Multimedia development with web-based connected massive open online course (cMOOCs) in basic physics material

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Abstract. This study aims to develop web-based multimedia cMOOCs in basic physics material. The research method used is research and development using the ADDIE model (Analyze-Design-Development-Implementation-Evaluation). The objects in this study were 31 students in the physics education study program at the State University of Jakarta. The research instruments used were material expert validation sheets, multimedia expert validation sheets, and multiple choice questions. The results of the material expert validation showed 94.19% (very good). The results of the multimedia expert validation showed 78.33% (good). The results of the small group trial got a score of 82.67% and the results of the large group trial showed 90.03%. The results of the assessment of the effectiveness of web cMOOCs in the basic physics material I, obtained N-gain at a score of 0.786 so that it falls into the very high category. Based on the data above, this study shows that cMOOCs web-based multimedia development in basic physics material I can be used as learning multimedia.

1. Introduction
Along with the influx of globalization, education will be more open and two-way, diverse, multidisciplinary, and related to competitive work productivity [1]. This gives students the opportunity to create good collaboration so that they can help them sharpen and develop their skills in this digital era. cMOOCs can be used as a transformation to build connections between fellow students [2].

The ability of technological pedagogical content knowledge (TPACK) in students of physics teacher candidates is needed in the industrial era 4.0 to improve their skills and abilities. Utilizing cMOOCs web-based multimedia makes them challenged to develop their abilities and increase their motivation. cMOOCs also require students to play an active role in the spirit of openness to form activities and collaborate with fellow participants to achieve expected goals [3].

2. Teaching Material
Teaching material is material that consists of knowledge to be shared with students. Teaching materials can be defined as packaging, definitions, and explanations of knowledge, experience, and illustrations of facts systematically and logically [4]. The material used in basic physics 1 teaching materials are books, modules, power point presentations, student worksheets, videos, audio, animation, and images

3. Multimedia Learning
Multimedia is a tool that can create dynamic and interactive presentations that combine text, graphics, animation, audio and video images, in other words multimedia can be interpreted as a set of media which is a combination of several relevant media in relation to instructional goals [5] According to Daryanto multimedia learning is useful for channeling messages, and can stimulate the choices,
feelings, attention and willingness of students so that the learning process intentionally occurs, aims
and is controlled [6].

Meanwhile according to Kustandi multimedia is a combination of at least two input or output
media from data or in general, multimedia is a combination of three elements, namely sound, image
and text[7]. Multimedia is the use of several media to convey information. The combination of media
is text, graphics, animation, images, video and sound[7].

Based on the above information, it can be synthesized that multimedia is the use of several media in
the form of text, graphics, animation, images, videos, and sounds to convey information, messages or
materials to users so that they seem attractive.

4. The use of Web cMOOCs in Physics Learning

Web is a multimedia-based technology that allows you to access more than just text. That is, you can
also download images, audio, video, and animation and engage in interactive games [8]. In addition,
according to Adelheid the web is a component or collection of components consisting of text, images,
sounds, animations so that it is more interesting information media to visit [9].

CMOOCs are part of MOOCs which are open online courses, available for a large number of
participants and free. In MOOCs students not only interact with educators but also they can interact
with fellow participants through discussion forums. Communication that is built between participants
can encourage them to help another, so that the creation of collective knowledge is no longer a
simple transmission of information on knowledge [10].

5. Research Method

The method used in this study is research and development (R & D) which refers to the model of
analysis, design, development, implementation, evaluation (ADDIE) [11]. The product developed in
this study is an open massive online connected course (cMOOCs) based on basic physics material I.
The instruments used in this study were the validation sheet of basic physics material I, multimedia
expert validation sheet, basic physics I multiple choice items which included mechanical material,
mechanical oscillations and waves, and thermodynamics as well as students' independent learning
questionnaire. The instrument items used are validated by using the product moment formula and the
reliability uses the KR-20 formula. Improve learners' independent learning.

Data analysis was performed using a Likert scale. This scale is used to measure the attitudes of
opinions and perceptions of a person or group of people about social phenomena [12]. In determining
the percentage of success used equation (1).

\[
P = \frac{S}{N} \times 100\% 
\]

Information:
P : Percentage of success (%)
S : Amount of obtained
N : Total maximum value

The data obtained is written in the interpretation of the score in table 1 below [12].

| Average Score | Interpretation |
|---------------|----------------|
| 0%-20%        | Bad            |
| 21%-40%       | Not Good       |
| 41%-60%       | Enough         |
| 61%-80%       | Good           |
| 81%-100%      | Very Good      |

The Pearson product moment formula can be seen in equation (2) below [13].
\[ r_{xy} = \frac{n \sum X Y - (\sum X)(\sum Y)}{\sqrt{n \sum X^2 - (\sum X)^2} \sqrt{n \sum Y^2 - (\sum Y)^2}} \] (2)

Information:
- \( r \): relationship Coefficient
- \( n \): amount of data
- \( \Sigma X \): total Score Variable X
- \( \Sigma Y \): total Score Variable Y

KR-20 for internal reliability of the items can be seen in equation (3) below[14].

\[ r_{II} = \left( \frac{n}{n-1} \right) \left( \frac{s^2 - \sum pq}{s^2} \right) \] (3)

Information:
- \( r_{II} \): overall test reliability
- \( p \): proportion of subjects who answer items correctly
- \( q \): proportion of subjects who answer items incorrectly (q = 1 - p)
- \( \sum pq \): number of multiplications p and q
- \( n \): many items
- \( S \): standard test deviation (standard deviation is the root of variance)

The analysis of the improvement of abilities possessed by students after following learning with N-gain is calculated using equation (4) as follows[15].

\[ N - Gain = \frac{posttestscore - prescore}{maximumprescore - prescore} \] (4)

The results of the N-gain calculation are categorized into 3 (three) categories[16]:
- High: N-gain 7 0.7
- Medium: 0.3 \( \leq N\text{-gain} \leq 0.7 \)
- Low: N-gain 0.3

6. Result and discussion
The product of development is the cMOOCs web as a basic physics learning multimedia I. This web is open to the public can be accessed anytime and anywhere. The main components of this web are: 1) administrator, whose role is to view student data, teacher data, add teacher accounts, and also receive instructors, add / update teachers and edit the front page of the website; 2) instructors (educators), have the role to apply teaching data, update material data in accordance with teaching applications, and arrange exam questions and weighting values; 3) Students who log in to access the web cMOOCs.

In addition to the main components above, the features found on the cMOOCs web are registers, logins, home, material, discussion forums, certificates, our team, news of activities, about us, and testimonials. The product from this web development is through a series of tests, namely, feasibility testing of material, multimedia and small group trials and large groups.

The material feasibility test was conducted by two material experts who work as lecturers in physics. The material feasibility test results are shown in the following figure (1).
Based on the figure above, the percentage of the whole test material feasibility that is equal to 92.69%. The material feasibility ranges from 81% - 100%, so based on the Likert scale the criteria are very good [12]. The suggestions given by validators I and II are adding test questions, defining wave propagation, the video displayed comes from credible sources. The multimedia feasibility test was carried out by two multimedia experts. The material feasibility test results are shown in figure (2) below.

**Figure 1.** Material feasibility test results

**Figure 2.** Multimedia feasibility test results
Based on the figure above, overall percentage for the multimedia feasibility test results are 78.33%, so the material feasibility ranges from 61% - 80%, so that good criteria are obtained [12]. The suggestions given by validators I and II are in the learning section provided, the image does not represent the title, our team’s image is disproportionate, the part about us the shape of the letter cannot be read clearly, and in the material the font size is too small, giving the number according to the order of the material.

The advice given by the material and multimedia validators is considered very useful so that improvements have been made in accordance with the suggestions given before the basic physics material I and the web multimedia cMOOCs are implemented in students.

The results of a small group trial of 5 students from large group of 31 students can be seen in the figure (3) below.

Based on the figure above shows that the aspects of text, animation, image, video, sound, and material with an overall average is 82.67% so that it includes a very good category[12]. The results of a large group trial of 31 students can be seen in the figure (4) below.

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**Figure 3. Results of small group trials**

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**Figure 4. Results of large group trials**
Based on the figure above shows that the text, animation, image, video, sound, and material aspects with the overall average are 90.03% so that it includes a very good category [12].

Based on the N-gain calculation that has been done, N-gain is obtained for basic physics material I which consists of mechanics of 0.818, oscillation and mechanical waves of 0.831, and thermodynamics of 0.711 so that the average score of $g \geq 0.786$ is obtained. N-gain scores obtained include very high categories [16].

From the results of the explanation above, cMOOCs web development research is also supported by several supporting factors, including: 1) cooperation and tolerance of time in giving research permits by the coordinator of the physics education study program FMIPA State University of Jakarta, the active participation of students in in studying and working on quiz questions and material related to research; 2) the willingness of students to share their time in attending compulsory learning at State University of Jakarta and taking online learning on the web cmoocs, communication has been established between participants in discussion forums that help each other and share knowledge related to the material being studied. This is in line with previous research which stated that with cMOOCs it also requires students to play an active role in the spirit of openness to form activities and collaborate with fellow participants to achieve expected goals [17]. Apart from that, it is also in line with previous research which concluded that cMOOCs provide opportunities for participants to create good collaboration so that it can help them sharpen and develop proficiency in the digital era [2]; 3) students have tried their best as expected. This can be seen in the results of their independent learning. As in the previous study, it was concluded that with maximum effort in information seeking will help students to achieve their learning goals [18].

In addition to the supporting factors described above, there are also several inhibiting factors in the study. This is known based on a questionnaire distributed to respondents after the end of learning at phycsera.com. The inhibiting factors are: 1) inadequate and less stable internet network so that it takes a long time to access learning online; 2) the density of the normal lecture schedule on campus so that students have difficulty in dividing time; 3) limited internet quota held by students to access learning online.

Another factor is the lack of maximum communication in discussion forums and social media as expected. Even though there has been information submission through Wikepedia, and the YouTube link.

7. Conclusion
The results of the application of the development of a massive open online online web-based multimedia course (cMOOCs) in basic physics material I which includes mechanics, oscillations and mechanical waves, thermodynamics are feasible to be applied in learning at universities.

8. Acknowledgment
We thank to Universitas Musamus for facilities, supports, and publications

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