Moodle-Based Learning Management System Application in the Development of Interactive Digital Module in Description Statistics Courses

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Abstract. This research is motivated by the importance of learning innovation in lectures during the COVID-19 pandemic which is in accordance with the era of the industrial revolution 4.0 to be able to increase the statistical literacy of prospective teacher students. This study aims to develop an interactive digital module using a Moodle-based Learning Management System (LMS) application. This research is a development research using research methods, namely R & D with the ADDIE model with 5 stages namely 1) Analysis, 2) Design, 3) Development, 4) Implementation, and 5) Evaluation. The subjects of this study were 26, 5th semester students at the Institut Pendidikan Indonesia, Garut. The instruments used are validity sheets, practicality sheets, effectiveness sheets, and student response sheets. The results of this study, based on the media expert test and the material expert test, the media was declared valid with an average of 89.67% which was categorized as very good. The learning media is declared practical based on the practicality test by the validator with an average of 89.33% which is categorized as very good. The results of the study indicate that the interactive digital module for this descriptive statistics course is suitable for use as a learning medium based on the results of validation by learning media experts, material experts, supporting lecturers, and student groups. The implications of this research can be used as a reference for academic practitioners in learning innovation in higher education.

Keywords: Moodle · Learning Management System · Interactive Digital Modules · Statistics Courses

1 Introduction

Information technology that is developing very rapidly in this day and age is a necessity that occurs in various aspects of life, as well as in aspects of education. The development of the world of education can be seen from the learning process such as curriculum development, the use of learning models, the selection of learning methods, the use of teaching materials and so on. This development covers every level of education, from

early childhood education to higher education. Education in higher education has a great responsibility for the process of achieving educational goals. Therefore, universities must be able to adapt to technological developments in the era of the industrial revolution 4.0.

Digital literacy does not only have the ability to use software or operate digital devices; but includes the complex range of cognitive, motor, sociological, and emotional skills that users need to function effectively in a digital environment.

One of the causes of low digital literacy skills is that teachers do not use learning media to support the learning process [1]. This opportunities for teachers to utilize technology in order to improve the quality of learning processes and outcomes. Learning can be improved by using technology-based learning media developed so that teachers and students can easily access and use these learning media [2]. Development of technology-based learning media includes digital modules. This digital module is a form of learning aid that contains materials, limitations, methods, and ways of conducting a final assessment that are arranged in an interesting and systematic way with the aim of achieving competence based on the level of complexity electronically [3, 4]. One of the advantages of digital modules is that teachers are able to deliver learning in class and can be continued outside the classroom [5].

Lecturers can use electronic books or digital modules as a means of delivering learning and students can access them easily. The Moodle-based Learning Management System application is one of the learning technologies that has become popularly used in the midst of the Covid19 pandemic. In addition to application, research related to LMS is also widely carried out in various universities in Indonesia. Regarding learning using a moodle-based system during the Covid-19 pandemic [6], implementation moodle-based E-learning during the Covid-19 pandemic, evaluation of moodle-based LMS training during the Covid-19 pandemic in vocational schools [7, 8], the development of a moodle-based virtual learning system as an online learning platform during the Covid-19 pandemic, and there are many other studies on the use of a moodle-based LMS as an online learning medium [9].

Based on these various studies, it can be said that the Moodle-based LMS application can be used to develop digital modules as online learning solutions both during the Covid-19 pandemic and as a hybrid learning model. The implementation of online learning in universities that has been going on for a long time has made students bored with the methods and teaching materials provided by lecturers. Modules that are not interactive create a monotonous learning atmosphere so that students experience boredom in the learning process. A student who experiences boredom in the teaching and learning process will get progress in learning outcomes [10].

One effort that must be done is to create a digital module that can make students interact directly with the module, for example, students can take quizzes directly, there is an online two-way discussion forum that animates the atmosphere of two-way interaction between students and teachers, quizzes interactive when virtual face-to-face meetings are held, and other interactive features that make students not experience boredom in learning. The Moodle-based Learning Management System application also has a feature to create interactive modules.

Based on this description, the purpose of this research is to use the Learning Management System (LMS) application with the Moodle platform in the development of

interactive digital modules in the Descriptive Statistics course. The expected benefit from this research is the creation of interactive digital modules that can be used as learning media both during the Covid-19 pandemic and as an alternative to online learning.

2 Methods

The type of research used is research and development (R&D) in education. According to Borg and Gall stated that "Educational Research and Development (R&D) is a process used to develop and validate educational products" [11]. This type of research is defined as a research method that produces certain products that are needs analysis and tests the effectiveness of these products [12]. The subjects of this study were 26 5th semester students at a private university in Garut Regency. The data collection instruments include: 1) validity test sheets, 2) practicality test sheets, and 3) student response sheets.

The focus of development in this research is the development of interactive digital modules using the Learning Management System with the Moodle platform [13]. The final product of this research is expected to help lecturers and students at various universities in Indonesia in the interactive, efficient, dynamic, and effective learning process for descriptive statistics courses, especially in universities.

This research and development method uses the ADDIE development model which consists of five stages, namely Analyze, Design, Development, Implementation, and Evaluation [14]. This development model can be a guideline for developing interactive digital modules so that they can help interactive, efficient, dynamic, and effective learning performance. Data collection is done by distributing questionnaires to experts or learning media experts and material experts as well as student groups. The questionnaire given to learning media experts and material experts aims to determine the validity and feasibility of interactive digital modules produced based on an assessment of the opinions of experts, then the validation results are used as the basis for improvements/revisions before the product is tested on students [15, 16]. While the questionnaire given to users, especially students, aims to see the validity and practicality of the interactive digital modules that have been developed [17].

Data analysis was carried out descriptively based on the percentage of questionnaire results given to experts or experts and to groups of students. The data analysis technique used changes the quantitative data in the questionnaire into a percentage form to determine the feasibility of teaching materials or interactive digital modules developed [18]. The decision-making criteria regarding the quality of the interactive digital module developed using a Likert scale with the validity criteria measured based on Table 1.

The validity test sheet was validated by material experts and media experts as validators of the learning media that had been made. Lecturers are given a practicality test sheet to assess practicality. The data obtained is then calculated as a whole from the aspects. The formula for calculating aspects of validity and practicality [20]. To determine the practicality of the developed digital module, the assessment qualification criteria in Table 2 are used.

Based on the assessment criteria in Table 2, the learning media can be said to be valid and practical if it meets the criteria of good or very good. To achieve the objectives of the research carried out, this research was carried out based on the stages of activities described in Table 3.

Table 1. Likert Scale Criteria for Digital Module Development

Criteria	Category
Score (81%–100%)	Very good
Score (61%–80%)	Good
Score (41%–60%)	Good Enough
Score a (21%–40%)	Not good
Score (0%–20%)	Very Not Good

[19]

Table 2. Practical Level of Interactive Digital Module

Criteria	Category
Score (81%–100%)	Very Practical
Score (61%–80%)	Practical
Score (41%–60%)	Practical enough
Score a (21%–40%)	Less Practical
Score (0%–20%)	Very Less Practical

Table 3. Stages of Interactive Digital Module Development activities with the ADDIE Model

Tahapan	Rincian Kegiatan
Analyze	1) Analysis of lesson plans 2) Material analysis 3) Analysis of problems in learning 4) Analysis of learning media
Design	1) Designing a lesson plan 2) Designing learning materials in digital form 3) Designing interactive digital module prototypes
Development	1) Develop interactive digital modules 2) Expert test
Implementation	Interactive digital module test by Students
Evaluation	Interactive digital module evaluation

3   Result and Discussion

The development of interactive digital modules in applied statistics learning for researchers, both students and lecturers, is a type of research and development using the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model which was developed using the Learning Management System with the Moodle platform which aims to improve learning performance interactive, efficient, dynamic, and effective.

3.1   Requirements Analysis

Requirements or needs analysis is carried out when conducting direct observations of students when the descriptive statistics course lectures take place in the classroom, both taught by the author himself and other statistics lecturers.

The results of observations and interviews show that the statistical learning process with conventional methods has many shortcomings, including the learning method tends to use the lecture method more so that the application of statistics in the form of practice is very less, there is no storage media for lecture history so that students cannot repeat the data processing material that has been learned. Have been studied, and the duration of time in class is limited so that sometimes learning outcomes and materials are not met. In addition, the Covid-19 pandemic condition also resulted in the application of conventional methods being considered inappropriate.

Therefore, online learning methods as an alternative are used by lecturers and students. However, a new problem that arises with the use of online methods is that students are less serious in focusing on following the learning material. This happens because in the implementation of the teaching and learning process, lecturers still use the lecture method only in delivering and explaining descriptive statistics courses and even only providing material files or assignments and students told to learn and do assignments independently so that students get bored quickly in following the lecture process.

3.2   Design Stage

The design stage is carried out to design learning plan activities, design materials that will be displayed in digital form, and design interactive digital module prototypes using the Learning Management System with the Moodle platform. At this stage, the features used in the development of this module are also designed such as the implementation of the label feature, the student attendance list feature, the feature for displaying PDF or PPT files, the quiz feature, the discussion forum feature. Figure 1 shows a prototype display of an interactive digital module that can be accessed online via the page of https://lecturer.institutpendidikan.ac.id/lms.

3.3   Development Stage

The development stage is carried out after designing an interactive digital module prototype. At this stage, the preparation of lesson plans, preparation of teaching materials, development of learning videos, discussion forums, and the creation of questions for quizzes has been carried out, then the content is entered into the Learning Management System application with the Moodle platform using various available features.

Fig. 1. Digital Module Prototype

3.4 Quiz Feature

This interactive digital module development activity is carried out based on the semester learning plan (RPS) so that every week the learning process is evaluated by giving assignments or quizzes. Procurement of evaluation of learning in the form of quizzes at every online meeting is very necessary to see the ability of students to master the material presented [21].

Even with interactive quizzes in the online learning process, it can increase student activity during the prevention of the spread of COVID-19 [22]. In a study conducted by Alsadoon [23] it was found that the use of online assessments was effective in helping to measure the level of student understanding. Meanwhile, it was easier for students to use web-based assessment (Moodle) because it was simpler, more efficient and effective [24].

Figure 2 shows the evaluation of learning in the form of an online interactive quiz given at every meeting. The quiz feature in this LMS can also be used as an online exam for the midterm and final exams [25].

3.5 Discussion Forum Features

This digital module also contains a discussion forum as a medium for discussion interactions between students and lecturers during the Covid-19 pandemic. With the application of discussion forums in this module, students have more benefits including students being able to communicate with lecturers and fellow students without being limited by space and time. In addition to students, lecturers also get more benefits from this discussion forum, including being able to save time in the teaching and learning process, reduce travel costs, save education costs, can reach a wider geographical area and can train students to be more independent in gaining knowledge [26] (Fig. 3).

In addition to the quiz features and discussion forums, there are also other features that can be developed as shown in Fig. 4.

In the activity features that can be added, namely 1) assignment, 2) attendance, 3) BigBlueBottonBN which consists of chat, choice, database, external tool, feedback, forum, glossary. 4) Interactive content consists of lessons, quizzes, SCORM packages, surveys, wikis, workshops, zoom meetings. And to add a source as shown in Fig. 5.
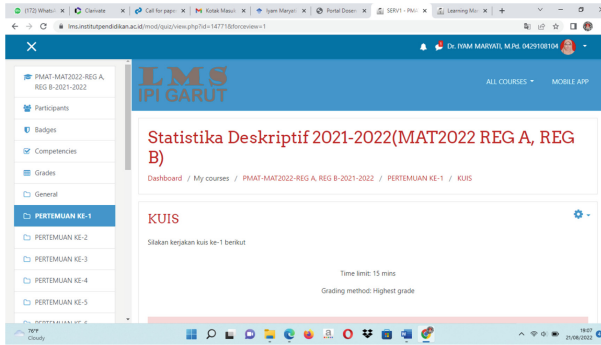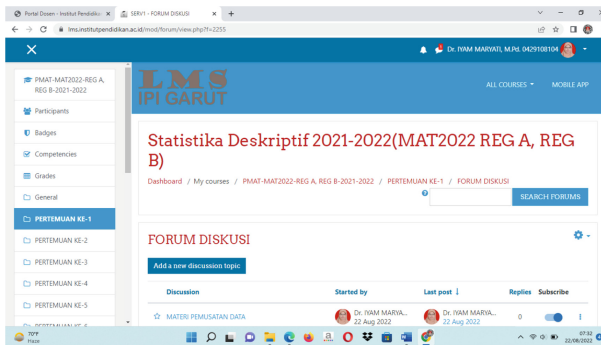
Fig. 2. Quiz feature

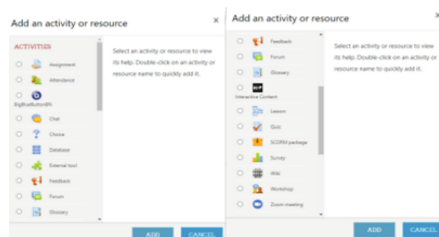**Fig. 3.** Discussion Forum Features

Fig. 4. Other Activity Features

In addition, the sources consist of books, files, folders, google meet for moodle, IMS content package (label, page, URL).

The development of this interactive digital module was also validated and revised by learning media experts and material experts before testing the product to student groups.
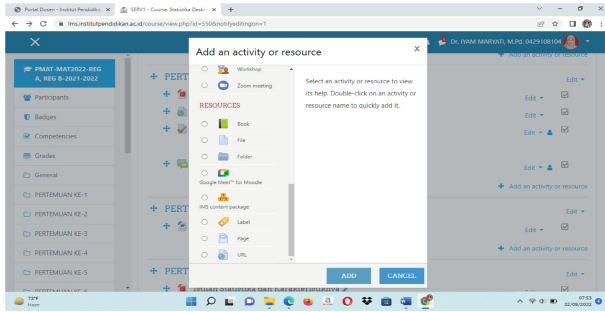
Fig. 5. Resources

Table 4 shows the results of the validation of learning media experts with an average percentage level of achievement of 89.67%, in the very good category, by making revisions in accordance with the suggestions of the validator before proceeding to the next stage.

The results of the validation of the learning media experts also show that the display aspect which consists of choosing the LMS template, the accuracy of the color selection, the attractiveness of the front cover, the accuracy of the layout proportions of the LMS features, and the consistency of the layout get a good rating with an achievement rate of 89%. Aspects of content or content consisting of the quality and accuracy of video presentation with material, suitability of presentation of images with material, suitability of presentation of interactive quizzes with material, suitability of presentation of discussion forums, attractiveness of teaching materials in the form of PDF and PPT received a very good assessment with a percentage level of achievement of 90%. Meanwhile, the flexibility aspect of the ease of use of this interactive digital module received a very good rating with an achievement rate of 90%.

In addition to validating media experts, the development of this interactive digital module was also validated by material experts. Table 5 shows the results of material expert validation with an average percentage level of achievement of 89.33%, in the very good category, by revising the material first according to the suggestions of the validator before proceeding to the development of the next material. The results of the material expert validation also show that in the aspect of presenting the material, the score is very good with an achievement level of 90%. The content aspect received a very good rating with an achievement rate of 89%. While the linguistic aspect received a good rating with an achievement level of 89%.

Table 4. Validation Results of Learning Media Experts

Aspect	Achievement	Category
Appearance	89%	Very Good
Content	90%	Very Good
Flexibility	90%	Very Good

Table 5. Material Expert Validation Results

Aspect	Achievement	Category
Presentation	90%	Very Good
contents	89%	Very Good
language	89%	Very Good

Based on the results of the validation of learning media experts and material experts, it shows that this interactive digital module is very valid and feasible to be implemented to the next stage.

3.6 Implementation Stage

The implementation stage is carried out after the development of the interactive digital module has been completed and has gone through a validation process by learning media experts and material experts. At this stage, interactive digital modules are tested on groups of students in the lecture process. Table 6 shows the survey results from the interactive digital module trials to groups of students. The number of students who use LMS for descriptive statistics lectures is 75 people. Aspects of the use of technology in the study of statistics obtained a very good assessment with the percentage level of achievement of 89%. This shows that applied statistics learning should use interactive technology to solve descriptive statistics problems, not just relying on conventional learning methods, especially during the Covid-19 pandemic.

Furthermore, in the aspect of quiz presentation, it received a very good assessment with an achievement rate percentage of 89%, this shows that the quizzes presented make students focus on doing quizzes. This shows that with the digital module, a student can play back the steps or learning descriptive statistics that are considered difficult or complicated anytime and anywhere, without having to ask the lecturer to repeat the material that has been delivered [27]. In the aspect of the discussion forum, it received a good rating with an achievement rate of 89%. This shows that the Moodle-based digital module allows students to easily interact with lecturers to ask questions and interaction between students to communicate related to learning materials through the discussion forum feature. The aspect of learning evaluation through online practice questions at every meeting through this digital module received a very good assessment with an achievement rate of 87%. This shows that the practice questions given make students feel more challenging, so they have their own charm and satisfaction to solve. The use of web-based assessments attracts the attention of students more than the use of traditional assessments [6]. The aspect of using statistics in everyday life gets a good rating with an achievement rate of 88%. Then on the aspect of ease and flexibility of using LMS, the score is very good with an achievement rate of 89%. This shows that interactive digital modules that can be accessed online provide convenience for students and are flexible to use without being limited by space and time.

Table 6. Student Group Validation Results

Statement	Achievement	Category
I like to study Statistics using technology-based teaching materials during the Covid-19 pandemic	90%	Very Good
The interactive quiz presentation kept me focused.	89%	Very Good
The discussion forum provided made it easy for me to interact with other students and lecturers to communicate and ask questions.	89%	Very Good
The practice questions given in the teaching materials are more challenging, so they have their own charm and satisfaction to complete.	87%	Very Good
Studying statistics with this technology-based teaching material makes me have the capacity and confidence to interpret every statistical principle in everyday life	88%	Very Good
Learning Statistics with LMS technology provides convenience and flexibility without being limited by space and time so that my other work is not neglected	89%	Very Good

3.7 Evaluation Stage

The evaluation stage is carried out after the digital module is developed and implemented. At this stage, a survey was also conducted on the practicality test of this interactive digital module. The results of the survey conducted to groups of students and lecturers who teach applied statistics courses state that statistics courses packaged in the form of interactive digital modules are very practical to use with an achievement rate of up to 89.33%. Therefore, based on the results of the validation test, the effectiveness test when the module is implemented, as well as the practicality test, it shows that the interactive digital module is suitable for use in the teaching and learning process during the covid-19 pandemic.

The development of interactive digital modules has gone through various processes, namely the process of fulfilling the needs analysis, the process of developing digital module features, the trial process of learning media experts, and the process of testing the module with groups of students and several lecturers who teach courses. These results indicate that the interactive digital module developed using the LMS with the Moodle platform can assist lecturers and students in explaining and understanding learning materials. This is supported by the opinion Herayanti [24] stating that the development of learning media with the Moodle platform is feasible to use to support the learning process in lectures. This study is in line with similar research which states that learning statistics using Moodle-based media can increase student interest and motivation in learning during the Covid19 pandemic [28]. This digital module contains various media that support the learning process. Learning media that contains multimedia content in it in the form of images, videos, animations, text, and audio are very useful for students, because they greatly facilitate and assist in the learning process [29].

In general, the use of Moodle-based interactive digital modules for applied statistics courses for economics and business is very helpful for students and students in carrying out the learning process during the COVID-19 pandemic. This study is in line with previous research conducted by Sara et al. [30] that the use of Moodle-based e-learning is very appropriate, in order to overcome conventional learning activities that cannot be carried out due to the COVID-19 pandemic and the availability of advice and infrastructure is needed so that learning outcomes can be realized.

4   Conclusion

The development of interactive digital modules has been developed using the Learning Management System (LMS) application with the Moodle platform. This digital module is suitable for use based on the validation results from learning media experts and material experts and obtained very good scores and is very practical for use by lecturers and students as a statistical learning medium in lectures during the Covid-19 pandemic. The development of the next interactive digital module is recommended to maximize the features contained in the Moodle-based LMS application so that the learning process is more effective.

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