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ORIGINAL RESEARCH

Physics learning module on google sites-assisted case-based learning measurement material

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Abstract

This study introduced the development of a physics learning module on the topic of measurements based on case-based learning, supported by Google Sites. In the research background, the importance of innovative approaches in physics education for enhancing student understanding had been recognized. Therefore, the primary aim of this research was to develop an effective instructional module that would improve students' comprehension of measurement concepts. The research adopted a research and development approach using the 4D development model (Define, Design, Develop, Disseminate). During the "Define" phase, the need for the module and the scope of the teaching material were identified. Subsequently, in the "Design" phase, the module structure was designed, and case-based learning strategies were planned. The "Develop" phase involved creating the module as per the specified design, including the integration of case-based scenarios and the utilization of the Google Sites platform. In the final "Disseminate" phase, an assessment was conducted on the usability and effectiveness of the developed module. The result of this study yielded a comprehensive physics learning module centered around measurement concepts and utilizing case-based learning techniques. The module was successfully validated as an effective teaching tool capable of enhancing students' understanding of measurement concepts.

Keywords: Physics education · Measirement· Learning Module · Case Based Learning · Google Sites

INTRODUCTION

Education is an effort to improve the quality of human resources in terms of thinking and expertise (Al Farisi, 2021). Education is the main key for a country to excel in global competition (Rahmadani & Qomariah, 2022). Education encourages change for the better from generation to generation. Education should produce innovative and creative things and produce a generation that is far more capable of bringing change (Hutabarat et al., 2022). The Ministry of Education and Culture through the Nadiem Makarim policy gave a message that students must be given freedom and flexibility in determining their goals and future according to student abilities, namely with the establishment of an independent curriculum.

The independent learning curriculum is a proposal to change the education system in order to accommodate educational progress that is relevant to today's modern times. The goal is to restore the essence of education by giving freedom to students to express themselves so that the

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skills they have can mature and develop. With the development of technology, it will be a driver of learning independence, because it can help break the education system that is considered rigid or less free, including the workload of the community (Muratov & Tadjieva, 2021). So that with the independent learning curriculum, teachers can be innovative, independent and creative in controlling the teaching and learning process (Anwar, Sukino, & Erwin, 2022).

This educational program is different from intracurricular learning, because the content is more optimized so that students have enough time to explore ideas and improve competence. Based on this, teachers are challenged to improve their skills in the field of teacher expertise, but many teachers have not been able to use technology to teach physics as a resource as well as a tool (Pillawaty, *et al.*, 2023). One of them is in making teaching materials, teachers should be able to develop teaching materials that contain material with various representations, be it sound, images, or videos so as to attract students to study physics. Modules are one of the teaching materials that can overcome these problems.

Modules are a set of teaching materials that are presented systematically so that students can learn without a teacher, arranged systematically and interestingly, covering the content of the material, teaching and learning methods, methods and assessments can be used independently (Sukardi, 2018). In line with this opinion, Prastowo (Nurbaeti & Sunarsih, 2020) suggests that modules are teaching materials that are arranged systematically in a language that can be understood by students according to their level of knowledge and age, so that they can learn on their own (independently) with the help or at least guidance of teachers. This is in accordance with the current educational paradigm where learning is more student-centered, and teachers act as facilitators of learning. With the module, students have the opportunity to practice learning independently, students can demonstrate how to learn according to their abilities and interests, students have the opportunity to test their own abilities by doing the exercises in the module (Al Azka, Setyawati, & Albab, 2019). Along with technological developments, modules can be integrated into the internet network through digital platforms, one of which is Google Sites.

Google Sites is one of the products of Google as a tool for creating websites. Users can take advantage of Google Sites because it is easy for novice users to create and manage (Jubaidah & Rizki Zulkarnain, 2020). The use of Google Site can help teachers to manipulate objects in delivering learning, this is according to Piaget's statement which states knowledge can arise and increase when interacting with the object being studied (Aminah, Amami, Wahyuni, & Rosita, 2021). Students also no longer need to download the material provided by the teacher, so it will not consume a lot of internet quota and memory. In addition, teachers also do not need to be confused in delivering material. This is because students can access it through Google Sites. The display in Google Sites can also be made as attractive as possible so that students do not feel bored in learning activities, one of which is physics learning (Nugroho & Hendrastomo, 2021).

Physics is one branch of science that studies objects in nature physically and written mathematically so that they can be understood by humans and used for the welfare of mankind. Based on this, physics learning cannot be separated from mastering concepts, applying them in solving physics problems, and working scientifically (Olimboyevich & Asadovna, 2022). However, physics learning in today's classes tends to emphasize mastery of concepts and exclude students' physics problem-solving abilities, so that students' ability to solve problems

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is still relatively low (Puspitasari, 2019). The problem-solving ability of students in Indonesia can be categorized as low as evidenced by the results of the PISA (Programme International Student Assesment) test conducted by the OECD (Organization for Economic Corporation and Development) in 2018 showing that in the field of science has an average score of 396 with an OECD average score of 489 (PISA, 2018). In the measurement material, students still find it difficult to solve problems in this material, so a learning model is needed to help overcome these problems.

Case-based learning is student-centered learning using cases as topics in learning (Safitri & Purbaningrum, 2020). Case is a learning medium in CBL. A case can often be presented as a narrative resembling a real-life situation that provides clear context and a central character, specimen, or element, where difficulties need to be resolved (Kulak & Newton, 2014). A case can also mean a case or problem that needs to be resolved. Cases used in learning are intended to be researched and resolved in discussion forums (Zhao, et al., 2020). Case learning challenges students to analyze the problem described in the actual case under discussion and draw conclusions based on the processing of available information (Safitri & Purbaningrum, 2020). With the help of this learning model, students are guided to solve problems in physics material with the learning steps in it. By combining teaching materials in the form of modules that can be accessed easily via students' smartphones, as well as materials arranged based on case-based learning steps, students' difficulties in solving physics learning problems can be helped and students have skills in solving problems.

Based on these descriptions, a study was conducted entitled "Physics Learning Module on Case Based Learning Measurement Material Assisted by Google Sites". The product resulting from the creation of case-based learning physics learning modules assisted by Google Sites is expected to be creative and interesting so that it can be useful, meaningful, and fun for its users

METODE

Types of Research

In this research the method used is research and development (Research and Development) which is a research design that aims to develop and validate educational products. With the development research model used in this study is a 4-D model. The 4-D step has the advantage that it is systematic and simple, does not take a long time compared to other models such as 3-D models and ADDIE. This model consists of four stages of development, namely define, design, develop, and disseminate which are adapted into the 4-P model of defining, planning, developing, and deploying (Lesmono, Wahyuni, & Dita Alfiana, 2012). Each step in this research can be seen in the Figure 1.

Figure 1 4D Devepopment Model

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Procedure

At the define stage, the objectives set and determine learning requirements which include learning and limiting learning materials. The steps taken at this stage, namely initial analysis, student analysis, task analysis, material analysis, and learning objectives. The initial analysis is carried out by analyzing the curriculum that applies and is used in schools. Then the analysis of learners is carried out using needs analysis. The results of curriculum and student analysis are used to analyze tasks, materials, and formulate learning objectives.

At the design stage (planning) a product design is produced. The design stage aims to design the developed product. The selection of media is adjusted to the results of the material analysis and adjusted to the characteristics of students. In this case, the media used is in the form of Google Sites that have been adjusted to the learning objectives and rules in the preparation of good products. The initial design of this study is a media design made before the trial. The resulting product at this stage is called draft module 1. At the develop stage, the final form of the product is produced and then validation tests are carried out by experts and trials in the form of user responses. The steps taken at this stage carry out product validation through questionnaires which contain aspects such as the following.

Instrumen Pengumpulan Data

The final form of the product is produced and then validation tests are carried out by experts and trials in the form of user responses. The steps taken at this stage carry out product validation through questionnaires which contain aspects can be seen in the Table 1.

Tabel 1. Instrument for validation

Aspect	Indicator
Content Validation	1. Material Coverage 2. Presentation of MateriaLanguage 3. Language
Learning Validation	1. Case Based Learning 2. Use of Modules in Learning 3. Language
Media Validation	1. Presentation Design 2. Interaction Usability 3. Accessibility 4. Reusability 5. Standar Compliance

Collecting Data

This research focuses on the development of case-based learning physics learning modules, for which the data is processed using the interpretation of a continuum scale of 5 to obtain the level of product validity. On a continuum scale, the measured variables are translated into indicators. Then indicators are used as a reference to compile instrument items that can be questions or statements.

The material validation sheet consists of 12 statement items developed from three aspects, namely the material coverage aspect consists of 7 statement items, the material presentation aspect consists of 3 statement items, and the language aspect consists of 2 statement items. The

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learning validation sheet consists of 13 statement items developed from three aspects, namely the case-based learning aspect consists of 2 statement items, the aspect of using modules in learning consists of 9 statement items, the language aspect consists of 2 statement items. Then, the media validation sheet consists of 24 statement items developed from five aspects, namely the media design aspect consists of 6 statement items, the ease of use aspect consists of 6 statement items, the ease of access aspect consists of 6 statement items, the ease of reuse aspect to develop other media consists of 3 statement items, and the standardization aspect consists of 3 statement items.

Analyze Data

To determine the validity value, it can be calculated in the following way:

$$Validity\ Score = \frac{total\ score\ obtained}{highest\ total\ score} \times 100\%$$

Then after getting the validity value, the percentage of validation interpretation can be determined with the following Table 2 (Riduwan, 2010).

Tabel 2. Interpretation of Validation Assessments

Percentage Score	Information
$n \leq 20\%$	Highly Invalid
$21\% < n \leq 40\%$	Invalid
$41\% < n \leq 60\%$	Quite Valid
$61\% < n \leq 80\%$	Valid
$81\% < n \leq 100\%$	Sangat Valid

The disseminate stage is the stage of using products that have been developed and have been tested on a wider scale. The dissemination stage is carried out to test the effectiveness of the product in learning activities in other schools on a limited scale. However, in this process, due to the inability of the researcher and lack of adequate time and funds so that the researcher only responds to the use of the product by teachers and learners by only looking at the modules created without doing the learning

RESULT AND DISCUSSION

The product developed in this research is the Physics Learning Module. In this case, the module was developed by utilizing a Google platform , namely Google Sites and can be accessed through the following link https://sites.google.com/view/modul-fisika-pengukuran/halaman-muka. This research chose to develop a physics learning module because with the module, the physics material delivered can be presented using a presentation format that is incorporated in one media only. Students can easily access learning media without having to open many search windows during physics lessons.

The content of the material delivered in this physics learning module contains the format of writing, images, and videos. The images in this module aim to clarify the material delivered in written form, while the videos in this module aim to explain the learning material in more depth. The development of this module uses a case-based learning model in delivering material with the aim that students can understand physics concepts independently with the presentation of various formats adjusted to the ability of students to capture understanding of the material.

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The material in this learning module is adjusted to the flow of learning objectives in class X learning outcomes (phase E) measurement material. This module can be a reference learning media that can be used and accessed easily. The use of this module can be operated independently by students and in accessing it simply press the link provided without having to install other additional applications. This module can be used in various electronic devices such as smartphones, laptops, computers, and tablets that are connected to the internet. This module will provide a display automatically according to the electronic device used.

Based on the results of a needs analysis through a google form conducted on grade X students in one of the State High Schools in Bekasi with a total of 35 students, 88.6% of students agreed to create a google sites-assisted module with cases related to life used and the rest expressed disagreement. Based on the needs analysis, a product was made in the form of a case-based learning module assisted by Google Sites.

Research on the development of physics learning modules produces learning media in digital form. Making modules uses the help of several applications such as google sites as the main application for making modules, google forms, and google docs to create practice problems.The content of the module consists of several parts, namely cover, preface, table of contents, instructions for use, study instructions, introduction, concept map, material, evaluation, and bibliography. The case-based learning model is included in the material in the form of student worksheets in the form of learning activities as in the following Table 3.

Table 3 Learning Activities in Modules

Phase	Learning Activity 1 (Magnitude, Units, and Dimensions)	Learning Activity 2 (Scientific Notation and Important Numbers)	Learning Activity 3 (Measurement, Measuring Instruments, Errors, and Measurement Uncertainty)
Preparation and Submission	Understand the case about dimensions and their calculations	Understand the case for the effect of density on other objects	Understand the case about the falling speed of an object
Discussion	Form groups of 5-6 people Complete an empty table	Form groups of 5-6 people Conducting experiments to determine the density of an object Collect experimental data into observation tables	Form groups of 5-6 people Conduct experiments on the free fall motion of objects Collect experimental data into observation tables
Observation	Observe the questions given and answer them as a group	Observe the questions given and answer them as a group	Observe the questions given and answer them as a group
Report the results of discussions	Summing up the calculation results and presenting them in front of the class	Summing up the calculation results and presenting them in front of the class	Summing up the calculation results and presenting them in front of the class
Evaluation	Working on evaluation questions as a form of reflection	Working on evaluation questions as a form of reflection	Working on evaluation questions as a form of reflection

Measurement materials are provided at the beginning before students work on worksheets. Measurement materials are packaged into videos and additional materials in the form of websites. After students understand the material through videos and websites, then students work on worksheets that can be filled directly by students without using paper to store the results of the discussion. This module makes it easier for students to study independently,

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especially in working on worksheets, because it has been arranged systematically. Then after the initial design was made, then validation of the module was carried out and the validation results were obtained as follows in Figure 2 through Figure 4.

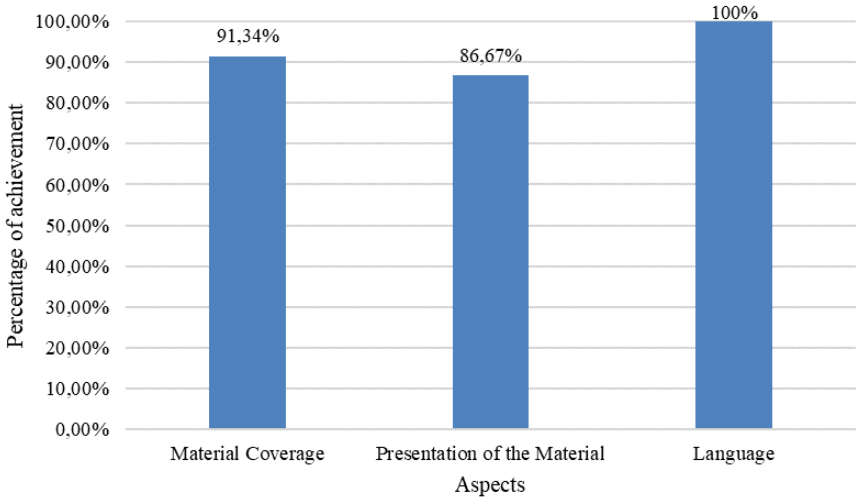

Figure 2. Histogram of material validation results

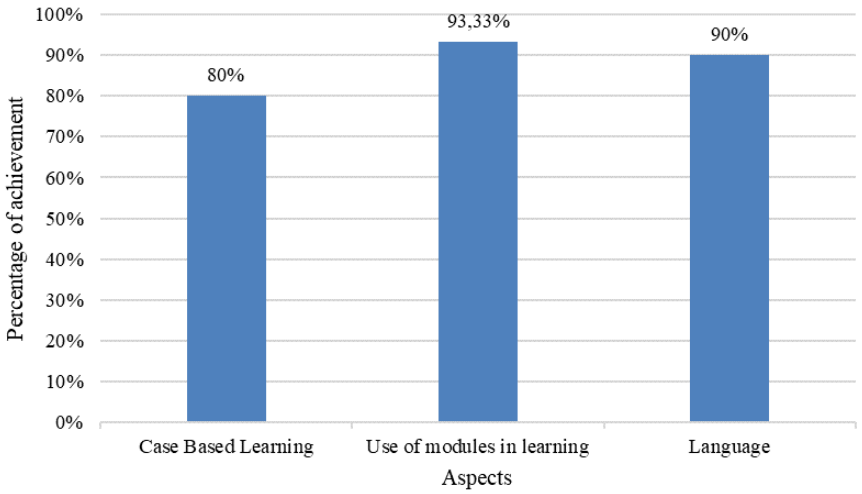

Figure 3. Learning validation result

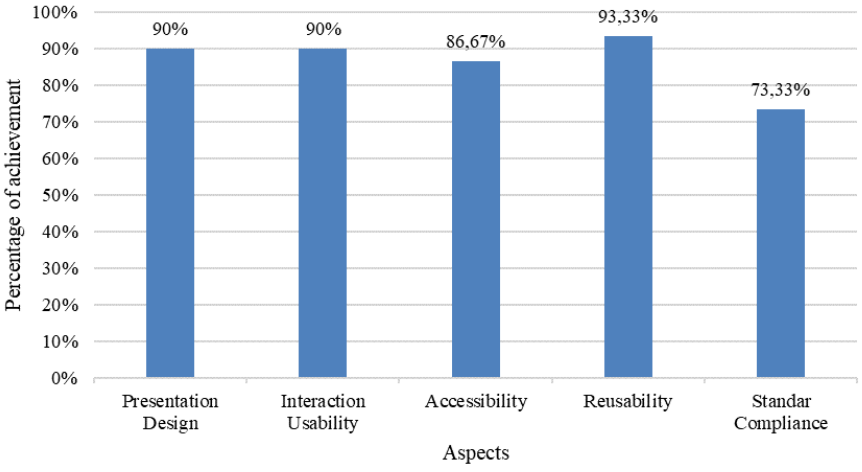

Figure 5 Media validation result

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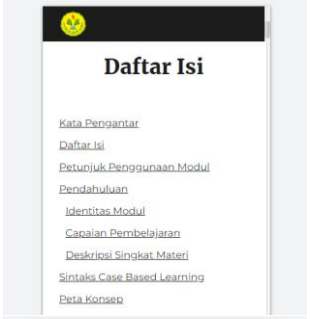
Based on the results of the validation above, a qualitative assessment was also obtained in the form of suggestions and input from experts which researchers then used to improve the products developed. The final results of the products developed after repairs are as in Table 4.

Table 4. The Products

Picture	Page Title	Short Description
	Initial view	The initial display of the module contains a background image and the contents of the module title are "Measurement" and there is the logo of the State University of Jakarta on the upper left side.
	Contents	Like the print module, in this module there is also a table of contents to make it easier for users to see the contents of the resulting module. This table of contents also contains *hyperlinks* making it easier for users to get to parts of the module.
	Instructions for use	In the module there are instructions for use that serve to provide information to users about how to use the module during learning.
	Introduction	The introduction contains the identity of the module, learning outcomes, and a brief description of the material that will be explained clearly in the learning activities. The learning outcomes used are in accordance with the independent curriculum on measurement.

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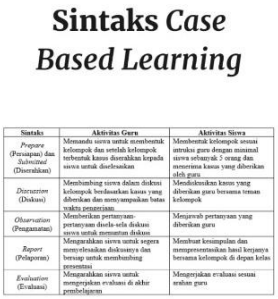
Picture	Page Title	Short Description
 	Syntax case based learning	This syntax is used during learning to achieve the objectives of the learning model using modules.
	Concept map	The concept map briefly describes the content of the learning material in the module.
	Learning activities and learning objectives	This module learning media divides the material into three learning activities with video links to the material according to the learning objectives to be achieved. This is done so that students in learning the material in the module can focus and understand the part of the material presented. Each activity has learning objectives to be achieved in each learning activity.
	Material Video	The material in this module is included in the video to attract learners to study it carefully. The video made has a duration that is not too long to prevent students' boredom of the material. In some of the videos provided, there are also sample questions to strengthen students' understanding of the material.

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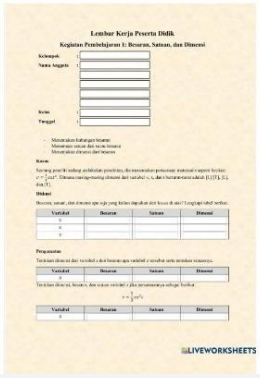
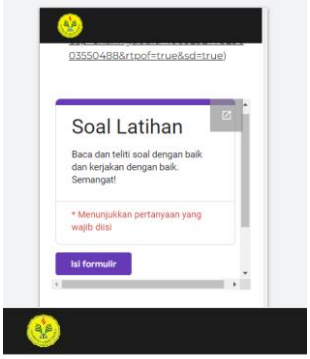
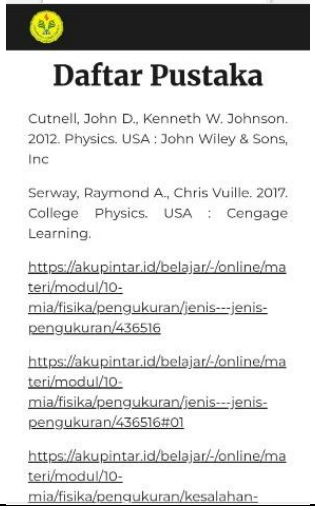
Picture	Page Title	Short Description
	Material links	The material link aims to provide additional material that is not provided in the video material. This link will take students to open the website according to the source listed.
	Project tasks	Project assignments are given at the end of learning according to the tasks listed in the module and are done in groups. This project assignment will later be presented by the group in front of the class.
	Practice questions	The practice questions are given after the three learning activities on this measurement material have all been completed. This practice question aims to strengthen students' understanding to the extent to which they are able to understand the material they have learned.
	Bibliography	Contains a list of reference modules used as source material consisting of author name, year published, book title, city, and publisher name.

Based on the validation results, the percentage of each validation, namely material, learning, and media validation was obtained at 91.67%, 90.77%, and 87.5%. Based on the

validation score interpretation table, the module is categorized as very valid for use as a medium for learning high school physics.

CONCLUSION

Based on the results of material, media, and learning validation tests by experts, as well as responses by physics teachers and students, it can be concluded that the physics learning module on the Google Sites assisted case-based learning measurement material developed is valid for physics learning media with an average value of 91.67% material validation percentage, an average value of 90.77% learning validation percentage. and the average score of media validation percentage is 87.5%.

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