-3} = Posttest of experimental group 3

Population and Samples

The population was all students of class X MIA at SMAN 1 Bantul, Indonesia and SMAN 2 Bantul, Indonesia, total of 378 students. SMA N 1 Bantul and SMAN 2 Bantul were chosen because the schools located in one zoning and have UN scores that were not different. The sample involved 195 students selected using cluster random sampling technique in 3 classes at SMAN 1 Bantul: X MIA 3 with 31 students as experimental group 1, X MIA 2 with 31 students as experimental group 2 and X MIA 6 with 31 students as experimental group 3. Then for SMAN 2 Bantul, which consisting of 3 classes: X MIA 4 with 34 students as experimental group 1, X MIA 5 with 34 students as experimental group 2 and X MIA 6 with 34 students as experimental group 3.

Cluster sampling was done because of the limitations of researchers to categorize or select research subjects in each school. Thus the researcher chooses several classes that have already existed randomly, then the selected class as research sample was made. Because the unit chosen was not individuals, but a group of individuals naturally in a place (class), sampling is referred as cluster sampling (Ary, Jacobs & Razavieh, 2011).

Instrument

The data were collected using 30 items of multiple-choice tests and five items of essays on factual, conceptual, procedural, and metacognitive knowledge with details of 10 items of factual knowledge, ten items of conceptual knowledge, 10 items of procedural knowledge and 5 items of metacognitive knowledge essays and student's metacognitive questionnaire. The factual, conceptual, procedural, and metacognitive knowledge test instruments have been validated by experts and have been tested to determine the level of validity and reliability. Validation test results were then analyzed using the quest program, and the results were obtained by infit mean MNSQ 1.04 and a standard deviation value of 0.43 so that it can be concluded that the test fit with the Rash Model so that all test items were suitable to be used in the study. The reliability result, according to Alpha Chronbach, was 0.80, so it can be concluded that the reliability of the instrument lied in a very high category.

Tabel 2.
Examples of metacognitive knowledge test

No	Answer the Questions Below Correctly!
1	When discussing with the teacher, a student stated that areas dominated by low vegetation, plants that could live in the form of secular plants and animals that dominated were snakes, lizards, and scorpions with a maximum air temperature of 50$_o$C while the lowest of -30$_o$C was a terrestrial ecosystem area with savanna biomes. However, the teacher does not approve the student's opinion; what causes the teacher does not approve the student's opinion?

2	A student observes the ecosystem component in his school environment. When observing these students found earthworms. Furthermore, the student makes an observation report; in the report, he writes that earthworms are biotic components that act as decomposers. However, the report received a revision from the teacher. What caused the teacher to revised the student report?

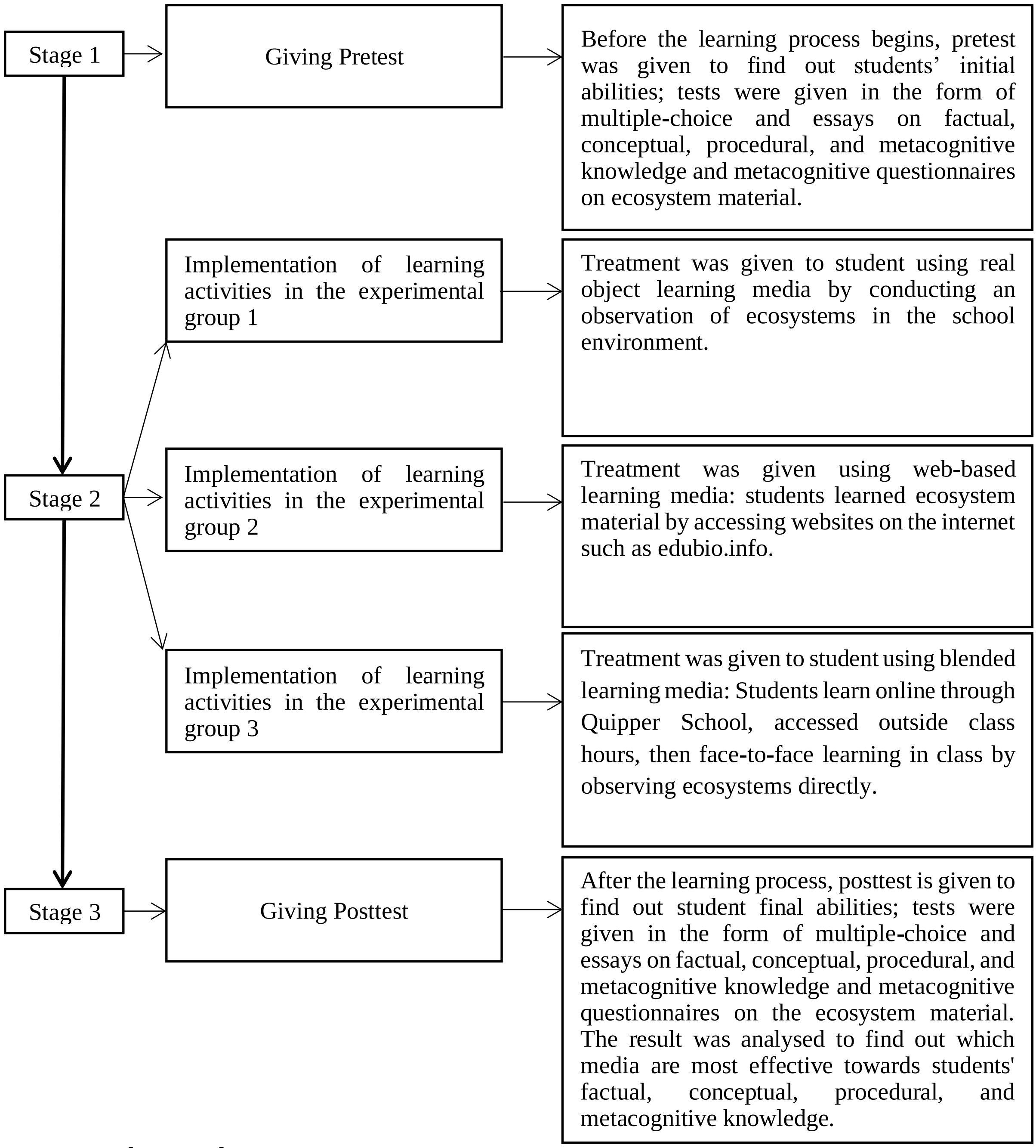

Figure 1. Research Procedure

Procedure

The procedure in this study consisted of three stages. The first stagewas started with the pretest of factual, conceptual, procedural, and metacognitive knowledge to know the initial abilities of each experimental group. Metacognitive questionnaire sheet with a Linkert scale was given to find out the students' initial metacognitive knowledge. The second stage was done by treatment to each experimental group; the first experimental group was treated with real object-based learning media that was by directly observing the ecosystem around the school, the second experimental group was given treatment with web-based learning media that focuses on the material ecosystem. The third experimental group was given treatment with learning media based on blended learning through the application of quipper school. All of these treatments use a scientific approach. Then the third stage was giving posttest factual, conceptual, procedural, and metacognitive knowledge in each experimental group to see improvement after different treatment being given, at this stage questionnaire sheet with Linkert scale was also given to find out the increase in students' metacognitive knowledge. The flowchart of this research procedure can be seen in Figure 1.

Data Analysis

Data analysis in this study used descriptive tests and inferential statistical tests. The descriptive test was used to determine the increase in student's fundamental knowledge before treatment being given and the student's final knowledge after treatment being given. Inferential statistical test in this study used a multivariate analysis of variance test to find out the most effective media on factual, conceptual, procedural, and metacognitive knowledge of students, before the multivariate analysis of variance test, a prerequisite test was conducted with normality and homogeneity tests. Data analysis was performed using the SPSS 24 for Windows program with the alpha value (0,05).

RESULTS AND DISCUSSION

The initial process of the implementation of this research was done by conducting initial data collection activities or pretest by providing multiple-choice questions to measure factual, conceptual, and procedural knowledge and students' metacognitive questionnaires as well as about metacognitive description of ecosystem material. The results of all classes before research was carried showed that student have the same initial ability as evidenced by the results of the analysis of the value of fundamental knowledge that is usually distributed and homogeneous. The next process was the implementation of research in which experimental group 1 using real object-based learning was done by conducting learning activities in the form of direct observation around the school environment, experimental group 2 using web-based learning namely learning activity by utilizing various sources of learning material available on the internet such as contained in edubio.info, and experimental group 3 using learning based on blended learning that is in its implementation using the help of Quipper School (Figure 2). The final process of this research was the final data collection or posttest. The learning material provided in this study was the ecosystem material.

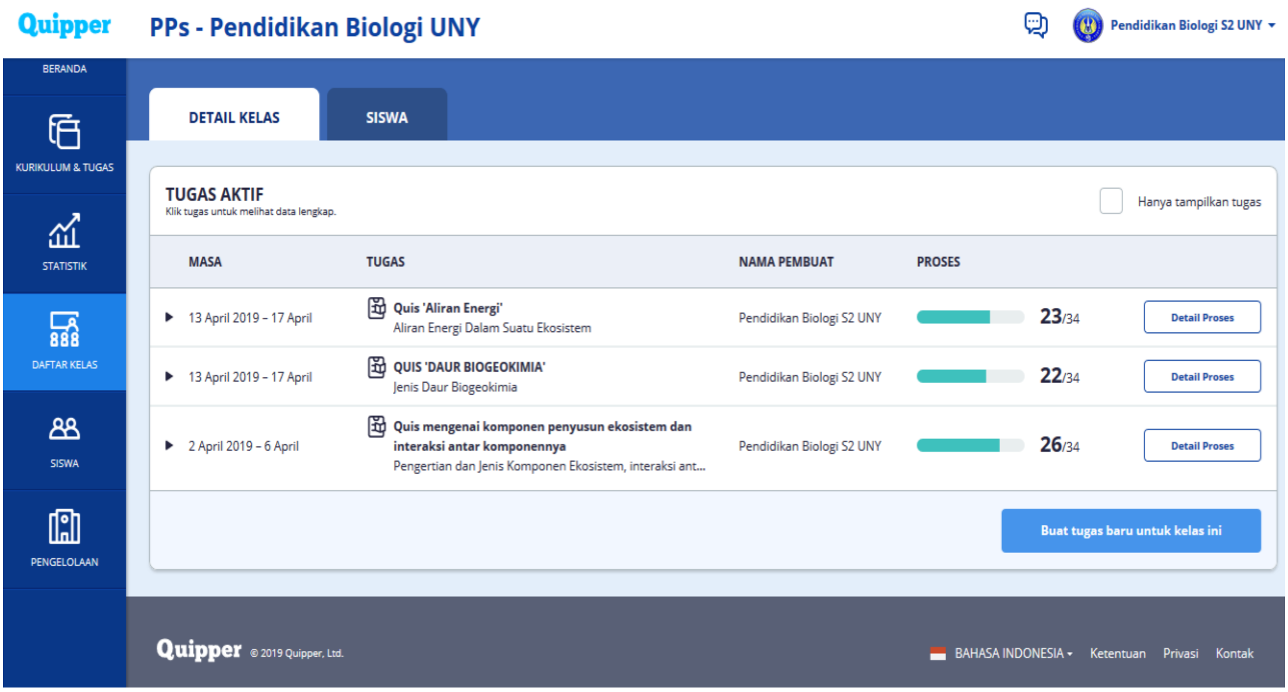

Figure 2. Learning activities through Quipper School

Factual, conceptual, procedural, and metacognitive knowledge data obtained from the results of the study were analyzed, and the following results were obtained.

Description of Student' Factual, Conceptual, Procedural and Metacognitive Knowledge Data
The following data are presented comparing the average value of factual, conceptual, procedural, and metacognitive knowledge of students before and after treatment.

Tabel 3
Comparison of Average Value of Factual, Conceptual, Procedural and Metacognitive Knowledge of Students

The Knowledge Dimension	Real object		Web		Blended Learning	
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
Factual	44,46	71,07	43,07	60,30	44,61	71,69
Conceptual	40,00	69,69	44,00	61,69	42,15	70,30
Procedural	45,38	71,07	43,07	66,92	42,00	69,69
Metacognitive	60,07	69,21	66,64	66,66	54,46	70,07

Based on the data above, there has been the differences in factual, conceptual, procedural, and metacognitive knowledge of students after treatment being given. Blended-based learning media have the highest average results, among other treatments. Blended learning that combines face-to-face learning with online-based learning can improve the factual, conceptual, procedural, and metacognitive knowledge of students. This is because students can do learning activities directly related to learning objects and strengthen what they get in the field with the material they get online. So students have better knowledge when compared to students who do learning using only real objects or web-based learning.

Factual Knowledge Data Description
The following table presents a comparison of the values of the descriptive results of factual knowledge of students before and after treatment.

Table 4
Descriptive Test Results of Students' Factual Knowledge.

	Real object		Web		Blended learning	
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
N	65,00	65,00	65,00	65,00	65,00	65,00
Range	70,00	60,00	70,00	60,00	70,00	60,00
Minimal Score	10,00	40,00	10,00	30,00	10,00	40,00
Maximal Score	80,00	100,00	80,00	90,00	80,00	100,00
Mean	44,46	71,07	43,07	60,30	44,61	71,69

The data in Table 4 shows that the average value of the factual knowledge pretest test results between classes that will be given real object-based learning, web, and blended learning treatments are not different. This showed that factual knowledge between classes is the same or not much different. Thus all three classes have met the requirements to be used as research samples because they already have relatively similar initial factual knowledge. The results of the average ability test of students' factual knowledge indicate a difference between classes given real object-based learning, web, and blended learning.

The average posttest results of factual knowledge of students who have been treated using real object learning and web-based learning has a difference of 10.77, with a difference that is so high it can be ascertained that the factual knowledge of students between classes is different, while the average results Average posttest factual knowledge of students who have been given the treatment of learning with blended learning and real object-based learning has a difference of 0.62, the difference is so small that it can be ascertained that the factual knowledge of students between classes is not much different. Meanwhile, the average posttest results of factual knowledge of students who have been given a treatment of blended learning and web-based learning have a difference of 11.39, with a difference that is so high it can be ascertained that the factual knowledge of students between classes is different. The difference in the value of factual knowledge will then be further tested using the Multivariate Analysis of Variance (MANOVA) test conducted to test the hypothesis.

Conceptual Knowledge Data Description

The following table presents a comparison of the value of the descriptive test results of students' conceptual knowledge before and after treatment was given.

Table 5

Descriptive Test Results of Students' Conceptual Knowledge

	Real object		Web		Blended learning	
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
N	65,00	65,00	65,00	65,00	65,00	65,00
Range	70,00	60,00	70,00	60,00	70,00	60,00
Minimal Score	10,00	40,00	10,00	30,00	10,00	40,00
Maximal Score	80,00	100,00	80,00	90,00	80,00	100,00
Mean	40,00	70,00	44,00	61,69	42,15	70,30

The data in Table 5 shows the average value of the results of the conceptual knowledge pretest test between classes that will be given the treatment of real object-based learning, the web, and blended learning is not much different. This shows that conceptual knowledge between classes is the same or not much different. Thus all three classes have met the requirements to be used as research samples because they already have relatively similar initial conceptual knowledge.

The average posttest results of conceptual knowledge of students who have been treated using real object learning and web-based learning has a difference of 8.00; the difference is high enough so that it can be ascertained that the conceptual knowledge of students between classes is different, while the average results Average posttest conceptual knowledge of students who have been given the treatment of learning with blended learning and real object-based learning has a difference of 0.61, the difference is small enough so that it can be ascertained that the conceptual knowledge of students between classes is not much different. Meanwhile, the average posttest results of conceptual knowledge of students who have been given a treatment of blended learning and web-based learning have a difference of 8.61; the difference is high enough so that it can be ascertained that the conceptual knowledge of students between classes is different. The difference in the value of conceptual knowledge will then be further tested using the Multivariate Analysis of Variance (MANOVA) test conducted to test the hypothesis.

Procedural Knowledge Data Description

The following table presents a comparison of the value of the descriptive test results of the procedural knowledge of students before and after treatment was given.

Table 6

Descriptive Test Results of Students Procedural Knowledge

	Real object		Web		Blended learning	
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
N	65,00	65,00	65,00	65,00	65,00	65,00
Range	70,00	60,00	70,00	70,00	70,00	60,00
Minimal	10,00	40,00	10,00	30,00	10,00	40,00
Maximal	80,00	100,00	80,00	100,00	80,00	100,00
Mean	45,38	71,07	43,07	66,92	42,00	69,69

The data in Table 6 shows that the average value of the results of the procedural knowledge pretest between classes that will be given a real object, web-based learning, and blended learning treatments are not much different. This shows that procedural knowledge between classes is the same or not much different. Thus all three classes have met the requirements to be used as research samples because they already have relatively similar initial procedural knowledge.

The average results of posttest procedural knowledge of students who have been treated using real object learning, web, and blended learning based learning have a relatively low average difference, so it can be ascertained that procedural knowledge between classes that have been given treatment is not so different. However, these results will be further tested using the Multivariate Analysis of Variance (MANOVA) test conducted to test the hypothesis.

Metacognitive Knowledge Data Description

The following table presents a comparison of the values of the results of the descriptive metacognitive knowledge of students before and after treatment.

Table 7

Descriptive Test of Students' Metacognitive Knowledge

	Real object		Web		Blended learning	
	Pretest	**Posttest**	**Pretest**	**Posttest**	**Pretest**	**Posttest**
N	65,00	65,00	65,00	65,00	65,00	65,00
Range	26,00	32,00	41,00	36,00	35,00	37,00
Minimal	48,00	55,00	47,00	50,00	39,00	49,00
Maximal	74,00	87,00	88,00	86,00	74,00	86,00
Mean	60,07	69,21	66,64	66,66	54,46	70,07

The data in Table 7 shows the average value of the results of the metacognitive knowledge pretest between classes that will be given the treatment of real object-based learning, the web, and blended learning is not much different. This shows that metacognitive knowledge between classes is the same or not much different. Thus all three classes have met the requirements to be used as research samples because they already have relatively similar initial metacognitive knowledge.

The average posttest results of metacognitive knowledge of students who have been treated using real object learning and web-based learning have a difference of 2.55. So the difference is not so high that the metacognitive knowledge of students between classes is likely not much different. While the average posttest average metacognitive knowledge results of students who have been given a treatment of blended learning and real object-based learning has a difference of 0.86. The difference is small enough so that it can be ascertained that the metacognitive knowledge of students between classes is not much different. Meanwhile, the average posttest results of metacognitive knowledge of students who have been given a treatment of blended learning and web-based learning have a difference of 3.41. The difference is high enough so that it can be ascertained that the metacognitive knowledge of students between classes is different. The difference in the value of metacognitive knowledge will then be further tested using the Multivariate Analysis of Variance (MANOVA) test conducted to test the hypothesis.

Prerequisite Analysis of the Normality and Homogeneity Test of Factual, Conceptual, Procedural, and Metacognitive Knowledge

Before the hypothesis test conducted, the research data have first had the normality and homogeneity test. Normality was done in this study using the Kolmogorov-Smirnov with a significance level of 0.05. This test was carried out with the help of IBM SPSS 24 for windows software with the following data results.

Table 8
Normality Test Results

The Knowledge Dimension	Experimental group	Kolmogorov-Smirnov(a)			
		Statistic	Df	Sig.	Conclusion
Factual Knowledge	Real object	,108	65	,056	Normal
	Web	,109	65	,052	Normal
	Blended	,109	65	,054	Normal
Conceptual Knowledge	Real object	,109	65	,052	Normal
	Web	,109	65	,054	Normal
	Blended	,109	65	,052	Normal
Procedural Knowledge	Real object	,109	65	,054	Normal
	Web	,109	65	,051	Normal
	Blended	,109	65	,052	Normal
Metacognitive Knowledge	Real object	,103	65	,086	Normal
	Web	,105	65	,070	Normal
	Blended	,080	65	,200*	Normal

The data in Table 8 shows the results of the acquisition of factual, conceptual, procedural, and metacognitive normality tests of students in each treatment class. Based on the Kolmogorov-Smirnov test results with a level of confidence, α = 0.05 in all treatment classes showed a significance value> 0.05 so that all data in the treatment class were normally distributed.

The second prerequisite test is a homogeneity test; a homogeneity test is performed to find out whether the data in the study have the same/homogeneous variance level or do not have the same/heterogeneous variant. Homogeneity test in this study was carried by the help of IBM SPSS 24 for windows, using the Levene test at a significance level of 0.05. The results of this homogeneity test can be seen in the following Table 9.

Table 9
Homogeneity Test Result

Variable	Sig. 2	Conclusion
	Levene Statistics	
Factual Knowledge	,926	Homogeneity
Conceptual Knowledge	,919	Homogeneity
Procedural Knowledge	,292	Homogeneity
Metacognitive Knowledge	,507	Homogeneity

Based on the homogeneity test results contained in Table 9 shows that the significance value obtained in each group in the two schools is above 0.05, so it can be concluded that the data variance obtained is homogeneous distribution because all the prerequisite tests have been fulfilled. It will proceed with hypothesis testing using multivariate analysis of variance test.

Differences in Effectiveness Between Learning Media Based on Real Object, Web and Blended Learning Towards Students' Factual, Conceptual, Procedural and Metacognitive Knowledge

Table 10
Multivariate Analysis of Variance Test Results

Effect	Value	F	Hypothesis df	Error df	Sig.
Pillai's Trace	,148	3,806	8,000	380,000	,000
Wilks' Lambda	,852	3,939b	8,000	378,000	,000
Hotelling's Trace	,173	4,071	8,000	376,000	,000
Roy's Largest Root	,171	8,101c	4,000	190,000	,000

Multivariate Analysis of Variance test conducted is to determine the effect of the treatment that has been given to the factual, conceptual, procedural and metacognitive knowledge of students using the Wilks' Lambda test because in this study using more than two variables. Based on the data in Table 10 it can be explained that the data obtained from the Multivariate test results based on the Wilks' Lambda test have a significance value of 0,000 because the significance value is less than 0.05, it can be concluded that each teaching method has different abilities in terms of influencing factual knowledge, conceptual, procedural and metacognitive knowledge.

Differences in Effectiveness Between Learning Media Based on Real Object, Web and Blended Learning Towards Students' Factual Knowledge

Between-subjects effects test results were conducted to determine differences in the effect of the results of the treatment that has been given to students' factual knowledge, as shown in Table 11 below:

Table 11

Tests of Between-Subjects Effects Result of Factual Knowledge

Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.
Factual Knowledge	5329,231	2	2664,615	8,287	,000

Based on data, Table 11 shows the significant value between the treatments given to students' factual knowledge. Based on these data, it has been the significance value obtained by factual knowledge below 0.05. Thus it can be concluded that there are differences in students' factual knowledge. Between-Subjects Effects test results show that all treatments given are effective against students' factual knowledge, so to find out which treatments are effective, Post-Hoc follow-up tests using Bonferroni's method and the following results are obtained:

Table 12

Multiple Comparison of Factual Knowledge Test Results

Dependent Variable	(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.
Factual Knowledge	Real object	Web	10,7692*	3,14531	,002
		Blended	-,6154	3,14531	1,000
	Web	Real object	-10,7692*	3,14531	,002
		Blended	-11,3846*	3,14531	,001
	Blended	Real object	,6154	3,14531	1,000
		Web	11,3846*	3,14531	,001

The data in Table 12 shows the results of a comparison test between treatments to find out which is more effective against students' factual knowledge. Based on the data in Table 12, it has been that real object-based learning is significantly different from web-based learning, and blended learning-based learning is significantly different from web-based learning in increasing students' factual knowledge.

The use of real object media is a learning process by involving students directly with learning objects, so students can interact in the process of observing or obtaining information related to what they are learning. Students can know facts directly about the material learned from the objects they observe. Thus their factual knowledge can increase. The same thing can be done for students who are applied to blended-based learning. Even in addition to being able to learn objects directly, students who apply blended learning can obtain additional information related to the object they are learning by looking for additional information on the internet or from the teaching material contained in the blended application. Meanwhile, students who are applied to web-based learning only get information related to what they learn from the internet, so they cannot interact with the objects they are learning, which causes the factual knowledge to be less developed. This causes a difference in factual knowledge between the class that is applied to the real object and blended with the class that is applied to web-based learning.

Differences in Effectiveness Between Learning Media Based on Real Object, Web and Blended Learning Towards Students' Conceptual Knowledge

Between-subjects effects test results were conducted to determine differences in the effect of the treatment that has been given to students' conceptual knowledge, as shown in Table 13.

Table 13
Between-Subjects Effects Test Results of Conceptual Knowledge

Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.
Conceptual Knowledge	3003,077	2	1501,538	4,765	,010

The data in Table 13 shows the significant value between treatments given to students' conceptual knowledge. Based on these data, it has been the significant value obtained by conceptual knowledge below 0.05. Thus it can be concluded that there are differences in students' conceptual knowledge. Between-Subjects Effects test results show that all treatments affect students' conceptual knowledge, so to find out which treatments are effective, Post-Hoc follow-up tests using Bonferroni's method and the following results are obtained:

Table 14
Multiple Comparison of Conceptual Knowledge Test Results

Dependent Variable	(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.
Conceptual Knowledge	Real object	Web	8,0000*	3,11380	,033
		Blended	-,6154	3,11380	1,000
	Web	Real object	-8,0000*	3,11380	,033
		Blended	-8,6154*	3,11380	,019
	Blended	Real object	,6154	3,11380	1,000
		Web	8,6154*	3,11380	,019

The data in Table 14 shows the results of a comparison test between treatments to find out which is more effective against students' conceptual knowledge. Based on the data in Table 14, it has been that real object-based learning is significantly different from web-based learning, and blended learning is significantly different from web-based learning in improving students' conceptual knowledge.

The results of the application of real object media and blended learning show significantly different from web-based learning media on students' conceptual knowledge. Students who are given real object-based learning and blended learning can master the concepts of learning material very well; this is because they can study the material obtained in the learning process directly so thoroughly that they understand the concepts of the material being studied very well.

Differences in Effectiveness between Learning Media Based On Real Object, Web and Blended Learning on Students' Procedural Knowledge

Between-subjects effects test results were conducted to determine differences in the effect of the treatment that has been given to students' procedural knowledge. Table 15 shows the significance values between treatments given to students' procedural knowledge. Based on these data, it has been the significance value obtained by procedural knowledge above 0.05. Thus it can be concluded that there is no difference in students' procedural knowledge.

Table 15
Between-Subjects Effects Test Results Procedural Knowledge

Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.
Procedural Knowledge	581,538	2	290,769	,841	,433

Students' procedural knowledge does not have a significant difference between classes applied to real object media, web, and blended learning. This is likely due to the lack of a learning process that leads to a process of processing or carrying out a detailed procedure, so students lack understanding in designing a procedure when making observations, especially on ecosystem material.

Differences in Effectiveness Between Learning Media Based on Real Object, Web and Blended Learning Towards Students' Metacognitive Knowledge

Between-subjects effects test results were conducted to determine the differences in the effect of the treatment that has been given to students' metacognitive knowledge, as shown in Table 16.

Table 16
Between-Subjects Effects Test Results Metacognitive Knowledge

Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.
Metacognitive Knowledge	410,133	2	205,067	3,203	,043

The data in Table 16 shows the significant value between treatments given to students' metacognitive knowledge. Based on these data, it has been the significance value obtained by metacognitive knowledge below 0.05. Thus it can be concluded that there are differences in students' metacognitive knowledge. Between-Subjects Effects test results show that all treatments affect students' metacognitive knowledge, so to find out which treatments are effective, Post-Hoc follow-up tests using Bonferroni's method and the following results are obtained.

Table 17
Multiple Comparison of Metacognitive Knowledge Test Results

Dependent Variable	(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.
Metacognitive Knowledge	Real object	Web	2,5538	1,40364	,211
		Blended	-,8615	1,40364	1,000
	Web	Real object	-2,5538	1,40364	,211
		Blended	-3,4154*	1,40364	,048
	Blended	Real object	,8615	1,40364	1,000
		Web	3,4154*	1,40364	,048

The data in Table 17 shows the results of a comparison test between treatments to find out which is more effective against students' metacognitive knowledge. Based on the data in Table 17, it has been that blended learning based learning differs significantly from web-based learning in improving students' metacognitive knowledge.

Real object learning was carried out in this research in the form of direct observation of the ecosystem in the school environment, so students will be more active in learning activities. Learning will be more active and enjoyable when students are directly involved in the learning process, with real object-based learning students will play an active role in every learning process such as observing, discussing and demonstrating what they find. So learning becomes more effective and will be stored for a long time in student memory (Khofiyah, Santoso, & Akbar, 2019). Real object-based learning makes students involved. It interacts directly with learning objects so that they can explore knowledge directly through the objects they learn so that students can apply the theories or concepts they get with the circumstances in the environment, thereby being able to practice optimizing growth factual and conceptual knowledge. This is consistent with the results of the research in Table 10 and Table 11 that real object-based learning is more effective than web-based learning. Learning by using real objects or learning directly into the field can make the learning process more meaningful and more memorable for students because students can connect what they learn with real-life (Bably & Nusrat, 2017). Therefore, real object-based learning will be more interesting for students so they can develop various abilities they have.

Web-based learning must begin to be accustomed to students because students are already accustomed to using technology and the internet. Web-based learning makes students free to find learning resources about what they learn from various sources available on the internet, making the web as the leading media in the learning process (Kammerer et al., 2018). Also, today, students can easily access the internet as a learning resource, with this ease expected to improve their learning achievement. Student achievement and cognitive skills with web-based learning methods have improved and developed well (Lakonpol, Ruangsuwan, & Terdtoon, 2015). In the digital era as it is today, web-based learning should be applied by teachers in schools, in addition to making it easier for teachers, web-based learning will provide convenience for students because students in the 21st century like today are active users in technology (Jayawardana, 2017).

The advantage of web-based learning is that the pages of the web can contain many sources of learning material, both those provided by the web or also sourced from other websites that are linked using hyperlinks so that the information obtained by students is more (Seribulan, Rahayu, & Isfaeni, 2014; Wasim, Sharma, Khan, & Siddiqui, 2014). However, web-based biology learning in this study is not so useful in increasing factual, conceptual, procedural and metacognitive knowledge of students, this is possible because the web that students use is not developed directly by the teacher but utilizes websites on the internet, so the material learning that students get is not deep enough. Therefore, teachers must continue to innovate in delivering learning material following the development of their students, and learning based on blended learning can be one of the learning media that can be applied by teachers in delivering learning through technology because through blended learning teachers will continue to do face-to-face learning with students so the teacher can control the learning process. (Indriani, Fathoni, & Riyana, 2018; Dung & Fatmawati, 2018; Wardani, Toenlioe, & Wedi, 2018). Blended learning and real object-based learning applied are considered to be more effective in improving students 'metacognitive knowledge. Because, according to the research results in Table 14, it has been that the results of the application of blended learning and real object-based learning are not significantly different from students' metacognitive knowledge. Thus blended learning and real object-based learning can be alternative learning media to develop students' metacognitive knowledge.

Given that metacognitive knowledge is still very rarely developed, students should be accustomed to start being trained to use metacognitive knowledge on an ongoing basis because it can foster student confidence. In learning and improving the mastery of their competencies so that students can gain maximum knowledge (Lukitasari, Hasan, & Murtafiah, 2019). As these results, learning based on blended learning is proven to be better in increasing students' factual and conceptual knowledge; this is following other studies that show that learning using blended learning affects student learning concepts and procedures (Sudarman, 2014). Other studies have shown that online learning by utilizing ICT has been shown to influence conceptual knowledge and students' independence in learning (Hasanah, Hasani, Fatah, Sari, & Romdani, 2018).

CONCLUSION

Based on the research that has been done, it can be concluded that real object-based learning media and blended learning are more effective in increasing factual, conceptual, and metacognitive knowledge of students better than web-based learning media. Direct learning with real objects can stimulate a variety of student knowledge, especially visually and kinesthetic, so that students will be more active in the learning process. Then that knowledge will be stronger when students explore concepts about what they are learning through the internet because students can explore various knowledge about what they are learning. For that, real object-based learning media and blended learning are highly recommended for teachers to use in biology learning.

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