USEJ 6 (2) (2017)

Unnes Science Education Journal

http://journal.unnes.ac.id/sju/index.php/usej

HOW DOES E-LEARNING HELP THE ACHIEVEMENT OF IQF? THE ANALYSIS OF E-LEARNING TASK OF CREATING TEMPORAL EVOLUTION CHART AND THE ABILITY TO SOLVE THE PROBLEMS IN THE SYMPTOMS OF VIBRATIONS AND WAVES

Wahono Widodo[1]✉, Laily Rosdiana[2]✉, Tutut Nurita[3]✉, An nuril Maulida Fauziah[4]✉

Lecturers of Science Education Department, Faculty of Math and Science,
Universitas Negeri Surabaya, Indonesia

Article Info

Received April 2017
Accepted June 2017
Published July 2017

Keywords:
e-learning, capability, graphs, problem solving, IQF

Abstract

The use of e-learning to improve students' ability in using technology to help solve the problem (Level 6 Indonesia Qualification Framework, IQF) is challenging. This study aimed to describe the use of e-learning to improve students' ability to create charts of the evolution of the spatial and temporal regions of the symptoms of vibrations and waves. The techniques were by using a computer, problem-solving skills, as well as the responses of students' prospective science teachers to use e-learning to the symptoms of vibrations and waves. This research is a quasi-experimental design with one shot case study. The research subject was 28 science student teachers semester 5. The treatment was in the form of learning materials, learning, performance tasks, and test essay on e-learning system UNESA (www.vilearn.unesa.ac.id). The ability to make charts the evolution of the spatial and temporal with computers and capacity to solve problems is measured using an appropriate rubric, student responses obtained through the questionnaire. The results showed, with the provision of sustainable performance tasks on e-learning followed up with feedback, students' ability to make a graph of the spatial, temporal evolution of the computer and problem-solving skills have increased. A total of 85.7% of the students stated that create the spatial and temporal evolution chart using a computer is hard, but 67.9% of them stated that the e-learning to assist them in making a graph. A total of 100% of the students can solve the problems of the minimum standards, with an average value of 82.9, which shows the use of e-learning helps students to master solving problems on vibrations and waves.

p-ISSN 2252-6617
e-ISSN 2502-6232

✉Corresponding author:
Wahono Widodo[1], Laily Rosdiana[2], Tutut Nurita[3], An nuril Maulida Fauziah[4]
Lecturers of Science Education Department, Faculty of Math and Science,
Universitas Negeri Surabaya, Indonesia
E-mail: [1]wahonow@gmail.com,
[2]lailyrosdiana@unesa.ac.id
[3]nurita.tutu@gmail.com
[4]annurilfauziah@unesa.ac.id

INTRODUCTION

Science was the activity to ask and do an experiment toward nature and then finding and stating the messages hidden within. John Rigden in Carin (1993) emphasized two characteristics of the nature of Science that were empiric and analytic. Scientists would not be satisfied with only doing observation. They searched for the means hidden, basic patterns, and found clear explanation sequences to be combined with their observation. The conceptual framework and theoretical structure are the imaginative results of a scientist's inquiry.

The students of prospective Science teachers, in the end, had to be capable of carrying out the learning process based on the Science characteristics above. In the more general context, the fresh graduates of Science Education had to reach level 6 for IQF in their fresh graduate profiles. The Indonesia Qualification Framework (IQF) is regulated by Presidential Decree Number 8 2012. It is the framework of the qualification of competence which could pair up, equalize, and integrate education department and work training department as well as working experience to give recognition of work competence according to the working structure in various sectors.

The sixth qualifying level of IQF was the standard of knowledge mastery which should be had by the bachelor degrees. Some keywords in IQF level 6 which were relevant to this research were: 1) to utilize the problems; 2) to master the theoretical concepts of certain knowledge and skill areas generally and the theoretical concepts of special knowledge and skill areas deeply; and also 3) to be able to complete the problems according to the procedures. Various courses existed, including Waves and Optics courses in the Science Education, should train the students to reach the IQF level 6 cumulatively.

Nowadays, the ability to understand graphs was essential for the students. A graph was a type of representation which was useful in resuming the data, processing and interpreting the new information from complex data. The presentation of graphs, diagrams, data tables, symbols, maps, and models was found considerably in various textbooks, articles, journals, and scientific magazines. Writing with transformation type was a form of visualizing the concepts to another format or model (Demirbag & Gunel, 2014). The presentation of graphs, data tables, symbols, maps, and diagrams brought the information, data organization, showed the relation patterns, and communicated the science knowledge.

In Science, there were many types of representations such as 1) Verbal description, that was to define a certain concept verbally; 2) Figure or diagram, helped to visualize something which was still abstract into something more concrete in order to help the students' understanding; 3) Graphs, through graphs, the long explanation could be illustrated as short information; 4) Mathematics, though mathematics representation, the quantitative problems could be explained and interpreted easier and clearer. It was following the presentation of the representations in Waldrip et al., (2010).

The knowledge of graphs and data interpretations in science and science education was important for the students. However, many elementary, secondary, until college the students still had difficulties in using, interpreting, and understanding graphs and data (Ben-Zvi et al., 1987; Krajcik, 1991; Leinhardt et al., 1990). The students' competence in interpreting graphs and data had become important in the science learning.

By the IQF level 6 and Science representations, the students of prospective Science teachers should have the ability to create graphs with computer help. This ability grew through e-learning system. Koran (2002) defined e-learning as any teaching and learning method using electronic circuits (LAN, WAN, Internet) to deliver learning content, interaction, or consultation. There were also some interpreting e-learning as a form of distance learning through the internet. Dong in Kamarga (2002) defined e-learning as an asynchronous learning activity through the electronic computing device to obtain suitable and necessary learning sources. Park (2009) emphasized that e-learning refers to the use of internet technology to send a series of solution which could improve knowledge and skills.

Polya (1985) proposed four steps in the problem-solving phase, i.e. understanding the problem, planning the resolution, solving the problem, and checking back every step that had been done. The phase of understanding the problem without understanding the given problem was impossible for the students to solve

correctly, and then they had to be able to organize plans or strategies. Problem-solving in this phase depended on the students' experience to be more creative in arranging the solution for a problem if the scheme to solve a problem had been well-made either it was written or not. The next step was for the students to be able to address the problem according to the plan which had been arranged and considered right. The last step of the problem-solving process according to Poyla was to check on the things which had been done from the first phase until the third one. With this kind of model, some mistakes would not happen and could be corrected so that the students could found the most suitable answer for the given problem.

Based on Sindu's (2013) research, problem-based e-learning model could be applied to the students with both high and low learning motivations. It was because problem-based e-learning continuously stimulated the students to involve in the learning process actively and to be able to develop their skills in e-learning. Nevertheless, according to Empy & Zhuang (2005) e-learning had limitations, such as; 1) culture. Many people were not interested in learning. Most people got used to listen to the lesson explained by the teacher and accept it. 2) Investment. E-learning users could gain some benefits. Nonetheless, the e-learning program providers had to spend some money to buy the software and hardware as the support devices for e-learning. 3) Technology and infrastructure. Technology and infrastructure problems were quite a lot, such as the lack of hardware specifications in computers to support e-learning, unsynchronized browser, even the internet users with uneven capacity across the region. 4) Material. The learning materials with physical objects obviously could not be inserted into e-learning application, such as sports and arts. However, e-learning could explain the concepts first.

There were some advantages in using e-learning to do assignments and quizzes, for example, it could handle many tasks efficiently (Larsson, 2014), the quiz presentations were better (von Franqué and Tellioglu, 2014), and it was flexible (Karaman, 2011). Also, e-learning was flexible and efficient to perform an examination and give assignment (Larsson, 2014). However, the online quiz with e-learning was carried out in the form of multiple choice test (Nakayama et al., 2010). Even though the problem-solving performance and Figures making with the help of the computer, this could not be trained and graded with just choosing the multiple choice option in the e-learning application. In line with this was the researcher's experience on the use of e-learning in the lectures, such as the students' tendency to copy-paste the assignments sent through e-learning system and the assessment system in e-learning which was considered only appropriate for multiple-choice items, not essay items.

This study focused on describing the student's ability in creating graphs, solving spatial and temporal problems on the vibration and wave symptoms, and the response of the students of prospective Science teachers by using e-learning. Through this study, some questions limiting the problems in this study included two parts, which were 1) how the students' ability solved the problems and created graphs of the data of vibration and wave materials?; 2) How the student's response to the use of e-learning in the vibration and wave course?

METHODS

This study was a quasi-experimental research. The purpose of the quasi experimental research was to find out the cause and effect relationship by involving the control group beside the experimental group; nonetheless, the selection of both groups did not use the random sampling technique (Arikunto, 2010). The research design used was one shot case study. Therefore, it was possible for descriptive analysis technique to process the data. The treatments were in the form of the learning process, learning strategy, performance task, and essay test in the Unesa e-learning system (www.vilearn.unesa.ac.id). The ability to create graphs of temporal and spatial evolution using the computer and capacity to solve a problem was measured using the students' response from the questionnaire.

The study took place in Science Education Department of Mathematics and Science Faculty of Unesa Surabaya in the even semester of the academic year of 2016/2017. The population was all of the students of 2014 class. The samples were the students of Science Education Department on class 2014 B. The sampling technique was purposive sampling technique.

The research procedures were divided into three steps that were planning, executing, and organizing the research result. The planning stage covered material development and uploading. The executing stage was in the form of Optical Wave learning using e-learning and post-tests.

The planning stage began with opening an account in www.vilearn.unesa.ac.id, then signing up the Optical Wave course, and the lecturer team and the students as e-learning participants. In the executing stage, the Optical Wave course materials were presented in the e-learning based on the material sequence which would be presented in every lecture accompanied with the assignments which should be done by the students. The course material inserted began from vibration, wave, sound, light, and optic. Various representations were also inserted in the indication of vibration, wave, and optic. The problems presented to be solved selected which were well structured including the demands to finish them in the graph representation. The instruction to make graphs in the e-learning application was in the form of Figures creation strategy, not the steps of making graphs with excel. Here was the example.

To make a graph, look at the amplitude. The deviation could not exceed the amplitude. Therefore, the deviation would have a price -0.04 until 0.04 m. Well, use a relatively thorough shift, for example, 0.0025. Use Excel "term" to do mathematics operation to find out v in the equation (7), that was * for x, sqr () for square, and sqrt () for square root.

The assignments given were in the forms of problem-solving questions, and inside it, there was Figures creation which should be done in the time span provided. If they passed the submitting time, then they were considered that they did not submit. Then, the assignments were corrected by the lecturer team and next, the students were given feedback through e-learning and face to face meeting. In the organization of the research result, the assignments taken as the data were only assignment 1, assignment 2, and assignment 3 because in that assignment there was problem-solving skill by creating graphs according to the IQF level 6.

The research instrument used the result-solving section by Polya; the rubric Figures result in section, and the student response questionnaire after undertaking learning process and task completion using e-learning. Those assignments were presented in the form of problem-solving problems involving spatial-temporal evolutionary graphs on vibration and wave materials. The data analysis technique covered descriptive analysis technique.

The way to analyze the data was by grading assignment 1, 2, and 3 based on Polya's steps. After that, a graph was made from the grades to find out the percentage of the students' problem-solving skills and Figures creation ability.

RESULTS AND DISCUSSION

Results

The vibration and Wave learning process by applying e-learning was optimal in improving the students of prospective Science teacher skills in solving the problem and creating graphs. In assignment 1, the students found difficulties when working on it because they were not used to learning and submitting their assignment using e-learning. The lecturers gave some help through e-learning system to the students in the form of feedbacks. The feedbacks were general (for every participant) and in every the students' works.

After the students got some feedbacks for assignment 1, the lecturer team gave the second assignment to know the shortage of the analysis process happened. The mistakes occurred in the assignment 2 where the students only copy-paste the graphs from friends; then they made the question. Thus it was not according to the appropriate solving analysis steps. From the mistakes happened in assignment 1 and 2, the lecturer team emphasized the proper analysis steps when solving the problem-based questions. Following this, the lecturer team gave assignment 3 as the task of consolidating materials from the mistakes appeared in assignment 1 and assignment 2. In reality, most the students had the right way of the problem analysis with the appropriate sequence, that was making the question first, then making the graphs based on the questions.

The problem-solving analysis could be seen in Figure 1 as follow.

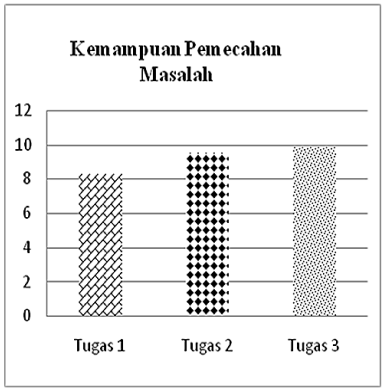

Figure 1. The problem solving analysis results by students

Based on Figures 1, it could be known that the students' ability in solving the problem improved from assignment 1 until assignment 3. The percentage for assignment 1 was 82.86%, assignment 2 was 95%, and assignment 3 was 98.57%. It could be said that generally, the students' ability in solving the problems on the vibration and wave materials had been good. The result of the students' skills to make graphs could be seen in Figure 2 as follow.

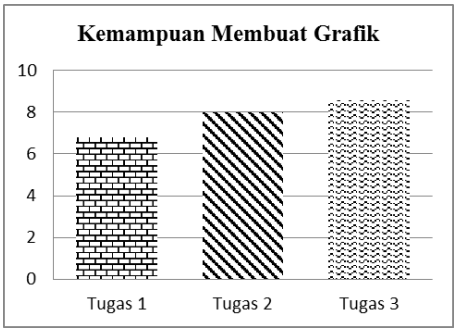

Figure 2. The analysis result of students' skills in making graph

Based on Figure 2, it could be known that the students' skills in making graphs also improved from assignment 1 until assignment 3. The percentage for assignment 1 was 67.87%, assignment 2 was 80%, and assignment 3 was 85.71%. It could be said that generally, the students' ability in solving the problems on the vibration and wave materials had been good. The result of the students' skills to make graphs could be seen in Figure 2 as follow.

The research findings had given contributions to the improvement of the ability of the students of prospective Science teachers in solving the problems and reading graphs, especially in Indonesia. After understanding the students' answers related to the capacity to solve the problems and make graphs, then the findings of the students' general difficulties stated were that the students found it difficult to make questions until solving the problem by creating an appropriate graph.

After understanding the students' answer regarding their skills in making graphs, three categories were 1) correct problem solving and Figures creation; 2) correct problem solving and wrong Figures creation; 3) wrong problem solving and Figures creation. Based on those categories, each finding could be explained as follows:

1. The students who could solve the problem and create graphs correctly presented the data like this.

Based on Figure 1, it seemed that the students had correctly made the questions, then solving the problem specifically until making the correct graphs. Therefore, when executing the Figures creation, it was based on the students' understanding.

2. The students who were able to solve the problem correctly nonetheless wrongly made the graphs, their data presentation was:

Based on Figure 2, it seemed that the students had correctly made the questions, then solving the problem specifically, nonetheless in making the graphs they were wrong, thus when executing the Figures creation, they made the wrong graphs. Thus it could be said that their understanding was not enough.

3. The students who could not solve the problems and make the correct graphs had this kind of data presentation.

Based on Figure 3, it seemed that the students were incorrect in making the questions so that the problem-solving was incorrect. Thus it affected the wrong Figures creation. It happened because the students did not measure the grades written in the questions. Thus the problem-solving was incorrect, and when executing the Figures creation, it became wrong, so that it could be said that the students' understanding was not enough.

The students' response regarding their ability in solving problems and making graphs on the vibration and wave learning through e-learning obtained from the questionnaire given to 28 respondents got the results as follows:

1. About 85.7% respondents stated that creating graphs through e-learning was still

difficult. The source of the difficulties was because they had to interpret the question, choose Δt appropriate to produce data to be made graphs through excel. However, about 14.3% respondents stated that creating graphs through e-learning was easy. According to one of the respondents who found it easy to use e-learning, "At first I faced difficulties, nonetheless because I had got the tasks to make graphs for several times. Thus, I was used to it."

2. About 32.1% respondents said that e-learning could not help them in making graphs; nonetheless, most of them that were 67.7%, stated that e-learning helps them in making the graphs. One of the statements from the respondents mentioned, "Yes, because in e-learning there were always assignments to create graphs so that my skill could be more honed."
3. About 85.7% respondents used the existed information, whereas 14.3% respondents chose to add the information from other sources to finish the assignments.

The research result showed that Optical Wave e-learning system developed in this research made the students able to learn. Various representations represent it, they did work hard to complete the performance task in the given time, and they could obtain sufficient feedbacks. Thus there were skill improvements in problem-solving and spatial-temporal evolutionary Figure creating on the indications of vibration and wave with the help of a computer. It is shown by Khoiriah's (2016) research which demonstrated that the use of multimedia in the science learning could improve the students' cognitive skills. The learning process with the help of various representations virtually inside e-learning was also relevant to the researchers from Ismail et al. (2016) and Taufiq et al. (2016) which was used the devices for e-learning.

CONCLUSION

From the research result, it could be concluded that Optical Wave course using e-learning could produce problem-solving mastery in the students. Also, e-learning system had a potential to train the skill frequently which was expected to be able to be developed during the face to face meeting only. This research showed that by using the correct strategy and good feedback, e-learning could improve the students' skill in creating temporal and spatial evolution graphs on the vibration and wave indications.

It was necessary to research on e-learning which allowed the delivery and assessment process of performance tasks to be more efficient.

REFERENCES

Arikunto, S. (2003). *Dasar–Dasar Evaluasi Pendidikan*. Jakarta: Pt Bumi Aksara.

Ben-Zvi, R., Eylon, B., & Silberstein, J. (1987). *Students' visualization of a chemical reaction. Education in Chemistry*, July, 117–120.

Carin, A.A.(1993).*Learning Theoris for Teaching*. Harper and Publisher. New York.

Demirbag, M., & Gunel, M. (2014). Integrating Argument-Based Science Inquiry with Modal Representations: Impact on Science Achievement, Argumentation, and Writing Skills. *Educational Sciences: Theory and Practice*, *14*(1), 386-391.

Empy, E. & Zhuang, H. (2005). *E-learning Konsep dan Aplikasi*. Yogyakarta : Andi Yogyakarta.

von Franqué, A., & Tellioglu, H. (2014). " UML Quiz": Automatic Conversion of Web-Based E-Learning Content in Mobile Applications. *International Association for Development of the Information Society*.

Ismail, I., Permanasari, A., & Setiawan, W. (2016). STEM Virtual Lab: An Alternative Practical Media To Enhance Student's Scientific Literacy. *Jurnal Pendidikan IPA Indonesia*, *5*(2).

Karaman, S. (2011). Examining the effects of flexible online exams on students' engagement in e-learning. *Educational Research and Reviews*, *6*(3), 259.

Khoiriah, K., Jalmo, T., & Abdurrahman, A. (2016). The Effect of Multimedia-Based Teaching Materials in Science Toward Students'cognitive Improvement. *Jurnal Pendidikan IPA Indonesia*, *5*(1), 75-82.

Krajcik, J.S. (1991). Developing students' understanding of chemical concepts. In S.M. Glynn, R.H. Yeany, & B.K. Britton (Eds.), *The psychology of learning science: International perspective on the psychological foundations of technology-based learning environments* (pp. 117–145). Hillsdale, NJ: Erlbaum

Koran, J.K.C. (2002). Aplikasi 'E-Learning'Dalam Pengajaran Dan Pembelajaran Di Sekolah-Sekolah Malaysia: Cadangan Perlaksanaan

Pada Senario Masa Kini. *Pasukan Projek Rintis Sekolah Bestari Bahagian Teknologi Pendidikan, Kementerian Pendidikan Malaysia*.

Larsson, K. (2014). The Management Challenge: Handling Exams Involving Large Quantities of Students, On and Off Campus–A Design Concept. *International Journal on E-Learning*, *13*(3), 291-306.

Leinhardt, G., Zaslavsky, O., & Stein, M.K. (1990). Functions, graphs, and graphing: Tasks, learning, and teaching. *Review of Educational Research*, 60, 1–64.

Taufiq, M., Amalia, A. V., Parmin, P., & Leviana, A. (2016). Design of Science Mobile Learning of Eclipse Phenomena with Conservation Insight Android-Based App Inventor 2. *Jurnal Pendidikan IPA Indonesia*, *5*(2).

Nakayama, M., Yamamoto, H., & Santiago, R. (2010). The Role of Essay Tests Assessment in e-Learning: A Japanese Case Study. *Electronic Journal of e-Learning*, *8*(2), 173-178.

Kamarga, H. (2002). *Belajar Sejarah melalui e-learning; Alternatif Mengakses Sumber Informasi Kesejarahan*. Jakarta: Inti Media.

Park, S. Y. (2009). An analysis of the technology acceptance model in understanding university students' behavioral intention to use e-learning. *Journal of Educational Technology & Society*, *12*(3), 150.

Polya, G. (1985). How To Solve It 2nd ed. New Jersey : Princeton University Press.

Sindu, I. G. P., Santyasa, I. W., & Warpala, I. W. S. (2013). Pengaruh Model E-Learning Berbasis Masalah dan Motivasi Belajar terhadap Hasil Belajar KKPI Siswa Kelas X di SMK Negeri 2 Singaraja. *Jurnal Teknologi Pembelajaran*, *3*.

Waldrip, B., Prain, V. & Carolan, J. (2010). "Using Multi-Modal Representation to Improve Learning in Junior Secondary Science". *Research Science Education.* 40, 65-80. http://paer.rutgers.edu/scientificAbilities/download/formAssesTask/MultiRep.pdf. (Januari 2017).