Designing Adaptive-Content trough E-learning on Electromagnetic Concept

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Abstract. Teacher competence development is a national education agenda. Although teachers haveadequate learning experience, based on *UKA* (Academic Competence Test) 2013 results, the content mastery of teachers is still low. In order to reach the maximum developmentof teacher, it is a must to consider the knowledge level of teachers andthe difficulty of content given. This study used a questionnaire given to 40 teachers but only 25 teachers who returned the questionnaire. According to the research, 82% of teachers stated that the electromagnetic is a difficult content. There are several factors why electro magnetic content is considered to be difficult by teachers such as it is abstract, uses a lot of mathematical equations, and correlation with other concepts and content material. From these results, adaptive e-learning design for teacher to learn electromagneticis created.

1. Introduction

Competence development of teachers is a national education agenda in improving the nationwide quality of education. Nationally, teachers have the professional competence standards that include the mastery of subject taught. Decent subject mastery will assist teachers in determining methods or strategies that can be conducted properly so that it can assist students in achieving the expected learning objectives.

In order to improve teacher professional competence, various activities have been carried out by the government such as teacher training. However, these activities have not been able to resolve the education problems occurred at national scale.According to Loucks-Horsley, science teacher training programs are less successful due to lack of attention to the background, experience, knowledge, beliefs and needs of teachers [1]. It can be seen from UKA (Academic Competence Test) of high school physics teacher in South Sumatra in 2013 that are grouped into three categories: high (> 75), moderate ($50 \leq x \leq 75$) and low (<50) (Source: P4TK Bandung).

Therefore, improving the effectiveness of teacher training in mastering physics content, the content given should be in accordance with the level of knowledge and experience of teachers. The level of

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knowledge of physics can be seen from the difficulties of physics content given. The level of knowledge can be seen from the level of difficulty of the content provided. Difficult content is given only to the students with higher level of knowledge while is given lower level. Some difficult concepts according to the students is to identify the source of the electric field like magnet and currents [2], used to, graphs, math such as algebra and geometry, complex mathematics, too many laws, principles and formulas, integrate to examples daily life [3, 4, 5]. In addition, experiments, mathematical equations, graph and explanation of the concept at the same time and the concept domain that is associated with other concepts such as force, terrain, electricity and so on [6, 7] so that more concepts involved, the more difficult comprehended.

The level of knowledge is determined by teststo classify students based on certain criteria. It uses Blooms taxonomy obtained from the tests and classified into beginner, intermediate, advanced and expert [8, 9]. The concept of physics tends to be hierarchy[10] from the level of difficulty, if a teacher fails to answer questions at the beginner level, the teacher is grouped into beginner level because teacher does not master the basic concepts well. Therefore, the questions were designed based on novice teacher level of knowledge and thus the test scores can discriminate experts and beginners groups. Two adaptive learning system resources (TSAL) can help teachers construct the content of their subject by using students' personal information such as learning styles and learning behavior[11].

Therefore, the physics content design for teachers should be based on the use of mathematics, the correlation with other concepts and the depth or scope of content. Hence, teachers will learn the appropriate level of knowledge. Ability to customize the content learnt with the level of teacher content knowledge is referred to adaptive.

The purpose of this study is to determine teachers' difficulty in the electrical force and the electrical field as the basis in developing adaptive content based on the level of teacher knowledge. Less difficult level of concept or easy concepts is given to teachers at the novice group, while the concept with a higher level of difficulty is given to the expert groups of teachers. Grouping the teachers into expert and novices is based on test results.

2. Methods

The research was accompanied on July 2015 in Palembang. The questionnaires, which were utilized in, collect teachers' response toward the difficult content via Liekert Scales (4 scales). The questionnaire was given to teacher directly and then a few days later asked return or direct complete his/her response. A total of 40 copies of the questionnaires were given to teachers about teachers' difficulties in understanding the content of electromagnetic. The questionnaires use Liekert scale. Out of 40 copies of the questionnaire given, 25 teachers returned them. Design research to design content of adaptive e-learning based on difficult content for teachers such as below:

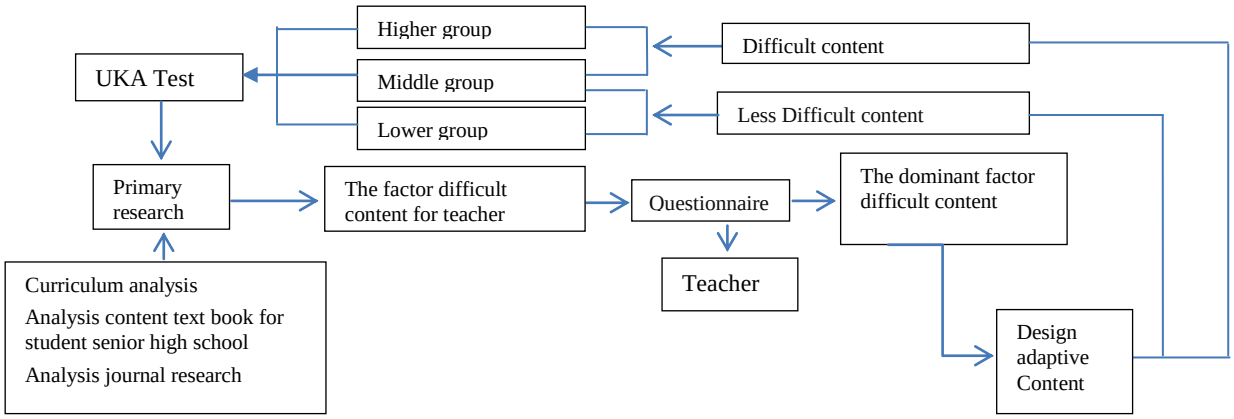

Figure 1. Design of adaptive-content base on teachers' response toward difficult concept.

3. Results and Discussions

The questionaires analysis gives result as follow:

Table 1. Teachers' response towards electro magnetic content.

The difficulties of electromagnetic concept	Response				% teachers' response
	SA[a]	*A*[b]	*TS*[c]	*STS*[d]	
The abstract concept	17	5	3	0	89
The use of higher level of math	10	8	4	3	75
Too many recitation and formula	12	8	5	0	82
Too many operations	15	8	2		88
Too theoretical	9	5	7	4	69
A lot of unfamiliar terms	16	5	4		87
A lot of sub-topic and terms used	14	8	3		86
Assosiated with other concepts	11	8	6		80
Average					82

[a]SA = Strongly Agree
[b]A = Agree
[c]DA = disagree
[d]SDA = strongly disagree

Based on Table 1, 82% of teachers or teachers in general responded that the electromagnetic concept is difficult [12]. Most of the teachers stated that the concept of electromagnetic is difficult because it is abstract. Abstract concept is a concept whose examples in everyday life are hardly found. To help students understand abstract concepts then a model concept is created so that it looks more real. Because the purpose of learning is to help students understand both abstract and concrete concepts, the content presented for the learners both expert and novice group is assisted with the model or illustrations to be more concrete. Then, the content presented does not distinguish the novice and experts group since it is an abstract concept.

Furthermore, the use of higher mathematics highlight used many mathematics calculations and formulas are employed in the electric force and electric field material. Learners have difficulty using mathematics in the electric force and electric field. A lot of sub topic and unfamiliar term cause the concept difficult. A lot of sub topic add load to learn so purpose more time to understand and unfamiliar term cause content strangecan it cause bore. The same thing is applied when dealing with the association of electromagnetic concepts with other concepts. Force two particles charge are hung by rope that effected gravitation more difficult than only force two particles on the floor because electrics force no effecting by gravitation. Therefore, based on these results, there are three major difficulties experienced by learners in learning electromagnet, namely the use of mathematics, concepts assosiation with other concepts and variables involved. Therefore, adaptive content are designed to accommodate these difficulties in planning the electromagnetic content covered

3.1. The use of mathematics

Integral: the use of integral in electrical magnet mainly atcontinuous charge electric field like line charge distribution, a ring of charge, balls and so forth. So, the concept of field caused by particular charge is given to the expert groups. Meanwhile, the electric field caused by point charges, the basic theory of electric field are given to the novice and expert groups. Thus, the participants can learn the basic theory of the electric field with a few mathapplications so that after completing the content. Consider the example of the application of integral in an electric field concept below.

Both groups receive the content of electric field caused by the point charge. The value of electric field can be measured by placing a very small test charge. It will cause the electrostatic force between the two charges:

$$\vec{F} = q_0 E \tag{1}$$

so

$$\vec{E} = \frac{\vec{F}}{q_0} = \frac{1}{q_0}\left(\frac{1}{4\pi\varepsilon_0}\frac{qq_0}{r^2}\right)\hat{r} = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}\hat{r} \tag{2}$$

As for the continuous charge distribution such as line charge with 2l length and λ charge density, the value of field charge within r is as shown by figure 1 below:

$$E = E\cos\theta = \int \frac{1}{4\pi\varepsilon_0}\cos\theta\frac{dq}{l^2 + r^2} \tag{3}$$

Solving these equations requires the integral ability so more difficult than charge point and thus the electric field caused by continuous charge is only given to expert group.
In physics, vectors has two known quantities based on the direction of motion. The vector magnitude or vector have its own operating system differs from scalar magnitude operating systems. Vectors used in electric style content is as the following equation:

$$\vec{F} = \frac{qq_1\left(\vec{r} - \vec{r_1}\right)}{4\pi\varepsilon_0\left|\vec{r} - \vec{r_1}\right|^{3/2}} + \frac{qq_1\left(\vec{r} - \vec{r_2}\right)}{4\pi\varepsilon_0\left|\vec{r} - \vec{r_2}\right|^{3/2}} \tag{4}$$

3.2. The correlations with other concepts
Electromagnetic concept can be connected with other concepts such as the motion of particles in an electric field, the equilibrium particle influenced by the electric and gravitational forces. To ensure that participants have comprehended the concept of force and the electric field, in the novice group electromagnetic concept has not been linked with other concepts while at expert groups, the concept is linked with other concepts. The relation electrostatic force to gravitation force

$$\overrightarrow{F_g} = \overrightarrow{F_e} \tag{5}$$

The solution is given more difficult with present gravitation force than without gravitation

3.3. The scope or depth of material
Various applications of electromagnetic concept magnets in various technologies are given to the expert group. The reason is the expert group requires more insight to increase their knowledge. Concepts such as force and torque on the dipole are only given to expert group while the novice group only learns electric field on the dipole and thus the novice group learn adequate subject. In line with researchers who interested in doing research about electromagnetic concept such as [12, 13], they stated that electromagnetic was one of challenging concept and it could be aided by multimedia and computer simulations.They also stated that scope and depth of content on electromagnetic should be definitely focused to the content. Furthermore, Kaniawati et al. [14] utilized computer simulation as a part of e-learning in physics context to analyze the conceptions in physics learning because e-learning need adaptive-content that could facilitate students' understanding. Although the adaptive-content utilized by Kaniawati et al. [14] was in computer format then paper based, both the adaptive-contents could facilitate students in learning physics concepts.

4. Conclusions

There are three difficulties teachers had in comprehending electromagnetic concept namely excessive use of mathematical equations, correlation of electromagnetic concept with many other concepts, and scope of content that must be considered for adaptive content. The design content would be implemented in creating adaptive e-learning.

5. References

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