MATLAB-based physics calculator: alternative for learning media for work and energy concept

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Abstract. Physics concept makes students less understanding of differential equations of the concept of business and energy. Learning about basic physics about effort and energy can be done with the MATLAB program in the form of a physics calculator by simulating physics formulas. This research uses development research methods (R&D) with 4D development model (Define, Design, Development, and Dissemination). Matlab-based physics calculator are created using Matlab software through a multimedia development format that formula, simulation and theory. The test of the product response was applied on 29 the students. The response items were measured using the Likert scale from 1 to 4 scales. The analysis technique was descriptive statistics. For media expert validation assessment is 3.43 and for material expert validation is 3.64. Overall the result of student response analysis indicates that this physics calculator is good (3.21 out of 4) for use in learning. Basic physics learning with the help of an MATLAB-based physics calculator can help students understand their coursework in a simulated form.

1. Introduction
The subject of physics is one of the subjects in science that require skilled learners to apply the concepts and principles of science gained so as to produce learners who are science and technology literate [1]. To achieve this goal learners are required to carry out practical activities which are the result of the knowledge gained. In the physics learning, understanding the concept is something that is absolute when a learner doing the learning process. Learning about basic physics has been using the understanding of physics theories and without mentoring in the form of models and simulations to give students an understanding. Dynamics is one of the concepts of physics that learn about the motion by looking at the cause. The vectors that affect the motion of this object make students confused and less familiar in describing the concept of motion. One of the dynamics materials that students learn is work and energy materials. Work and energy materials require students to understand style. Physical understanding of dynamics can also be done with experimentation but it takes time and is less effective if applied on campus.

Media learning plays an important role to be used by the learning media teachers should be able to make students motivated to learn [2]. The use of innovative technology in education provides educators with a valuable opportunity for making improvement in the curriculum in order to make it an interactive one which is more inclusive and interesting [3]. The development of information and technology today
becomes one of support in terms of education. With uses technology-based learning media will turn
conventional learning into digital. A lot of learning media can be used to complement the physics
learning, one of them with Matlab. One strategy for students to understand business and energy material
is with simulated media using MATLAB. Models and simulations that will be illustrated to provide a
learning understanding of effort and energy.

MATLAB uses the concept of array/Matrik as its standard variable element without requiring the
declaration of arrays as in other languages. It can also be integrated with applications and external
programming languages such as C, Java, .NET and Microsoft Excel [4]. Matlab Software has different
applications, especially in application that require mathematical calculations. It is important to know
that Matlab performs all mathematical calculations in the form of matrices [5]. Matlab is very powerful
tool for technical computing and simulation. It is time saving tool for high performance computations
because it is optimized for this kind of tasks. It also supports lack of real word system in education [6].

MATLAB has evolved into a sophisticated programming environment that contains functions to
perform signal processing tasks, linear algebra, and other mathematical calculations. MATLAB also
contains a toolbox that contains additional functions for specific applications [7]. MATLAB is
extensible, in the sense that a user can write new functions to add to the library when available functions
cannot perform certain tasks.

By using MATLAB-based Learning Media is able to change the way or strategy of fun physics
learning. A learning media product that is packed into a physics calculator makes the latest innovations
to learn physics.

2. Method
This study is a development using the 4D approach (define, design, develop, and disseminate).
Furthermore, the physics calculator tested on the students taking the course of Fundamental Physics in
university in Jakarta, Indonesia for Academic Year 2019/2020. Number of the user samples is 29
students. Matlab-based physics calculator are created using Matlab software through a multimedia
development format that formula, simulation and theory.

The test of the material expert and media expert to validation of the physics calculator. Product
eligibility is analyzed using a questionnaire instrument with a Likert scale. Product eligibility criteria is
exposed in table 1.

| Score          | Criteria   |
|----------------|------------|
| 3,25 < score ≤ 4 | Very good  |
| 2,76 < score ≤ 3,25 | Good   |
| 2,1 < score ≤ 2,75 | Enough   |
| 0 < score ≤ 2,0  | Not good   |

The response items were measured using the Likert scale from 1 to 4 scales. Means for identifying
user response is the questionnaire. The questionnaire. The scale of the instrument is the Likert scale
from 1 (Absolutely Disagree) to 4 (Absolutely Agree). In this research is quantitative and qualitative
research. Quantitative descriptive method is used when calculating the frequency of choice answers by
respondents to the questions in the questionnaire.

3. Result and Discussion
The creation of the MATLAB-based physics calculator is an innovation to make it easier to resolve
physical problems. One of them is physics calculator with work and energy. This physics calculator is
designed to help students understand and solve the business and energy materials.
Figure 1. GUI display on the physics calculator

Figure 1. Is the GUI display of the business and energy material Physics Calculator. This physics calculator is created by creating two panels i.e. the first panel as the initial display and the second panel as the menu display. The GUI in the first panel will display the logo and title on the physics calculator. While the GUI in the second panel displays the menu of work and energy.

Figure 2. GUI mix display

To make the physics calculator look more simple, the first panel and the second panel are merged overlapping, as in Figure 2. This is so that when we run the MATLAB program on the physics calculator, it will display in one screen. The second Panel contains the menu to be counted, the number input of the problem, and the results searched in the physics calculator. The GUI in the second panel uses a ListBox toolbar to serve as a menu of options to display the options to look for in the physics problem.
Figure 3. a. Cover layout b. Menu layout on physics calculator

Figure 3. A is the cover display of the initial display on the physics calculator. In this initial view, there is a menu button shown in Figure 3b. The material Menu presented will display a physics calculator that can be selected in the Question box. This Menu can be used to calculate the effort of potential energy, the efforts of the energy of Iknetik, kinetic energy, potential energy, and mechanical energy. The right view there is a box that can be filled in as input of the question to be counted. The box input will adapt to what will be calculated.

![Image of physics calculator for kinetic energy calculation](image1.png)

Figure 4. Display of physics calculator for the kinetic energy calculation

Figure 4 is the view of the physics calculator for kinetic energy calculations. In that view can calculate the value of kinetic energy, mass, and speed of objects, depending on what is known in the matter of physics. The Physics calculator display also displays emblems and units. So that students can understand directly what is the symbol and the unit sought in accordance with SI units. In addition, the physics calculator display will also display the physics formula in the column below, according to the calculation result.

After the design and product Physics Calculator is finished created then the next step is a trial calculator physics. The first test by physicist is seen in terms of materials and media. From the test results of the validation by the material experts acquired an average value of 3.64. Which suggests that, the physics calculator deserves to be tested in school and can make Can be created for broader material
and graphic images are displayed. From the test results of the validation by the media experts acquired an average value of 3.43. Which suggests that, the physics calculator can be displayed in a smartphone so easy to use and carry. The look of physics calculator packed more interesting for easy to read and understand.

The second test is to students to know the student's response to the physics calculator. The test of the product response was applied on 29 the students. Overall the result of student response analysis indicates that this physics calculator is good (3.21 out of 4) for use in learning. The students learn more about using the physics calculator so that it is not hard anymore to understand the physics formula.

By utilizing MATLAB, users can perform data analysis, develop algorithms and create models and applications [8]. Students can learn independently with the physics calculator. According to Antonios, matlab is a strong candidate for programming educational applications in a corresponding wide range of subjects [9]. GUI is a tool to display the classic control theory system stability criteria graphically, quickly, easily and accurately. This is done by exploiting the powerful computational and graphical functions of Matlab. MATLAB display equipped with images and graphics makes the physics calculator easy to understand by students.

The physics calculator would hopefully enable the students to develop skills regarding the implementation of the filters, operators, methods and techniques used for image processing and computer vision. Sae as research of Gil to use MATLAB application, our teaching-learning process thus permits the accomplishment of knowledge assimilation, student motivation and skill development through the use of a continuous evaluation strategy to solve practical and real problems by means of short projects designed using MATLAB applications [10]. By using Matlab can compare between theory and experimentation with MATLAB application. The existing GUI display can explain a physical phenomenon [11].

In a blend of fundamentals and applications, MATLAB Deep Learning employs MATLAB as the underlying programming language and tool for the examples and case studies in learning [12].

The learning media occupies an important position as one of the supporting components in the learning system [13]. Media or teaching materials will help students in quality question to make interactive learning process because the learning experience becomes more meaningful and satisfying [14]. It also can motivate learners due to increase interest in learning to be faster and more productive [15]. Physics calculator to be one of the alternative learning media that can motivate students’ learning and active in class.

4. Conclusion
Based on the results of tests conducted on the application can be concluded that the physics-based MATLAB calculator on the concept of work and energy can be used as physics learning medium. For media expert validation assessment is 3.43 and for material expert validation is 3.64. Overall the result of student response analysis indicates that this physics calculator is good (3.21 out of 4) for use in learning. Physics calculator to be one of the alternative learning media that can motivate students’ learning and active in class.

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