

PAPER • OPEN ACCESS

Improving Students' Conceptual Understanding of Biology through Quipper School

To cite this article: Ayu Ratri Wardyaningrum and Slamet Suyanto 2019 *J. Phys.: Conf. Ser.* **1233** 012001

View the [article online](#) for updates and enhancements.



IOP | ebooks™

Bringing you innovative digital publishing with leading voices to create your essential collection of books in STEM research.

Start exploring the collection - download the first chapter of every title for free.

Improving Students' Conceptual Understanding of Biology through Quipper School

Ayu Ratri Wardyaningrum* and Slamet Suyanto
Yogyakarta State University, Indonesia

*Email: a.ningrum.an@gmail.com

Abstract. Learning difficulties of students in understanding human physiology concepts are caused by the abstract objects because the physiological process occurs inside the human body. The condition causes the student learning outcomes become low. In order to overcome the problem, Quipper School, as an online-based learning media, is develop as a medium. It has various interesting features that facilitate students learning meaningfully and support student learning. This research aims to improve students' conceptual understanding of biology through Quipper School. This research was conducted at SMA Negeri 2 Ngaglik and SMA Negeri 1 Prambanan in 11th grade, using quasi-experiment method, pretest-post-test nonequivalent control group design. Data were collected by using test instruments and analyzed by using normalized gain score and different test with Mann-Whitney U Test. The normalized gain score results showed that both the control and experimental classes increased in the conceptual understanding with medium category, namely of 0.38 and 0.62, respectively. The different tests results indicated that there was a very significant difference between increasing the understanding of science concept in two sample classes, with a significance value of 0.000. Thus, it could be concluded that the use of Quipper School was effectively in improving students' understanding of scientific concepts.

Keywords: Quipper School; Online learning media; Conceptual understanding; Biology.

1. Introduction

Biology learning has different characteristics from learning in general. Biology learning is the process of interaction between students and the objects they learn. It consist of objects, processes, and products. Biology learning becomes more meaningful when students observe the object they learn directly. It helps students in understanding the material concepts. However, not all biological symptoms and phenomena can be observed directly, especially in physiological processes that occur in the body of living things, one of which is about the human reproductive system. The human reproductive system is a material that is considered difficult by 11th grade students. The material studied includes the organs in the body that make up the human reproductive system to the physiological processes that take place in it. A lot of topics, the abstract objects of study, and the limited learning time are the factors of students' learning difficulties. According to Cimer in [1] that there are three reasons that make biology difficult to learn: (1) many concepts and biological events that cannot be seen with the naked eye, they are too abstract/not visible; (2) students are "forced" to memorize biological facts in learning them; and (3) some students mentioned that the time available to study biology was insufficient. As a result, students' understanding of the material they learned became low. This is evident in the low learning outcomes of the students [1], [2].



Based on biology tests conducted in 3 high schools in Sleman regency, the results showed that the average test scores of each school were 45.3, 54.4, and 59.4 respectively. Those value were below the specified minimum completeness value, which is equal to 70. Based on observations, students tend to only receive and memorize biological material delivered by the teacher during learning in the class. They are not eager to develop the learning material. When students were given a test about concepts understanding, students tend to have difficulty in answering because their knowledge was limited to what teacher given. This condition was contrary to the opinion of Konicek Moran & Keeley in [3] that students who have an understanding of a concept, they will be able to: (1) think with it, (2) use it in places other than what they learn, (3) express it in words themselves, (4) and metaphors or analogies for that. In other words, students have made their own concepts. This is what is called conceptual understanding [3].

Through his research, Gabel identified several effective strategies for learning science that could help students to understand the concepts of the material being studied. One of which was a real-life situation. According to him, one way to represent a real-life situation is to use computer simulations. Computers can not only simulate what happens at the macroscopic level, but can also show what happens at the particle level [2]. Lubiano in [4] added that using ICT (Information and Communication Technologies) would facilitate students' understanding and retention of lesson which can eventually improve achievement in Science [4].

One of the teaching materials that fit to those criteria is Quipper School. Quipper School is one of the innovations in learning that is expected to help students learning difficulties. Quipper School is an online platform that utilizes the internet in its use. Quipper School as one of Learning Management System (LMS) contains a variety of features that facilitate teachers in designing learning and helping students in understanding the lessons [5], [6]. The teachers can input various combinations of teaching materials between texts, e-books, videos, pictures, graphs, and links to other online learning resources as a unit to deliver the contents of the subject matter. The students can choose teaching materials that make it easier for them to understand the material.

This platform using technological sophistication in education world that can facilitate student to study and keep in touch with their teacher, anywhere and anytime. In addition, there are various types of exercise questions in Quipper School accordance with the material presented. In that exams features, students can doing practice anywhere and anytime, then they immediately know whether their answers are right or wrong, know the value they get and can access information about the progress of the learning process of students in the progress track feature [5], [6], [7]. The existence of various facilities is expected to be effective in helping students to improve understanding of scientific concepts.

The rest of this paper is organized as follow: Section 2 describes the proposed research method. Section 3 presented the obtained results and following by discussion. Finally Section 4 concludes this work.

2. Proposed Research Method

This research used a quasi-experiment method with Pretest-post-test Nonequivalent Control Group Design [8]. The design of this research was shown in Table 1 as following.

Table 1. Pretest-post-test Nonequivalent Control Group Design

Group	Pretest	Treatment	post-test
Experiment	O ₁	X	O ₂
Control	O ₃	-	O ₄

Table 1 above showed that there was a test to find out the initial knowledge of students called pretest (O₁ in the experiment group and O₃ in the control group), treatment (X) where e-learning using Quipper School is applied in the learning process, and in the end of learning process student will given

the final test called post-test pretest (O_2 in the experiment group and O_4 in the control group) to find out the improvement of students' concept understanding.

This research was an implementation stage of the development research about biological learning material development based on Quipper School. The population were the student of 11th grade in High School Sleman District which has a computer laboratory, allow their students to use smartphones during lessons, and both teachers and students have the ability to operate computers, such as browsing, uploading and downloading via internet. The research samples were students of 11th grade in SMA Negeri 2 Ngaglik and SMA Negeri 1 Prambanan which consisted of 50 students as experimental group and 50 students as control group. The experimental group used the blended learning method using Quipper School, while the control group used conventional learning process (lecture and discussion methods) as usual.

Data of students' conceptual understanding was collected using an objective test in a form of 30 multiple choice questions covering the four cognitive levels in Bloom taxonomy, they were remembering, understanding, applying, and analyzing. The objective test have been validated in expert judgment by human physiology lecturers and then empirically validated by students of 12th grade who had received material about the human reproductive system, as many as 30 students.

The analysis technique used was normalized gain analysis to determine the criteria for improving students' concept understanding. The statistical tests began with normality test and homogeneity test. Normality test was used to find out the normality of data distribution, using Kolmogorov-Smirnov test. The test of homogeneity of variance was used to find out whether the variance of data in the experimental group and the control group are homogeneous or not, using Levene's test. The hypothesis analysis used is Mann-Whitney U Test with a significance level of 0.05 to determine the effectiveness of Quipper School for improving students' concepts understanding.

3. Results and Discussion

This section presents obtained results and following by discussion.

3.1. Use Quipper School in Learning

In the experimental group, blended learning was used as a method learning using Quipper School. Blended learning was a combination of face to face learning and online learning. According to Stein and Graham (2014), blended learning as a combination of on-site (i.e. face to face) learning with online experience to produce effective, efficient, and flexible learning [9], [10], [11] Generally, blended learning was used when online learning resources ranging from collaborative activities to assessments were meaningfully into course with classroom instruction [12]. The use of blended learning methods in this research was intended to optimize the use of Quipper School in improving students' understanding of concepts. Khlaisang and Likhitamrongkiat (2015) states that blended learning is an appropriate method to improve students' cognitive abilities, including the concept of understanding aspects [11], [13]. Blended learning combines multiple delivery media that are designed to complement each other also promote learning and application-learned behavior [10]. Face to face learning was needed in learning to guide and direct students so that they avoid misconceptions. Quipper School was used by students to prepare initial knowledge about the material to be discussed with the teacher when face to face learning in the classroom. The chat feature in QS could bridge the discussion between students and teachers, but face to face learning would provide a more meaningful discussion atmosphere.

3.2. The improvement of students' conceptual understanding

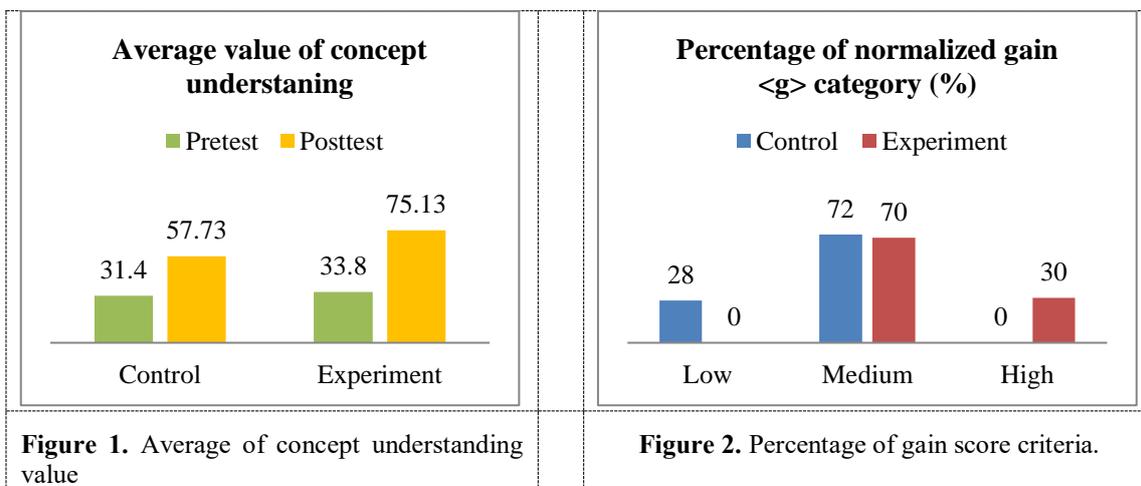
The improvement of students' concept understanding was determined by calculating the score of normalized gain $\langle g \rangle$ was processed through data of pretest and post-test score which has been executed by all participant students. Normalized gain analysis aims to find out the criteria for improving students' concept understanding after learning using Quipper School, whether low, medium, or high. The result of normalized gain $\langle g \rangle$ calculation presented in Table 2 as following.

Table 2. The improvement of student’s conceptual understanding

Group	Pretest Average	post-test Average	<g>	Category
Experiment	33.80	75.13	0.62	Medium
Control	31.40	57.73	0.38	Medium

Table 2 above showed that student’s conceptual understanding for both the experiment group and the control group has increased, but it has differences. The increasing in the experiment group was higher than the control group. In the experiment group, the average of pretest was 33.80 and the average of post-test was 75.13 (Figure 1). Meanwhile, in the control group, the average of pretest was 31.40 and the average of post-test was 57.73 (see Figure 1). It was noticed that the improvement of students’ conceptual understanding in the experiment and the control group were different after the treatment. Based on the calculation results of normalized gain, both of the experiment and the control group showed the same category of understanding improvement, namely in the medium category. Their normalized gain score was 0.62 and 0.38, respectively.

Although the category for conceptual understanding improvement in both classes were in the medium criteria, it seems that the experiment group has students whose the concept understanding were increased in the medium and high category more than the control group. In fact, in the control group, no student whose understanding increased in the high category (see Figure 2).



In the control group, the percentage of students whose the concept understanding increased with low category was 28% and the medium category was 72%. Meanwhile, in the experiment group, there were medium and high categories for students whose the percentage of concept understanding increased, respectively 70% and 30%. This result was strengthened by the analysis of different tests.

3.3. The effectiveness of Quipper School in improving students' conceptual understandings

Descriptive analysis showed that the increase of students’ concept understanding in the experiment group was greater than the control group. Therefore, it was necessary hypothesis testing was done to determine the significance of differences in students concept understanding after treatment. In addition, the hypothesis testing was also needed to determine the effectiveness of using Quipper School in improving students' concept understanding. The result of students conceptual understanding statistical test shown in Table 3 as following.

Table 3. The results of students' conceptual understanding statistical test

Data	Group	n	Normality		Homogenous		Mann-Whitney U Test	
			Sig.	Inter.	Sig.	Inter.	Sig.	Inter.
Pretest	Experiment	50	0.063	Normal	0.060	Homogen	0.132	no significant difference
	Control	50	0.022	Not normal				
post-test	Experiment	50	0.005	Not normal	0.062	Homogen	0.00	significant difference
	Control	50	0.004	Not normal				

Note : normality criterion : if the significance value (Sig.) > 0.05, the data distribution in that group was normal; homogeneity criterion : if the significance value (Sig.) > 0.05, the data variance were homogen; Mann-Whitney U Test criterion : if the significance value (Sig.) > 0.05, there was no significance difference between two groups

Table 3 above showed that the significance value of the control group in the pretest and post-test and the significance value of the experiment group in the post-test was smaller than 0.05. Therefore, the data distribution of those groups was not normal. The result of the homogeneity of variance, the significance values were greater than 0.05. Therefore, the data variance were homogeneous for both at pretest and post-test. The distributions of pretest and post-test score were not normal when examined using Kolmogorov-Smirnov test for normality, so that the hypothesis analysis used is Mann-Whitney U Test with a significance level of 0.05 to determine the effectiveness of improving students' understanding of concepts using Quipper School [12].

The results of the pretest different tests showed that the significance value obtained by $0.132 > 0.05$. It informs that no significance difference between two sample group before learning, indicates that both the experiment and the control group had the same competence before learning. Thus, it could be considered that before learning students had the same ability so that there were no disturbing factors from the students' initial abilities that affect the post-test results of students after learning. In the post-test different tests result, it was found the significant differences in concept understanding between the control group and the experiment group. This can be seen from the value of significance equal to $0.00 < 0.05$. It means that the treatment using Quipper School during learning promotes students' conceptual understanding. Thus it could be said that the use of Quipper School in learning effective to improve students' conceptual understanding of the material of the human reproduction system.

In the beginning of learning, the teacher gives an explanation of the concepts of human reproduction system in each topic. Furthermore, the student are given opportunity to gain insight by opening Quipper School through school computer or students' smart phone. In order to increase the understanding of students' concepts the teacher gave assignment to them to groups and conduct discussion according to the topic being studied, by involving Quipper School. In the experimental groups learning process, students play an active role in learning activities. The students play an active role in building a concepts according to the material they learned. This condition makes a meaningful learning for students [11], [14]. Meaningful learning enables students to understand the concepts better [11].

Outside the class, students can learning independently using a variety of media available on the Quipper School. Through the Quipper School, teachers can input various kinds of teaching media. Invisible human reproductive organs can be presented in the form of images and animation. Physiological processes that occur in the human reproductive system can be presented in the form of animation and video. To add an explanation of the images, videos, and animations presented, there are material presentations in the form of text that are integrated with other teaching media. Students' needs for material can be facilitated and this way can help students to understanding the material. They can choose the material substance that they want to be studied without having to carry a heavy text book. They had the opportunity to learn better and repeat the subject matter. They can deepen their understanding of the subject matter [14].

Quipper School as computer-based media can help to create effective learning processes because it fulfill the display aspects such as text, video, images, and animation. It also fulfills important components in the learning process, namely discursive, adaptive, interactive, and reflective [15]. In the discursive aspect, Quipper School have a message feature that allows students to discuss with their teacher. When students have difficulties for learning outside of school hours, they can ask their teacher through that feature. Teacher can directly answer via online (through message features) or discuss it in the class at the next meeting. Therefore, student difficulties can be solved [5], [6], [7]. This discussion process will facilitate students to find an information from difficult concepts. Through this activity students will be able to explain something based on their own thoughts, while the teacher will provide feedback that will trigger student attention and involvement. In the adaptive aspects, teacher adapts the interaction of students with their environment through image representation or animation. Thus the student will compare the knowledge he had before with the object he observed. Students will be able to interpret the thoughts they build. In the interactive aspect, there are various kinds of teaching media in the form of videos, images, animations, and a combination of the three that allows students to interact actively and enhance their experiences. In Quipper School, various forms of questions, such as multiple choice, matching, and stuffing. The presented questions have been designed to help students for improving their concepts understanding, in accordance with the cognitive level of Bloom taxonomy. After doing the exercises, students can immediately know the results of their work, then they can find out the level of mastery of their material. What material that they have mastered and not mastered yet. The last, in the reflective aspects, students reflect on their learning experiences and their relationship to the teacher's description. Therefore, students will be able to adjust their own concepts.

The analysis results showed that the use of Quipper School during learning could improve students' conceptual understanding better than conventional learning. The use of Quipper School in learning had been proven to improve students' understanding of concepts effectively, especially in the material of the human reproductive system.

4. Conclusion

This paper has presented Quipper School an online-based learning media to improve students' conceptual understanding of biology subjects. From the results, it can be drawn a conclusion that there are significant differences in students' conceptual understanding in human reproductive system between the experimental group and the control group. The category of student conceptual understanding improvement are medium in both of the two groups. However, the test result difference shows that there are significance differences in conceptual understanding between the experiment group and the control group with the sig. value is 0.000. It means that the use of Quipper School in human reproductive system learning can facilitate effectively the enhancement of students' conceptual understanding in science.

Acknowledgment

Author would like to thank Dr. Slamet Suyanto as the supervisor who always provides input, guidance and support from the preparation to completion of this research. Authors thank to the headmaster of SMA Negeri 2 Ngaglik and SMA Negeri 1 Prambanan for research permission at the school, to the teachers and the staffs who have helped so that research can run smoothly. Special thanks to biology teachers in SMAN 2 Ngaglik and SMAN 1 Prambanan for assistance, support, and collaboration during the research

References

- [1] Çimer A 2012 *Educ. Res. and Rev* **7** 61-71
- [2] Gabel D 2003 *Educ. Horizons* **81** 70-76
- [3] Konicek-Moran R and Keeley P 2015 *Teaching for Conceptual Understanding in Science*. (Virginia: NSTA Press) pp 1-6
- [4] Lubiano M L D 2017 *The Southern Luzon J. of Arts and Sci.* **9** 39-51
- [5] Trisnangsih S, Suyanto S and Rahayu T 2016 *J. Pend. Bio.* **5** 28-36

- [6] Saptani D A 2017 *Advances in Social Science, Education and Humanities Research (ASSEHR)* **82** 233-5
- [7] Mulyono H 2016 *Teaching English with Technol.* **16** 59-70
- [8] Komarudin U, Rustaman N Y and Hasanah L 2016 *Proc. Conf. on Math., Scie., and Comp. Sci. Edu.* (AIP Publishing) pp 1-6
- [9] Stein J and Graham C R 2014 *Essential for Blended Learning: A Standards-Based Guide* (New York: Routledge) p 12-13
- [10] Psycharis S, Kalogiannakis M and Chalatzoglidis G 2013 *Eurasia J. of Math., Sci., & Technol. Edu.* **9** 11-21
- [11] Wijanayu A, Hardyanto W and Isnaeni W 2018 *J. of Prim. Edu.* **7** 88-95
- [12] Hill M, Sharma M D and Johnston H 2015 *Eur. J. Phys* **36** 1-20
- [13] Khlaisang J and Likhitdamrongkiat M 2015 *Procedia – Soc. and Behav. Sci.* **174** 759-767
- [14] Kosasi S 2015 Perancangan *e-learning* untuk meningkatkan motivasi belajar guru dan siswa. *Pros. Sem. Nas. Pend. Tek. Informatika (Singaraja, Bali, 12 September 2015)* pp 82-88
- [15] Laurillard D 1993 *J. of Edu. Television.* **19** 81-93