The implementation of discovery learning using personal site in physics online classroom

L L Sarah
Lab School Senior High School, UPI, Bandung, Indonesia
E-mail: lialaesa@smalabupi.sch.id

Abstract. This study aim to describe the implementation of discovery learning using personal site in online physics classroom. Learning process still could not conducted by face to face at school instead students and teachers have to conduct learning process by online learning. There are many platform and resources for online learning, but teachers need to design these resources to make a meaningful learning for students. An alternative approach or learning model as a meaningful learning is discovery learning. Personal sites was designed according to discovery learning step model in rubber, spring and Hooke's law concepts. Personal teacher's site contain some videos, text, simulation and guide of data collecting depend on the needs of discovery environment. In addition, students also used personal sites to make a report (e-portfolio) about the result of their learning process, made generalization, work in a group and presenting. Students show their abilities in independent investigation, data collecting and making a report using personal site. Based on normalized gain score 0.63, there is increasing students’ learning outcome with learning effectivity in average category. In addition, percentage of students who complete all assignments on time 80% mean that discovery learning using personal site has good criteria for students’ interaction with learning material. These indicates that discovery learning is an alternative method in online physics classroom although there are many things need to improve and develop such as animation or simulation and guided experiments.

1. Introduction
In March 2020, the Indonesian Government announced that schools should close because of the emerging threats and impact of Coronavirus (COVID-19) in Indonesia [1]. COVID-19 has had worldwide impact on individual health and the economies of many countries including Indonesia [1]. In an attempt to contain the spread of the virus, the government decision required that all school activities including teaching and learning process should be conducted from home. This decision required a significant change of learning and teaching process, moving from the normal classrooms (with face-to-face approaches) to virtual classrooms (applying online learning approaches). The decision and consequential changes presented teachers with new challenges in design and facilitating student learning process in online[2]. In order to conduct meaningful learning, in this research Discovery Learning method will be implemented on the Personal Site to enhance students’ activities and learning outcome. So that this study purposes to know how the effectivity of implementation Discovery Learning using personal site in physics online classroom.
Effective teaching online is not just about making a video or using video conferencing to replace the normal face-to-face teacher-student interactions. Students not only need access learning material but also to collaborate among them[2]. Because teaching for learning is complex and teaching online is different to teaching face-to-face. For example when teacher want to know whether students really learn about the material or not, in online learning teacher need a special tools because teacher could not see the students learn in their home. Different from face to face learning while interaction between teachers and students is an important key, there is a problem related to the teacher-student interactions during online lesson [3]. There are some challenges faced by teachers when teaching an online course. Teachers require planning and preparation more time in online learning than face-to-face class to be well-prepared and ready[2]. When the teacher carry out face to face learning to distance learning then the teacher adjust strategy and material is the fundamental thing[3].

Students need meaningful learning to learn new concepts in any learning mode, including online learning. Online learning, not only recording the teacher explaining a material then uploading it to the network, then students are seen to watch the recording. [3] explains that:

“Web facilities are just a tool. It’s like we have paper and pens in a classroom which are tools. The approach could be group discussion or a lecture. The tools help the student to learn. But the learning takes place within a pedagogical structure, or an approach”

But how the design of an approach or pedagogical structure in online learning. There are many kind of method or approach to design a meaningful learning, one of them is Discovery Learning. Some researches concludes that discovery model improves student learning outcomes, for example the application of the guided improve students’ learning outcome especially in understanding the concept[4], discovery learning encourage students’ creative thinking ability in learning subject[5-6]. The other research show that learning outcome in natural science has significant effect using discovery learning model [7]. Likewise in learning science.

Discovery learning has three main characteristic, they are concern on active learning, development of meaningful learning and change attitude and problem solving [6]. The student is an active participant in the learning process rather than as a passive who just receive a new concept from the teachers. Active involvement to construct new concept is a deeper processing information. Information which is as a learning result in the deeper processing means looking at the material beyond memorization [6].

Discovery learning method has six sequence are stimulation, problem identification, data collection, data processing verification and generalization [8]. First step discovery learning is stimulation. Stimulation is the step of exposing students to something that causes confusion (curiosity) in the form of phenomena related to concepts. Some activities in the stimulation step are ask the questions, suggest reading book, show the phenomena or other activity that lead preparation to the problem [8]. Second step is problem identification. This step is identification of problems relevant to the subject matter, then one of them is selected and formulated in the form of a hypothesis. The activities in identify problems could be through questioning, observation, etc. [9]. Third step is data collection, is the step where students are given the opportunity to collect data through investigations to answer questions or prove hypotheses [8]. Fourth step is data processing, it is the step of data processing activities that have been obtained by students. This step serves as generalization, so that students will get new knowledge from alternative answers that need to be proven logically. Fifth step is verification, it is step that carry out careful examinations to prove the hypothesis determined based on and the results of data processing. The last step of discovery learning is generalization, it is an interesting basis that can be used as a principle for all the same events or problems.

Discovery learning has been implemented in Virtual Museum Indonesia as a website to learn about rocks and material. This is a kind of online environment material. In the website of Virtual Museum Indonesia for rocks and material, discovery learning was designed to presents the concept so students can learn independently [11]. The research concludes that discovery learning method in virtual learning
has good prospect to increase students learning outcome. The other research about implementation
discovery learning in online environment [4]. The research conclude that there is significant learning
outcome using discovery learning with E-Learning Edmodo enhancing presentation application [4].
Related to some research before that discovery learning has positive impact to students learning outcome
in online learning mode, this research would implement discovery learning using personal site in physics
online classroom. This research will figure out how students’ activity in online learning using personal
site which has content material was presented as step by step discovery learning model. Finally, this
research will find out the learning effectivity in physics online classroom using discovery learning based
personal site.

An important part of online learning design is embedding pedagogical structure into the technology
[12]. There are many technologies that we can use to support online learning, for example, learning
management systems (LMS) such as Moodle, or free open access application such as G suite for
education and Microsoft teams. Even more interesting, we can use the YouTube channel to store content
of videos, game and many HTML application or Web 2.0 Tools so the learning content becomes more
interesting [10]. However, the technologies mentioned above certainly have limitations, especially if we
want to design online learning based on discovery learning approach both hands-on and virtual.

2. Methods
The method in this research is quasi experiment one group pretest posttest design. Before the lesson,
students got the pretest and after finished lesson, students got posttest. The gain score of Pretest
Posttest aim to get effectivity of learning process. The gain score can be formulated by:

\[
< g > = \frac{T_1 - T_i}{T_{max} - T_i}
\]  

(1)

Based on normalized gain score, the effectivity learning can be determined by table 1.

| <g>   | Criteria Category |
|-------|-------------------|
| 0,70 < <g> < 1,00 | High             |
| 0,30 < <g> < 0,70 | Average          |
| 0,00 < <g> < 0,30 | Low              |
| <g> = 0          | Stable           |
| -1,00 < <g> < 0  | Decrease         |

In the other hand, to get student’s interaction during learning process, Google classroom was used
by teacher to see how many student complete the assignment. How many students complete the
assignments is indicator of interaction between students and learning material (The Site). Percentage of
students’ interaction can be calculated from number of students complete the assignment divided by
total number of students. If the percentage more than 70%, it indicates that there is a good opportunity
to enhance students’ interaction with learning material using personal site with discovery learning.

The last method is questionnaire in order to get students’ respond. Students answer some questions
about experience when using the site, what is the problem that they found, and how many they use the site,
3. Result and Discussion

Discovery Learning Using Personal Site has been implemented in grade 11 Senior High School, Laboratory School Indonesia University of Education. The implementation of discovery learning consists of rubber, spring and Hooke’s Law concept. In this study, I used Google site to implement Discovery Learning on my physics online material. Personal site has address http://lialaesa.smalabupi.sch.id. Personal site was designed according to discovery learning step model in rubber, spring and Hooke's law concepts. Teacher’s Personal site contain some videos, text, simulation and guide of data collecting depend on the needs of discovery environment. The outline of how I designed discovery learning for rubber, spring and Hooke’s Law concept in my Personal Site, is in table 2 below.

| Step of Discovery Learning | Design In Personal Site | Application |
|---------------------------|-------------------------|-------------|
| Simulation                | Description the use of rubber in our daily life and review of Hooke’s Law of spring | Text, Picture, Video, Phet Simulation |
| Problem Identification    | Question the elasticity of the rubber and the strength | Text, Google Meet, Google Classroom |
| Data Collection           | Guidance about experiment from home to investigate characteristic of the rubber (is the rubber has same characteristic with spring (Hooke’s Law)) | Google doc |
| Data Processing           | Guidance how to make a graph form the data | Video |
| Verification              | Students present their result of observation/experiment, data and the analysis and do discussion session, some students groups presenting and another groups responding to the presenter | Student’s Site, Meet, Video |
| Generalization            | Conclusion of principle or concept of Rubber’ elasticity | Student’s site |

Based on number of students who complete the assignment for every steps, here is the percentage for every steps.

| Step of Discovery Learning | Percentage |
|---------------------------|------------|
| Simulation                | 86,54%     |
| Problem Identification    | 80%        |
| Data Collection           | 80%        |
| Data Processing           | 80%        |
| Verification              | 80%        |
| Generalization            | 80%        |

Table 2. Design of discovery learning.

Table 3. Percentage of students complete the assignments
Based on the table above, we can see that student’s interaction with learning material that was presented on discovery learning model in Personal Site has good criteria. In the first sequence, students were active in reading text and did the simulation on the site about elasticity in daily life, constant of spring, Hooke’s law and series parallel of some spring. 13.46% students missed assignments but 86.54% students submit the review of their resume after reading and did the simulation on the site. These mean that most students can complete the assignment and did the learning process using personal site in the first sequence (simulation). After reading sequence, teachers and students conducted meeting online as second sequence (problem identification).

In order to increase students interaction, I use virtual laboratory like PHET (http://phet.simulation.colorado.edu), YouTube channel to upload verification video and some another worksheet online and doc online. Students also have their own site to write and present their learning result or observation and discussion result.

During meeting online, students more active answering teacher’s question and discussion with others in order to make a problem identification about rubber’s elasticity. In the end of meeting online, students agree to answer the question about rubber’s elasticity, how is the elasticity of the rubber? Is it suitable with Hooke’s Law?, how is constant of series system of some rubbers?, and how is constant of parallel system of some rubbers?

After meeting online, students have a week to conduct the observation or experiment in their house using an experiment instructions that have been developed by teacher in google doc. Students could make a modification and creations using local material that they have at home to get some further data based on their modifications. They worked in a group with 5 or 6 members. They made their own site to present about their experiment consist of materials, the procedure, data, their analysis and conclusion. When they finished developing the site, they sent the link to the teacher in Google Classroom assignment. Teacher can see how the collaboration process between students when they conduct the experiment. 20% students missed the assignment of experiment and did not conduct the experiment at home. Some students could not make a collaboration with their friends because they did not have some close friends, some of them said that They did not conduct the experiment because it is too hard for them. But 80% students could complete the sequence of data collection and data processing and finished the assignment of experiment. Students show their abilities in independent investigation, data collection and communication by making a report using their personal site. Here some pictures of them.

![Picture 1. Some of Students’ Site](image)

After students finished their report of their experiment at home, teacher and students meet on online to discuss about the result of experiment (verification) and make generalization of the concept. During discussion session, students did presentation confidently. Students in a group take their part to present and other students give a question to the presenter. Discussion session feel more active.

Finally, based on pretest and post test, learning process has normalized gain score 0.63. It is in average category. These mean that discovery learning using personal site in physics online classroom can improve students learning outcome. Students learn the concept independently whenever they have time, students also can repeat the learning process through the site as long as they have internet access. These finding also was strengthened by the result of questionnaire that 83.1% students very often (more than 1 times a week) using the site when they learn. 82% of students also agree that using teacher's site
make it easier than using handbook. Teacher's site was more attractive with videos and animations and
easy to use.

The result of this research is appropriate with the research of [14] that discovery learning in online
platform can improve students learning outcome. So discovery learning using personal site has a good
opportunity for the teachers to develop an interactive meaningful learning. Nevertheless, the personal
site still need development and improvement based on the questionnaire and students experience
especially in appearance menu, simulation of concept and guide of experiments.

4. Conclusions
Discovery learning Using Personal Site (Google Sites) is an alternative method to provide meaningful
learning and increase students interaction with learning material during online learning. More than 80%
students active during learning and complete the tasks. Personal Site also help teacher to conduct more
interactive learning during synchronous teaching learning. 82% students agree that Personal Site help
them to understand the concept because the Site contain video and interactive simulation. Finally,
Discovery Learning Using Personal Site improved students outcomes with normalized gain score is 0.63
in average category. But there many things still need to develop and improve especially in simulation
and strategy.

5. References
[1] Djalante R, Lassa J, Setiamarga D, Sudjatma A, Indrawan M, Haryanto B, Mahfud C, Sinapoy M
S, Djalante S, Rafliana I, Gunawan L A, Surtiari G A K and Warsilah H 2020 Review and
analysis of current responses to COVID-19 in Indonesia: Period of January to March 2020
Prog. Disaster Sci. 6 100091
[2] Atmojo A E P and Nugroho A 2020 EFL Classes Must Go Online! Teaching Activities and
Challenges during COVID-19 Pandemic in Indonesia Regist. J. 13 49–76
[3] Hamid R, Sentryo I and Hasan S 2020 Online learning and its problems in the Covid-19
emergency period J. Prima Edukasia 8 86–95
[4] Sumianingrum N E 2017 Efektivitas Metode Discovery Learning Berbantuan E-Learning di SMA
Negeri 1 Jepara PEMBELAJAR J. Ilmu Pendidikan, Keguruan, dan Pembelajaran 86–95
[5] Rahman M H 2017 Using Discovery Learning to Encourage Creative Thinking Int. J. Soc. Sci.
Educat. Stud. 4
[6] Svinicki M D 1998 A theoretical foundation for discovery learning. Am. J. Physiol. 275 4–7
[7] Suendarti M 2017 The Effect of Learning Discovery Model on the Learning Outcomes of Natural
Science of Junior High School Students Indonesia Int. J. Environ. Sci. Educ. 12 2213–6
[8] Anggraini R D, Murni A and Sakur 2018 Differences in students’ learning outcomes between
discovery learning and conventional learning models J. Phys. Conf. Ser. 1088
[9] Ellizar E, Hardeli H, Beltris S and Suharni R 2018 Development of Scientific Approach Based
on Discovery Learning Module IOP Conf. Ser. Mater. Sci. Eng. 335
[10] Light D and Polin D K 2010 Integrating Web 2.0 tools into the classroom: Changing the culture
of learning EDC Cent. Child. Technol. 1–34
[11] Sarah L L, Prihatmanto A S and Rusmin P H 2012 The design and implementation discovery
learning method on virtual museum of Indonesia: (A case study museum of geology for rock
materials) International Conference on System Engineering and Technology (ICSET), 1-5
[12] Shaw G 2018 Chapter 5: Learning and teaching in the online era Successful University Teaching
in Times of Diversity (Darwin, Australia: PALGRAVE) pp 83-189
[13] Hake 2008 Analyzing Change/Gain Score. Retrieved Feb 17, 2017. Retrieved from Dept. of
Physics, Indiana University: http://www.physics.indiana.edu/~sdi/AnalyzingChangeGain.pdf
[14] Syukri M 2020 The application of guided discovery learning model to improve students concepts
understanding J. of Phys.: Conf. Ser 1460 012122