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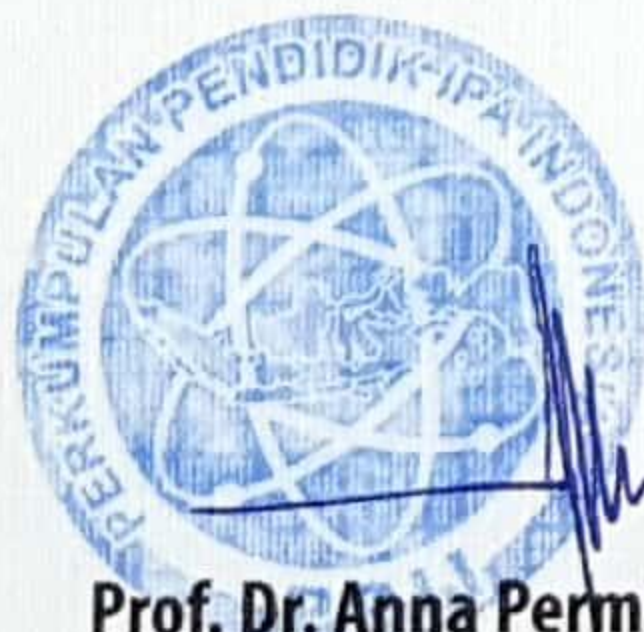
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E-learning task analysis making temporal evolution graphics on symptoms of waves and the ability to solve problems

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E-learning task analysis making temporal evolution graphics on symptoms of waves and the ability to solve problems

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Abstract. This study aimed to describe the ability of pre-service teachers to create graphs, solve the problem of spatial and temporal evolution on the symptoms of vibrations and waves. The learning was conducted using e-learning method. The research design is a quasi-experimental design with one-shot case study. The e-learning contained learning materials and tasks involving answering tasks, making questions, solving their own questions, and making graphs. The participants of the study was 28 students of Science Department, Universitas Negeri Surabaya. The results obtained by using the e-learning were that the students' ability increase gradually from task 1 to task 3 (the tasks consisted of three tasks). Additionally, based on the questionnaire with 28 respondents, it showed that 24 respondents stated that making graphs via e-learning were still difficult. Four respondents said that it was easy to make graphs via e-learning. Nine respondents stated that the e-learning did not help them in making graphs and 19 respondents stated that the e-learning help in creating graphs. The conclusion of the study is that the students was able to make graphs on paper sheet, but they got difficulty to make the graphs in e-learning (the virtual form).

1. Introduction

Science is an activity to ask and conduct an investigation of the universe then find and declare hidden messages that are in it.

John Rigden emphasizes two characteristics in the nature of science. First, IPA has an empirical character. The empirical aspects of the world must be considered first when studying the science. These empirical aspects are all aspects that can be observed or encountered directly. Guiding the child to investigate and describe the objects around him is an important achievement in science learning at the elementary and secondary levels.

The second characteristic is that science has analytical properties. Scientists will not be satisfied just by doing the observation. They search for hidden meanings, archetypes, and put forward a clear set of explanations to integrate with their observations. Conceptual frameworks and theoretical structures are the imaginative outcomes of analytical investigations of scientists. New observations can encourage the discovery of new concepts, theories, and accumulations of knowledge that can motivate the question of new facts. Observation is an empirical experience in seeking understanding, the theory is a temporary understanding in search of further empirical justification.

Paulu and Margery Martin (in Carin, 1993) stated that discussing the nature of science with children proved useful.

They discussed science as:

- Watch what happened
- Trying to be able to consider what we observe,



- Using new knowledge that we have to predict what will happen in the future, and
- Test predictions under controlled conditions to see the correctness of those predictions.

KKNI (Curriculum of Indonesia for Higher Education) regulated by Presidential Regulation No. 8 of 2012, which is the elaboration of the higher regulations. In the regulation, in Pasal 1 paragraph (1), it is explained that what is meant by the Indonesian National Qualification Framework (KKNI) is a framework of competency qualification that can match, equalize and integrate between the field of education and the field of job training and work experience in the framework of granting recognition of work competence in accordance with the structure of work in various sectors.

Overall implementation strategy of KKNI should be able to reflect some of the following:

- become an integral part of the national human resource management and improvement strategy;
- be a reference for the development and improvement of national education quality generally and higher education in particular;
- guide industry, businesses, and government institutions to plan and develop career paths;
- serve as guidelines and guidance on developing and enhancing the quality of private and government training institutions;
- serve as guidelines for professional associations to develop professional development; and
- be the guidance of the workers or the broader community to develop themselves and careers.

In the learning conditions at the Higher Working Unit in accordance with the implementation strategy of first and second KKNI which in essence the quality of national education and higher education in particular need to manage and improve the quality of human resources. Description of learning achievement for each level of qualification of graduates Higher education can be found in Decree of the Minister of National Education of Republic of Indonesia Number 232 / U / 2000 on Guidelines for the Formulation of Higher Education Curriculum and Assessment of Learning Outcomes, article 3 (paragraph (2), paragraph (3), and paragraph (4)), and article 4 (paragraph (2), paragraph (3), paragraph (4), and paragraph (5)). In the Ministerial Decree the description of the learning outcomes explained that the Graduate Program graduated results are directed to have the following qualifications:

- a. mastering the scientific basis and skills in a particular field of expertise so as to be able to find, understand, explain, and formulate ways of solving problems within the area of expertise;
- b. able to apply his knowledge and skills in accordance with his area of expertise in productive activities and services to the community with attitudes and behavior in accordance with the common life order;
- c. able to behave and behave in bringing themselves to work in the field of their expertise and in community life together;
- d. able to follow the development of science, technology, and / or art that is his expertise.

In this present era, according to the above information the ability to understand the graphics for students is very important. Graphs are a useful type of representation in summarizing data, processing and interpreting new information from complex data. The presentation of graphs, diagrams, data tables, symbols, maps, and models is found in many textbooks, articles, journals, and scientific magazines. Writing with this type of transformation is a manifestation in visualizing concepts to other formats or models (Latour, 1987). The presentation of graphs, data tables, symbols, maps and diagrams carries information, organizes data, shows relationships patterns, and communicates scientific knowledge.

In Science there are many types of representations, among others: 1). The verbal description, which is to define from a verbal concept. 2). Pictures or diagrams, through pictures can help visualizing something that is still abstract becomes more concrete so that will help students understanding. 3). Graphs, through graphs, then a long explanation can be illustrated into short information. 4). Mathematics, through this mathematical representation, the quantitative problems can be explained and interpreted to be easier and clearer.

Knowledge of graphical interpretation and data in the field of science and science learning is essential for students to have this competency. However, many elementary, middle-to-senior students still have difficulties in using, interpreting, and understanding graphs and data (Ben-Zvi, Eylon, & Silberstein, 1987; Krajcik, 1991; Leinhardt, Zaslavsky, & Stein, 1990). Student competence in graphic and data interpretation has become an important part of science learning.

Student competence in making graphs easier with the help of IT systems. IT systems in learning in universities one of them using e-learning help. Jaya Kumar C. Koran (2002) defines e-learning as an arbitrary teaching and learning that uses electronic circuits (LAN, WAN, or internet) to convey learning content, interaction, or guidance. There are also interpreting e-learning as a form of distance education conducted through the internet media. While Dong (in Kamarga, 2002) defines e-learning as an asynchronous learning activity through a computer electronic device that obtains learning materials to suit their needs. Or e-learning is defined as follows: e-Learning is a generic term for all technologically supported learning as an array of teaching and learning tools as phone bridging, audio and videotapes, teleconferencing, satellite transmissions, and the more recognized web-based training or computer aided instruction also commonly referred to as online courses (Soekartawi, Haryono and Librero, 2002). Rosenberg (2001) stresses that e-learning refers to the use of Internet technology to deliver a range of solutions that can increase knowledge and skills.

This research focused on describing students' ability in making graphs, solving spatial and temporal evolution problems on vibration and wave phenomena, and student responses by using elearning. Through this research, some questions that limit the problem in this activity include 2 parts, namely: 1. How the ability of students to solve problems and create a graph of a data material vibration and wave? 2. How does the student respond to the lecture of vibrations and waves when using elearning?

2. Research method

This type of research is quasi experimental or quasi experimental research. This quasi experimental research aims to reveal causal relationships by involving the control group in addition to the experimental group, but the separation of both groups is not by Suharsimi random technique (2010: 9). The design in this study used one shot case study. Therefore, it allows descriptive analysis in processing the data.

The research was conducted in S1 Science Education Study Program of FMIPA Unesa Surabaya even semester of academic year 2016-2017. The population is all students of class of 2014. The sample is student of Science Prodi Science Class 2014 B. Sampling technique is by way of purposive sampling. The variables in this study are control and response variables. The control variable is the material that is taught by the teacher of vibration material and the wave that is written on elearning, while the response variable is the result of making the graph and solving the problem.

The research procedure is divided into three stages: planning, implementation, preparation of research results. The research instrument is about test that is uploaded in elearning and student response questionnaire after doing learning using elearning.

The sheet instrument covers the concept of vibration and wave. The problem represents aspects of problem-solving skills and graphics. Data analysis techniques include descriptive analysis.

3. Result and discussion

Learning vibrations and waves by applying e-learning are more optimal for improving problem-solving and graphics-making skills of pre-service science teachers. For problem solving skills can be seen in Figure 1 as follows:

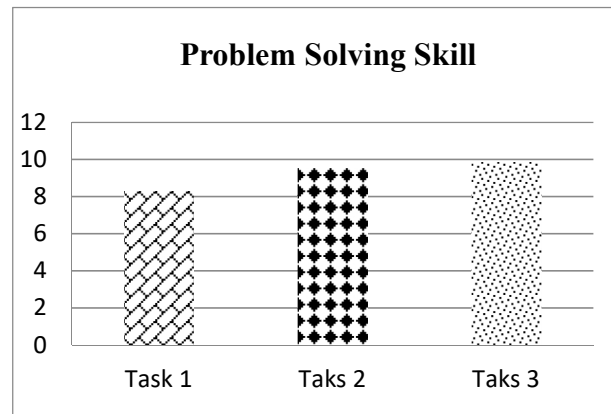


Figure 1. Profile of Students' Problem Solving Skills.

Based on Figure 1 it can be seen that the ability of students in solving problems increases from task 1 to task 3. It can be said that in general the ability of students in solving the problem on the material vibration and the wave is good.

The results of student ability in making graphs can be seen in Figure 2 as follows:

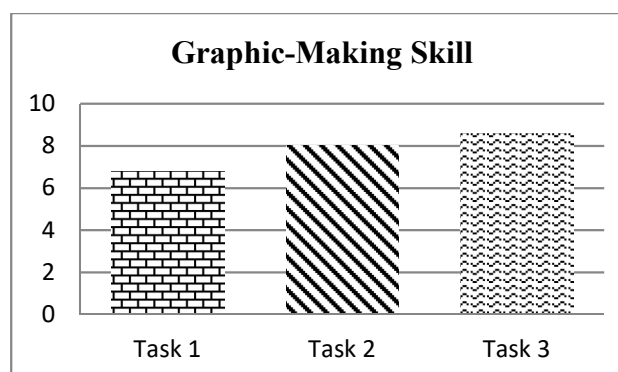


Figure 2. Profile of Students' Graphic-Making Skill.

Based on Figure 2 it can be seen that the ability of students in making graphs also increased from task 1 to task 3. It can be said that in general the ability of students in making graphics on the material vibration and the wave is good.

The findings of this research have contributed to the improvement of students' ability to solve problems and to read graphs of potential science teachers, especially in Indonesia. After conducting a study of student answers related to problem-solving skills and graphs, it can be said that the findings about the general difficulties of prospective students of science teachers are students having difficulty in making problems to solve problems by making a graph precisely.

After doing a study on the student's answer related to the ability to make the graph, got 3 categories, namely: 1) problem solving and graphic making right, 2) solving the problem precisely, but making the graph less appropriate, 3) problem solving and making chart wrong. Based on these categories, each of the findings can be submitted as follows:

Students who are able to solve problems and create graphs appropriately, display the data as follows:

Sebuah pegas yang panjangnya 24 cm digantung pada salah satu ujungnya, sedangkan

1. Sebuah pegas yang panjangnya 24 cm digantungkan pada salah satu ujungnya, sedangkan ujung lain diberi beban 50 gram, sehingga panjangnya menjadi 26 cm. Beban ditarik sejauh 14 cm dari titik setimbangnya, sehingga bergetar. Tentukan :

- Konstanta pegasnya
- Energi total (energi mekanik) getaran
- Kecepatan maksimum getaran
- Besar kecepatan ketika beban berada sejauh 1 cm dari titik setimbangnya.
- Grafik besar kecepatan terhadap simpangan yang dihasilkan dari program pengolah angka (misal Excel) yang kemudian dicopy-paste-kan ke pengolah kata Anda. Catatan : untuk menuliskan persamaan, gunakan equation editor.

Diketahui : $m = 50 \text{ gr} = 0,05 \text{ kg}$
 $x = 2 \text{ cm} = 0,02 \text{ m}$
 $A = 14 \text{ cm} = 0,14 \text{ m}$
 $g = 9,8 \text{ m/s}^2$

Penyelesaian :

- Konstanta pegas (k)
 $k = \frac{F}{x} = \frac{m \cdot g}{x} = \frac{0,05 \cdot 9,8}{0,02} = 24,5 \text{ N/m}$
- Energi total getaran (E_m)
 $E_m = E_{p \text{ max}} = \frac{1}{2} k \cdot A^2 = \frac{1}{2} \cdot 24,5 \cdot (0,14)^2 = 0,2401 \text{ J}$
- Kecepatan maksimum getaran (v_0)
 $v_0 = A \sqrt{\frac{k}{m}} = 0,14 \sqrt{\frac{24,5}{0,05}} = 0,14 \sqrt{490} = 3,099 \text{ m/s}$
- kecepatan ketika beban berada sejauh 1 cm dari titik setimbangnya.
 $v = v_0 \sqrt{1 - \frac{x^2}{A^2}} = 2,19 \sqrt{1 - \frac{(0,02)^2}{(0,14)^2}} = 2,19 \sqrt{1 - \frac{0,0004}{0,0196}} = 2,19 \sqrt{0,9796} = 2,17 \text{ m/s}$
 $E_m = \frac{1}{2} (156,8) \text{ N/m} \cdot (0,08)^2 \text{ m}$
 $E_m = 0,5 \text{ joule}$

c) $v_0 = A \sqrt{\frac{k}{m}}$
 $v_0 = 0,08 \text{ m} \sqrt{\frac{156,8 \text{ N/m}}{0,32 \text{ kg}}}$
 $v_0 = 1,771 \text{ m/s}$

d) $v = v_0 \sqrt{1 - \frac{x^2}{A^2}}$
 $v = 1,771 \text{ m/s} \sqrt{1 - \frac{(0,01)^2 \text{ m}}{(0,08)^2 \text{ m}}}$
 $v = 1,757 \text{ m/s}$

e) Hubungan kecepatan (v) dengan simpangan (y)

Tabel 1. Hasil perhitungan A, E_m , v_0 , dan v pada setiap simpangan

m (kg)	x (m)	k (N/m)	A (m)	E_m (J)	v_0 (m/s)	v (m/s)	y
0.32	0.02	156.8	0.08	0.5	1.771	0	-0.08
0.32	0.02	156.8	0.08	0.5	1.771	0.857381688	-0.07
0.32	0.02	156.8	0.08	0.5	1.771	1.171406393	-0.06
0.32	0.02	156.8	0.08	0.5	1.771	1.382486432	-0.05
0.32	0.02	156.8	0.08	0.5	1.771	1.53373099	-0.04
0.32	0.02	156.8	0.08	0.5	1.771	1.64176094	-0.03
0.32	0.02	156.8	0.08	0.5	1.771	1.714763377	-0.02
0.32	0.02	156.8	0.08	0.5	1.771	1.757109589	-0.01
0.32	0.02	156.8	0.08	0.5	1.771	1.771	0
0.32	0.02	156.8	0.08	0.5	1.771	1.757109589	0.01
0.32	0.02	156.8	0.08	0.5	1.771	1.714763377	0.02
0.32	0.02	156.8	0.08	0.5	1.771	1.64176094	0.03
0.32	0.02	156.8	0.08	0.5	1.771	1.53373099	0.04
0.32	0.02	156.8	0.08	0.5	1.771	1.382486432	0.05
0.32	0.02	156.8	0.08	0.5	1.771	1.171406393	0.06
0.32	0.02	156.8	0.08	0.5	1.771	0.857381688	0.07
0.32	0.02	156.8	0.08	0.5	1.771	0	0.08

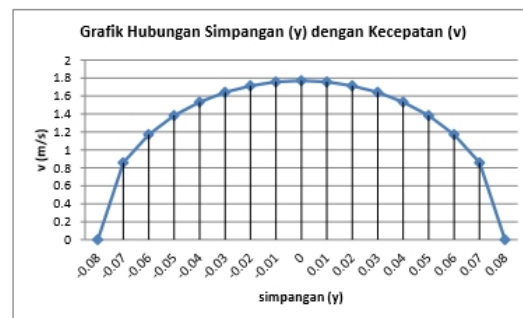


Figure 3. The results of solving the problem and making the chart appropriately.

Based on Figure 3, it appears that the student is right in making the problem, then solving the problem in detail to make the chart exactly. So when the execution of making the graph to be in accordance with the understanding of students.

- Students who are able to solve the problem correctly, but make the graph less precise, the data display as follows:

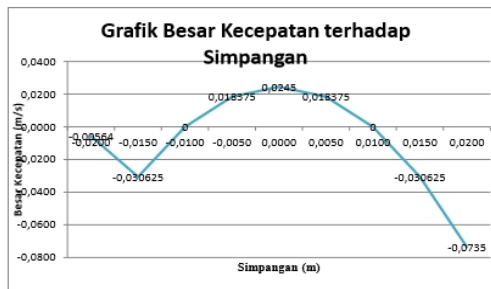


Figure 4. The result of solving the problem and making the graph appropriately

Based on Figure 4, it appears that the student is right in making the problem, then can solve the problem in detail, but in making the graph less precise because the student does not take into account the value written on the problem, so that when the execution of graphic making becomes less precise, so it can be said that students lack understanding.

Students who are not able to solve problems and make graphs appropriately, display the data as

Sebuah pegas yang panjangnya 24 cm digantungkan pada salah satu ujungnya, sedangkan ujung lain diberi beban 500 gram, sehingga panjangnya menjadi 10 cm. Beban ditarik sejauh 35 cm dari titik setimbangnya, sehingga bergetar.

Tentukan: a. konstanta pegasnya b. energi total (energi mekanik) getaran c. kecepatan maksimum getaran d. besar kecepatan ketika beban berada sejauh 1 cm dari titik setimbangnya. e. grafik besar kecepatan terhadap simpangan yang dihasilkan dari program pengolah angka (misal Excel) yang kemudian dicopy-paste-kan ke pengolah kata Anda. Catatan: untuk menuliskan persamaan, gunakan equation editor.

Diketahui :

$$m = 500 \text{ g} = 0,5 \text{ kg}$$

$$x = 10 \text{ cm} = 0,1 \text{ m}$$

$$A = 35 \text{ cm} = 0,35 \text{ m}$$

$$g = 10 \text{ m/s}^2$$

Penyelesaian :

a. $k = \frac{F}{x}$
 $k = \frac{m \cdot g}{x} = \frac{0,5 \cdot g}{0,1} = 50 \text{ N/m}$

b. $Em = Ep_{max}$
 $Em = \frac{1}{2} k \cdot A^2 = \frac{1}{2} \cdot 50 \cdot (0,35)^2 = 3,0625 \text{ J}$

follows:

d. Kecepatan ketika beban berada sejauh 1 cm dari titik setimbang

$$V = V_0 \sqrt{1 - \frac{x^2}{A^2}}$$

$$V = 3,5 \sqrt{1 - \frac{(0,01)^2}{(0,35)^2}}$$

$$V = 3,5 \sqrt{0,9} = 3,32 \text{ m/s}$$

e. Grafik besar kecepatan terhadap simpangan

x	0	0,05	0,1	0,2	0,25	0,3	0,35
v	3,5	3,466078	3,35410197	2,87228132	2,44948974	1,80277564	0



Figure 5. Results solve the problem and make the chart wrong

Based on Figure 5, it appears that the student is less precise in making the problem, thus solving the problem is less precise, thus affecting the graph making is wrong. This is because students do not take into account the amount of value written on the problem, so the problem solving is less precise and when the execution of the graph making is wrong, so it can be said that the students understanding less.

Student responses related to problem solving skills and graphics on learning vibration and waves done with elearning obtained in a questionnaire that has been distributed to 28 respondents obtained the following results:

1. A total of 24 respondents stated that making graphs through vi-learn is still difficult, one of the respondents mentioned that the difficulty, because it must enter and process from excel first, but as many as 4 respondents stated that making the graph through vi-learn easy it like opinion from one of the respondents who said that initially had difficulty but because it has several times get the task to make the graph so that become more accustomed.
2. A total of 9 respondents stated that Vi-learn did not help them in making the graph, but most respondents were 19 people stated that V-learned helped in making the graph, one opinion from the respondent mentioned that Yes, because in V-learn always there is a task to create a graph so that it can train students.
3. Tips in completing the task on v-learn most of the respondents that as many as 24 people doing business manually with most of the business that is reading books and learning with friends. While 4 other respondents chose to use software and internet to complete the task.

4. Conclusion

The results of this study can be concluded that:

1. Students are still having difficulty in making the problem that can be solved correctly with graphic results also appropriate.
2. Students only make a matter of origin without associating with its physical meaning.
3. Students are still difficult in formulating questions from the questions that have been made into the graph, so that makes the interpretation becomes not sharp.

Acknoeledgement

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