Development of web based massive open online course on fundamental physics subject to increase students’ higher order thinking skill

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Abstract. This study aims to develop massive open online course web vinnarrai.com as E-learning on fundamental physics subject and to increase higher order thinking skill of students. This research method used research and development by the ADDIE (Analyse-Design-Development-Implementation-Evaluation) model. The object of this study was 30 students in the physics education program of State University of Jakarta. The validation in this research used material expert validation sheet, media expert validation sheet, learning validation sheet, multiple choice questions, and higher order thinking skill questionnaire. Material expert validation results show 86.5 % (very good). Media expert validation results show 88.0 % (very good). Learning validation results show 89.0 % (very good). Based on the results of the investigation on the effectiveness of vinnarrai.com web on fundamental physics subject, obtained N-gain equal to score of 0.72 in high category. This shows the increased score of higher order thinking skill participants. Based on data above, this study showed that the development of Massive Open Online Course on fundamental physics subject can increase high order thinking Skill of Students.

1. Introduction

Education is an essential aspect of life which is needed to build a personality, attitude and behavior. Education is not only change of behavior process but also a process to educate. There are some efforts done by government to improve education quality. The improvement of education quality will be achieved if all components of education put their efforts to do a change to become better. School has to provide facility to enhance students, teachers as facilitator, and perfects curriculum. Learning outcomes are the abilities of the students after they received a learning experience [1].

Development of technology also require students’ learning skills to support learning activity. Nowadays, development of information and communication technology has changed the way of learning. Education is changing at a rate that has never been happened before. To prepare students to be success in global condition, they need a new skill which is Higher Order Thinking Skill (HOTS) [2]. Definition of Higher Order Thinking Skill by Haladyna and Bloom are as follow: analysis (C4), evaluation (C5) and creation (C6) [3]. In this research, high order thinking skill can be seen at the questions from Task 1, Task 2, Task 3, Task 4, Mid Test and Final Test. Task 1 as pre-test and final test as post-test.

As the technology developed, education nowadays is no longer be limited by time and space. Informal education can be chosen as learning alternative for elementary and middle education. As for
high education, students can access MOOCs which was developed by universities around the world freely and open source [4].

Online learning has been increasing significantly for past fifteen years. The newest development which enable hundred thousand of students to participate at the same time in one course is MOOCs that was provided by worldwide institutes. MOOCs is an online open course which enables large number of participants. MOOCs is an acronym for:

- **Massive**
  MOOCs has *infinite scalability* principle, which means that number of participant who can participate can reach hundreds of thousands for each courses.

- **Open**
  There are no special requirements to participate in MOOCs other than device to access it and internet connectivity. There are also some MOOCs that only charge assessment and certificate fees to its participants.

- **Online**
  During the early times of its development, MOOCs offered online access to whole part of its activity. However, nowadays some universities use MOOCs to support conventional courses. University provides courses material through MOOCs so that students can use those material for their courses. This online course is often combined with conventional course.

- **Courses**
  Courses in MOOCs are managed as one full course and designed according to learning goals. There is also an online discussion in a forum provided by MOOCs. Characteristic of MOOCs are openness variation, obstacles to persistence, and pedagogic structure. High dropout rate showed that learning obstacles are significant challenge. In Indonesia, application of MOOCs was developed, unfortunately not by universities.

  MOOCs that developed by universities in Indonesia are still limited. It’s expected that MOOCs which was developed in this research can be used for physics education students in State University of Jakarta. With this goal, contents and course plans which showed are expected to support physics education curriculum.

  In research by Kristina, *Participants' Perceptions of Learning and Networking in Connectivist MOOCs*, concluded that students’ participation in MOOCs encourages them to develop their skills and increases motivation. MOOCs also demands students to be active and collaborate with other user in order to achieve the expected goal.

  Questionnaire had also given to some respondents in several universities. The result, 57,1% stated that their respective lecturer has already used online learning. As for the form, 85,9% was website. However, the content of the website is mainly pdf file; no videos or simulations are available. Discussion forum and certificate of achievement are also not available in the website. About 93,8% stated that development of MOOCs for learning media is necessary and 92,2% stated that MOOC can encourages them to study independently.

  According to description above, this research will develop web-based MOOCs which provides advantages for everyone who want to study informally, independent, and discussing with users. Therefore, it’s necessary to develop web-based MOOCs for students of physics education, State University of Jakarta.

2. **Methods**

This research used *research and development* (R&D) method with ADDIE model. Steps of ADDIE model that is used are [5]:

2.1. **Analysis**

Analysis is the first step in ADDIE model. In this step program designer have to do a need analysis to collect information related to problems faced by students in undergraduate degree.
2.2. Design
Design is the second step in ADDIE model where researcher designs the e-learning with xMOOCs characteristic so that students are expected to achieve goals and competence of following subject.

2.3. Development
Development is the third step in ADDIE model. In this step, learning materials for e-learning are produced and developed.

2.4. Implementation
Implementation is the fourth step in ADDIE. In this step, instructor implemented the e-learning in class according to teaching plan.

2.5. Evaluation
Evaluation is the last step in ADDIE model. In this step, e-learning is evaluated in order to improve its efficiency and effectiveness. Based on this evaluation results any improvements are done to perfects the e-learning.

Research instruments that were used in this research are: learning material experts validation sheet, media expert validation sheet, learning validation sheet, and multiple-choice questions.

3. Results and discussion
Product of this research is website vinnarrai.com as fundamental physics e-learning. This website is open to students of Physics Department, State University of Jakarta and can be accessed anytime and anywhere. Main components of this website are: 1). Administrator. Administrator organizes student’s data, teacher’s data, hire teachers, and updates website; 2). Teachers. Teachers apply learning data, updates learning materials, and organizes test questions and score; 3). Students. Students attend online learning in vinnarrai.com such as taking quizzes, final exam, discussion forum and information sharing with another user. Student must register to login vinnarrai.com.

Features in vinnarrai.com are: 1). Register; 2). Login; 3). Home; 4). Learning Materials; 5). Discussion Forum and certificate.

![Figure 1. Main page.](image1)

![Figure 2. Login page.](image2)
3.1. Validation by experts

Product of this research is validated by material experts, media experts, and learning experts. Validation by experts in this research use questionnaire result is shown in table 1.

| No | Material expert | Media expert | Learning expert |
|----|-----------------|--------------|-----------------|
| 1  | 87              | 88           | 90              |
| 2  | 86              | 88           | 88              |
| Average | 86.5 | 88 | 89 |

Validation result by material expert is obtained by 86.5%, media expert by 88%, and learning experts 89%. Results showed that the product is considered in very good category in material, media and learning aspects.

3.2. N-gain

N-gain is calculated using formula [6]:

$$\langle g \rangle = \frac{S_{\text{post}} - S_{\text{pre}}}{S_{\text{max}} - S_{\text{pre}}}$$  \hspace{1cm} (1)

$S_{\text{post}}$ is average post-test score, $S_{\text{pre}}$ is average pretest score and $S_{\text{max}}$ is ideal maximum score. N-gain calculation is done to see whether the developed product can increase students’ Higher Order Thinking Skill or not. In this research, high order thinking skill can be measured by the questions (C4 as analysis,
C5 as evaluation, and C6 as creation) from Task 1, Task 2, Task 3, Task 4, Mid Test and Final Test at vinnarrai.com. Task 1 as pre-test and final test as post-test. N-gain result is shown in table 2.

**Table 2. N-gain result.**

| Pre-test Average Score | Post-test Average Score | N-gain |
|------------------------|-------------------------|--------|
| 43.75                  | 84.50                   | 0.72   |

From calculation of Higher Order Thinking Skill data (pre-test and post-test) to students at State University of Jakarta on pre-test July 2018 and on post-test August 2018, obtained N-gain score by 0.72. According to classification table of N-gain, the obtained score is in high category. Classification table of N-gain is shown in table 3 [6].

**Table 3. Classification of N-gain.**

| N-gain Score | Category |
|--------------|----------|
| <g> ≥ 0.7    | High     |
| 0.7 < <g> ≥ 0.3 | Medium   |
| <g> < 0.3    | Low      |

4. Conclusion

Material expert validation results showed 86.5 % (very good). Media expert validation results showed 88.0 % (very good). Learning validation results showed 89.0 % (very good). This massive open online course as E-Learning can increase students’ Higher Order Thinking Skill (HOTS), proved by N-gain result = 0.72 in high category. So, development of massive open online course on the fundamental physics subject can increase high order thinking skill of students.

5. References

[1] Serevina V 2017 Development of Enterpreneurship based Learning Model to Increase Physics Learning Outcomes of Students. 29th International Business Information Management Association Vienna: IBIMA

[2] Serevina V 2018 Improving Students’ Self-directed Learning Outcomes on Mechanics Subject by Using E-Learning. 30th International Business Information Management Association. Madrid: IBIMA

[3] Kinard J 2006 Creating rigorous mathematical thinking: a dynamic that drives mathematics and science conceptual development Transsylvanian Journal of Psychology-Erdély Pszichológiai Szemle, Special issue .251-266

[4] Adams C 2014 Distance Education, Catherine Adams 35 2 202-216.

[5] Sugiyono 2015 Metode Penelitian Pendidikan Bandung: Alfabeta

[6] Hake R 1999 Analyzing Change/Gain Scores USA: Woodland Hills