Implementation e-learning as a formative assessment to explore mastery concept’s student on magnetic field material

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Abstract. E-learning is the tool for helping teachers as well as students to evaluate the physics learning. The current study aims to determine the effect of using e-learning as a form of formative assessment in the students’ mastery concepts in the topic magnetic material. This study is conducted using the mixed method of the explanatory design method. The qualitative data is as supporting of quantitative data. The research subjects were students of class XII IPA 2 Pujon NU Islamic High Schools as many as 31 students. The mastery of concept data is taken from the pre-test and post-test and strengthened by the results of formative assessment. Acquisition of mastery concept values are based on the analysis obtaining that the average pre-test and post-test values increased for each indicator of achievement of competency. The increase of the value from 33 points to 54 points that has a maximum score of 100 points. In the formative assessment, the highest score of the first meeting is 40 points, the second meeting is 45 points and the third meeting is 25 points.

1. Introduction
The use of e-learning in the teaching and learning process is one of innovation from 21st-century learning [1,2]. The combination of technology in learning can help students improve mastery of concepts that will support the skills needed in the 21st century [3] and one of infrastructure on modern learning [4]. Some of these skills include problem-solving skills, critical thinking skills and creative thinking [5]. Moreover, there are many forms of e-learning developed in learning. One of them is the integration of formative assessment in e-learning [6]. The concept of E-learning learning is a bridge between students and teachers [7].

Furthermore, formative assessment plays an important role in the process of learning physics. Its main role is as material for self-evaluation of students and teachers [8,9]. The benefits of formative assessment for students is to measure the abilities obtained after the learning process, while for teachers is a self-evaluation material to teach better and master the content better [2,9]. The development of information technology enables formative assessment which is packaged in the form of e-learning. The purpose is to increase the self-assessment and self-regulation of students [10,11].
The formative assessment in the form of e-learning is used to support the achievement of physics learning. The use of e-learning will save students time in class so that learning objectives can be achieved to the maximum [1,3,12]. The results of the formative assessment represent the achievement of the expected indicators of competency achievement in each learning process [13]. This, of course, will affect the metacognition and mastery of students' concepts in analyzing physical content on a problem or statement.

The physics subject is a subject that is still considered as a difficult subject by students. This assumption is because the content is full of mathematical symbols, especially in magnetic field material [13,14]. Magnetism is an important topic in basic physics both at the level of high school and college because magnetism is one of the basic knowledge related to current technological developments [15,16].

However, some previous studies established that students' abilities were still low in explaining a magnetic field phenomenon in experiments [17,18] because most weak students understood magnetic fields as terrain and could not visualize the concept of magnetic fields in moving charges. Other studies also found that the majority of students were unable to argue that silent charge was a source of a magnetic field [18]. Most students also tend to develop magnetic models as electricity, where magnetic poles are areas that normally are at the end of a magnet that has excess and lack of charge [19].

Some of the findings above describe the mastery of students' concepts of magnetic fields is still low. Therefore, research on the use of e-learning as a formative feedback assessment needs to be done to determine the impact it has on the mastery of students' concepts in magnetic field material.

1.1. E-Learning As Formative Assessment

The use of e-learning during the learning process has become the focus in the field of education today, especially in order to develop the skills needed by 21st-century people listed in the 2013 curriculum [20] [14]. This curriculum requires learning outcomes to produce 4C abilities for students who are able to have the critical thinking, collaborative, communicative and creativity. e-learning has been developed as a material and learning media that can help students [1,6].

Development of e-learning is designed to involve students in the process of virtual inquiry [20]. To be specific, in the process a problem is presented, and students will go through the process of gathering information to investigate and argue to answer a problem. Moreover, the students can give the evaluation results as a whole based on evidence in one session of online learning, the teacher will also always presents a formative test at the end of the lesson to get the appropriate formative feedback [6]. E-learning packaging as a formative assessment designed with formative feedback will help students to have the self-regulation. The formative feedback will help students find misconceptions experienced when working on problems presented in formative assessment [2].

The key point of formative assessment is the existence of clear formative feedback and according to student needs. This formative feedback will directly help students reinforce the concepts they have. Formative assessment accompanied by formative feedback directly supports the achievement of the objectives of learning [12]. The task/assignment in order to have the remedial. Every work on the wrong items will get formative feedback directly, thus, the students can rework the help of the formative feedback given.

Formative assessment is conducted in three meetings. The first meeting discussed the sub-themes of magnetic fields caused by the straight-flowing wire. The second meeting concerning the sub-themes of magnetic fields caused by circulating circular wires and the third meeting discussed sub-themes concerning magnetic force (Lorentz style). The formative assessment results were used to determine the impact of mastery of student concepts which was reinforced by structured interviews regarding the benefits obtained by students while working on formative questions in the form of e-learning. The purpose of the interview was to find out student comments related to the feedback given by the teacher in e-learning. Thus, the
formative evaluation is used as a guide for students and teachers to understand indicators of competence in the form of achievement in physics learning.

1.2. Mastery Concept Of Magnetic Field

The mastery of concepts is the basis of reinforcement of the skills needed by century society [15,19]. Moreover, mastery of concepts regarding physics, especially magnetism and electricity [13]. Magnetism and electricity is the basis for developing technology. In addition, magnetism is a physical variable that can be measured directly from various physical events that occur around. Thus, mastery of students' concepts regarding magnetism must be maximally fulfilled. It is used to understand physical phenomena that occur around and resolve physical problems that occur around critically.

2. Methods

The current study was conducted by the mixed method using explanatory design method. The research subjects were 31 students of class XII majoring in Science program of 2 Pujon NU Islamic High School. The quantitative data obtained from the value of the pre-test and post-test of the mastery questions that have been passed the test of empirical validity and expert validity test. However, qualitative data strengthen quantitative data through structured interviews. Moreover, the scores were obtained from the validity test results as follows:

| Question variables | Expert validation | Empirical Validation | Category |
|--------------------|-------------------|----------------------|----------|
| Mastery the concept| First Validator: 81 | Second Validator: 83 | 17 question are valid | 0.7 | High |

The next step, the formative assessment can be accessed independently by the students at http://smailon.ip-dynamic.com:5789/. E-learning can be accessed by the students by having a username and username integrated with the electronic report. Moreover, the students also can repeat.

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\[ X = \frac{\sum Y}{\Sigma N} \times 100\% \]

Note:
- \( X \) : The percentage of the students answering correctly
- \( \Sigma Y \) : The average of the students answering correctly
- \( \Sigma N \) : The number of the students answering all the questions
3. Result and Discussion

3.1. Data of pre-test result on the mastery of the concept
The followings are the results of the pre-test mastery of student concepts for the overall indicators of achievement of the questions

Table 2. Mastery concept pre-test statistical results

| Statistical       | Number |
|-------------------|--------|
| Mean              | 33     |
| Median            | 34     |
| Modus             | 30     |
| Standard deviation| 6      |

Based on Table 2 above, the average mastery of students' concepts at the pre-test is 33 points, the middle score of 30 students is 34 points, the value of most students is 30 points and variations in the overall score of students are 6 points from a maximum scale of 100 points. At the pre-test, the average score obtained by students was 33 points for mastering the concept. The percentage of students answering correctly on each indicator of mastery of concepts when pre-test is presented in Table 3.

Table 3. Pre-test of the concept mastery

| Number Of question | Achievement of indicator competencies                                      | The percentage of correct answers (%) |
|--------------------|--------------------------------------------------------------------------|--------------------------------------|
| 1, 2, 3, 10, 11    | Analyzing the field direction Magnets around the current wire            | 13                                   |
| 4, 5, 6, 8         | Analyzing the force direction Magnets contained charged particles in a uniform of magnetic field | 7                                    |
| 9, 14, 15, 17      | Analyzing the force direction Magnets caused by the current wire         | 8                                    |
| 16                 | Analyzing the magnetic fields caused by cargo movement                   | 4                                    |
| 7, 12, 13          | Analyzing the field strength magnets around the current wire             | 10                                   |

Based on Table 3 regarding the mastery of the concept of magnetic fields and magnetic forces, the lowest percentage of students in achieving the competency indicator analyzes the magnetic field caused by moving charges with the percentage of students answering correctly is only 4%, namely in question number 16. The results of the interview were structured on 3 students who received the lowest score, that the difficulty of the students analyzed the concept of magnetic fields. The problem of confusing physics is that makes students confused to determine the strength of the magnetic field in a moving charge. Students find it difficult to visualize the direction of the magnetic field in each electron charge. The students request that the teacher provide an animation, media-based cooperative learning model.

3.2. The results of the formative assessment in three meetings

3.2.1. The first meeting. The first meeting discussed the case of a magnetic field caused by the straight-flowing wire.
Based on Figure 1, the highest score obtained by students on the formative questions presented in e-learning is 90 points in one student, the lowest score is 15 points as many as 3 students and the total score is 40 points out of 10 students from a maximum score of 100 points.

3.2.2. The Second Meeting. The second meeting discussed the case of a magnetic field caused by a fast-flowing wire.

Based on Figure 2, the highest value of formative questions in the case of circular magnetic fields in the wire is 85 points by 3 students, the lowest value of 5 points as much as 1 student and the highest score of students is 45 points by 9 students from a maximum score of 100 points.
3.2.3. The third meeting. The third Meeting discussed the magnetic force topic (Lorentz force)

![Figure 3. The graph of the formative assessment in meeting 3](image-url)

Based on Figure 3, the highest value of formative matter in the case of magnetic force generated by current wire is 65 points as much as 1 student, the lowest value is 5 points as much as 6 students and the highest value obtained by students is 25 points by 18 students from a maximum score of 100 points.

3.3. The Pre-Test Result of mastery the concept On summative test

| Table 4. Statistical result of post-test of mastery the concept |
|---------------------------------|----------------|
| Statistical result | Number |
| Mean | 54 |
| Median | 59 |
| Mode | 52 |
| Standard deviation | 3 |

Based on Table 4, the average value of all students in the concept mastery post-test was 54 points, the middle score of all students was 59 points, the highest score of students was 52 points and the variation in the overall score of students was 3 points. The following is the percentage of students' correct answers in the mastery concept obtained from the pre-test

| Table 5. The percentage of the number of students answering the questions correctly |
|---------------------------------|----------------|
| Number Of question | Achievement of indicator competencies | The percentage of correct answers (%) |
| 1, 2, 3, 10, 11 | Analyzing the field direction | 45 |
| | Magnets around the current wire | |
Analyzing the force direction
Magnets contained charged particles in a uniform of the magnetic

Analyzing the force direction
Magnets caused by the current wire

Analyzing the magnetic fields caused by cargo movement

Analyzing the field strength magnets around the current wire

Based on Table 5, the lowest percentage of students answering correctly is on the competency achievement indicator analyzing the direction of the magnetic force caused by the current wire. This is evidenced by the comparison of students' correct answers to the number of questions with a value of 28%.

To strengthen students' answers, the teacher conducts structured interviews after the test is complete. Most students feel helped by formative assessment in the form of e-learning. The presentation of formative questions accompanied by formative feedback can support the strengthening of students' concepts in magnetic field material. After obtaining an evaluation, students can use the feedback material to work on the post-test questions. Additionally, the use of e-learning is recognized by students as free time at home for interactive learning, so that it is more interesting and challenging. Students have a long time to process the analogy of thinking and sharing learning experiences with other students.

The current study supports previous research which stated that mastery of physics concepts students who learn through e-learning can evaluate learning outcomes independently, both for students themselves and teachers. The students’ thinking leads to how to solve the problem of magnetic field concepts with different answer models. This allows students to have a model of solving other problems and creating with peers while exchanging opinions [13]. Students who have mastery of good physics concepts can apply their learning outcomes in daily life [3].

4. Conclusion
In conclusion, the summative value of mastery of students' concepts for the overall indicators of achievement of questions increases. The improvement is evidenced by an increase in the percentage of the results of the student's pre-test and post-test. This is influenced by the ease obtained by students in e-learning based formative assessment. The formative assessments accompanied by formative feedback recognized by students help them develop concepts that are not yet intact. Moreover, the formative feedback obtained is experienced by students to help students find the concept as a whole in solving problems. Although, there is one student who does not work on formative question number 2 and one student does not do formative question number 3. However, overall students experience helped by the use of e-learning as a medium for formative feedback assessment.

Acknowledgment
We thank all participants involved in this study especially the XII IPA 2 students played as the research subjects and school stakeholder who have helped develop the E-Learning application.

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