The Effectiveness of Digital Learning Media in Mobile Programming Courses Using Case-Based Learning

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Abstract. This study aimed at developing digital learning media in mobile programming courses using a case-based learning model. The research method used was research and development (R&D) with the ADDIE research model (analysis, design, development, implementation, and evaluation). The results revealed that digital learning media in the mobile programming course was very good. It was based on an individual test score of 94%, the small group test score of 92.4%, and the large group test result of 90.4%. All results were in the very good category. The effectiveness test results using the gain normality test (n-gain) are 0.754. It means the effectiveness of digital learning media was categorized as effective.

Keywords: digital, media, effectiveness, case-based, programming

1 Introduction

Technology development demands an education system to provide human resources (HR) to compete globally. The demands in the education system require national education policies to prepare human resources that can face future challenges effectively and efficiently from school age by utilizing technological advances, including communication and information technology advances. Education is a form of the realization of dynamic and development-laden human culture. It is the change and development of education that happens in line with the cultural changes in life. Changes in the improvement of education at all levels need to be made continuously. One of the changes made by the government in the field of education is to make improvements to the existing education curriculum [1]. Innovative and creative learning in the classroom is expected. The application of learning models at every school level is a learning model that demands students to think creatively productively. One way to practice students' critical and creative thinking is by confronting the problem of solving cases. Giving a case will stimulate students' thinking skills by providing their critical and creative ideas in solving the case. For example, in mobile programming, a practicum course aims to provide initial knowledge to students in making mobile applications. In this study, students are introduced to the basic concepts of mobile programming that they must be able to develop and become a complete application. The process of learning mobile programming must be structured from

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basic units (simple) to more complex ones. Intensive training and mentoring are needed until students reach the learning goals with expected results.

However, the Covid-19 pandemic (Coronaviruses Disease) significantly impacts learning. One of the actual effects caused is the change in teaching and learning activities from conventional (face-to-face) to online. In this situation, the learning media is important in transferring subject matter from teachers to students. Digital learning media is one of the digital learning media that is growing rapidly and has managed to steal the attention of many parties both in education and industry. The availability of various learning resources on the internet plays an important role in learning during this pandemic period. But there are still obstacles students face, such as unstructured learning activities caused by the available media is not intact. Unstructured learning makes it difficult for students to learn, especially in mobile programming that must be studied in order. Based on the problems, there needs to be a digital learning media that is able to provide structured learning. The learning media created should also be able to facilitate students to hone their critical and creative thinking skills to develop an application based on the basic concepts they have learned. Case-based learning is a learning strategy that builds students' analytical skills related to actual situations (contextual) that are complex and relevant to teaching materials [2]. The development of case-oriented digital learning media in mobile programming courses can guide students to understand the basic concepts of mobile programming and hone students' skills in developing the concept in a given case. So that students have programming knowledge and are also able to develop and implement such knowledge based on the case faced.

2 Literature review

2.1 Digital learning media

The development of information and communication technology has shifted into the digital era. Information and publications that were originally only documented and disseminated through printed sheets of paper but are now starting to use electronic media as an alternative substitute. In education, the use of technology and information in learning is known as e-learning. E-learning refers to learning through the use of electronic devices. One form of learning materials in a digital or electronic format that introduces content more interestingly and interactively is the e-module [3]. E-modules are electronic modules that are teaching materials presented systematically so that their use can be learned with or without a facilitator or teacher. An e-module displays information or manuscripts in an electronically recorded book format using a hard disk, floppy disk, CD, or flash disk and can be opened and read using a computer or electronic book reader (e-book reader). Digital learning media is a systematic and interesting teaching material that includes the content of the material, methods, and evaluations that can be used independently to achieve the expected competencies in the form of electronic media.

The advantages of the use of the digital-book in improving students' academic achievement, among others, can be seen as follows [3]:

1. It contains all the advantages of books. Aside from consisting of interactive formats containing audio, images, and videos, interactive electronic books can also be read on computers or other devices.

2. Provides new opportunities or ways of managing information. The E-book includes many useful learning activities and strategies to improve academic achievement outcomes.
3. Provides the opportunity to view the content anywhere and anytime without restrictions. Therefore, students can download electronic books to be able to preview information and learn at any time.
4. Allows students to store and organize them easily, then to make them easily accessible to read.
5. It allows students to use a different learning style. Electronic books also provide the ability to navigate through menus, graphics, and hyperlinks.
6. The role of teachers changes from sources of information and knowledge to facilitators in education. The role of students will change from an informed recipient to a more positive role in participating in continuous learning information.
7. Provides freedom and flexibility for students to learn in accordance with their ability, time, and learning pace.

2.2 Case-based learning

Case-based learning is a student-centered learning method that uses cases. Cases are complex factual to stimulate students in discussions and resolve problems based on the specified case [5]. Case-based learning is a constructivism learning approach in which problems are presented in various cases [6]. Case-based learning is regularly described as a coaching approach that calls for college students to actively participate in actual or hypothetical problems, reflecting the kind of experiences experienced in the discipline being studied naturally. Case-based learning is the use of a case-based approach that engages students in a discussion of specific situations and examples of real events in the world. One alternative strategy in improving the understanding of mathematical teaching materials is to apply the learning through Case-based learning (CBL). CBL is a learning strategy that builds students' analytical skills concerning complex real (contextual) situations and is relevant to teaching materials. Learning that imparts the concept of reasoning in students by linking their previous knowledge to real-life contexts will impact students' comprehension abilities [8].

The objectives of case-based learning are as follows [9]:
1. Improves students' critical thinking skills in solving problems.
2. Allows students to understand the theory (to know) while also being able to act.
3. Encourages students to have the ability to synthesize and evaluate.
4. Trains students to think constructively can be done by providing students with materials that can make them think constructively.

The benefits of case-based learning are as follows [9]:
1. Cases allow students to experience firsthand dealing with various problems.
2. Provides an actual case for students to use theoretical knowledge to solve problems.
3. Trains students to make the right decisions in solving problems.
4. Provides opportunities to participate in classes and gain experience in presenting ideas to others.
5. Cases facilitate the development of a sense of judgment, not just uncritically accepting what the lecturer teaches or the key answers available on the back pages of a textbook.
6. Involves student participation to be creative and critical.

7. Allows students to be skilled in communicating, writing, presenting, and debating according to their abilities.

Characteristics of case-based learning [10]

1. The case is an educational instrument that appears in the form of a narrative. The narrative brings real-life situations into the classroom.
2. Study Questions is a listing of observation questions supplied on the quilt of every case. Study questions sell information because they inspire college students to use what they recognize in reading facts and featuring answers instead of simply remembering facts, names, labels, formulas, definitions, etc. In the disconnected method, every phase/phase has its very own dialogue question.
3. Small-Group Work: college students speak their responses to have a look at questions in small groups. Students have the opportunity to discuss cases and questions with each other before the overall class discussion. Each section is studied and discussed in small groups with the case method disconnected. The learned part and the solutions that may be discussed, the next part of the case is given to the student.
4. Group discussion: Students need to participate in the learning activities actively. The "big idea" of the case is examined, and teachers' work helps students extract meaning. Teachers always treat students and their ideas with respect to express their ideas with confidence. The teacher manages the discussion phase to encourage students to tackle real problems critically by developing their own meanings rather than bringing them in. Students will meet in full class discussion sessions after reviewing each part of the individual case-based learning methodology.
5. Follow-up Activities: Students may need to know more because class discussions stimulate their needs. It is highly motivating to read and learn more. Follow-up activities can be carried out individually or in groups, and the activity used is a matter of teacher assessment of student needs. Textbooks, articles from newspapers and magazines, tables, data charts, research reports, videos, and other written and visual information can be used as sources.

3 Methodology

The study applied research and development methods. Research and development (R&D) is a research method used to produce a particular product and test the effectiveness of a product. The development model of this research was the ADDIE model, which is a learning design development model based on an effective and efficient systems approach and has an interactive process. In other words, the evaluation results of each stage can read the development of the next stage [12]. The ADDIE model is a model that provides the opportunity to conduct continuous evaluation and revision in each stage [13], and the steps of the ADDIE development model that will be adopted in this study are as follows in **Figure 1**:

Fig. 1. ADDIE design model.

3.1. Analysis

Conduct analysis of the material that needs to be developed, analyze student characteristics perform media analysis, and perform software analysis.

3.2. Design

It consists of creating learning media design, content creation in the form of videos and images, as well as navigation buttons and menus that later be used in the media to be developed.

3.3. Development

The development stage in this research led to the creation of media-oriented to the characteristics of students' cognitive style and validation of content and media in developed media.

3.4. Implementation

Conduct media trials that have been declared valid by experts through content and media tests. Conduct small group trials, large group tests, and field tests and measure the effectiveness of learning to use learning media that has been developed. The formula used to calculate the percentage of each subject is as follows [14]:

$$Presentage = \sum \frac{item\ score\ x\ quality}{number\ of\ item\ x\ highest\ quality}\ 100\%. \quad (1)$$

The results of the percentage calculation were converted to table 1.

Table 1. Conversion rate achievement scale 5 [15].

Level of Achievement	Qualifications	Description
90%-100%	Very Good	No need revision
75%-89%	Good	No need revision
65%-74%	Enough	Revision
55%-64%	Less	Revision
0%-54%	Very Less	Revision

3.5. Evaluation

It is a systematic process to collect and present information that can be used in making policies and drafting subsequent policies. Evaluation is also research to collect, analyze, and present useful information about the object of evaluation [16]. The evaluation process was carried out at each stage of ADDIE, but in this study, the evaluation process was also carried out at the end to find the level of effectiveness in the use of digital learning media.

4 Result and discussion

The results obtained at each stage of the study are:

4.1. Analysis

The needs analysis showed that learners/students of the 3rd-semester informatics engineering education study program were happy with the learning delivered with interactive learning content through images, videos, sounds, and practicum exercises in this pandemic period. Based on the results of questionnaires given to learners, a number of 25 people stated that in this pandemic period, learners found it challenging to learn mobile programming independently because mobile programming courses are programming materials that they just got to be strengthened. Unlimited but unstructured learning resources confuse students in the learning process and understanding of this course. Providing the results of the analysis, then the creation of digital learning media could help students understand in the eyes of mobile programming lectures presented online speech and structured presentation.

4.2. Design

The result of the design process was digital learning media designed by applying the case-based learning model. The case-on mobile programmer learning aims to train students' understanding and ability to solve mobile programming cases. The students were given a theory or basic concept. After that, they presented a case related to the given material/concept. It aimed at knowing the ability of students to implement theory into practicum. Therefore, students were really trained in their hard skills, especially in mobile programming. Further, evaluations were conducted at the design stage to ensure conformity between the cases given to the basic concepts.

4.3. Development

Digital learning media was developed on the e-learning platform Undiksha. It began with creating a course called Mobile Programming and was attended by 25 participants from the informatics engineering education study program. Participants were 3rd-semester students who

took mobile programming courses. Digital learning media was designed by applying learning throughout the application evaluation. First, the students presented modules or videos containing basic materials/concepts on mobile programming. Second, to further explore the material, students were given the freedom to export-related materials freely. A forum was provided to conduct online discussions on e-learning. The three students were given a case in a practicum to apply the studied concepts or materials. Finally, the student's understanding/ability was evaluated at the end of the semester.

4.4. Implementation

In the implementation phase, several tests were conducted, including individual tests, small group tests, and large group tests. The goal was to find out how well the product was being developed. The test process was carried out by spreading the questionnaire to students. Individual tests were conducted by spreading test questionnaires to 3 students with low, medium, and high ability. The results of the individual test questionnaire obtained the total score of the subject's overall assessment of 282, from the score, was calculated the percentage of the overall achievement rate of the subject amounted to 94% and based on Table 1, falls into the category of "Very Good." The small group test was conducted by spreading the test questionnaire to 9 students with low, medium, and high ability. The results of the individual test questionnaire obtained the total assessment score of the subject by 832, from the score was calculated the percentage of the overall achievement rate of the subject amounted to 92.4% and based on Table 1 falls into the category "Very Good." Large group tests were conducted by spreading test questionnaires to 25 students with low, medium, and high ability. The results of the individual test questionnaire obtained the total assessment score of the subject by 2262, from the score was calculated the percentage of the overall achievement rate of the subject amounted to 90.4% and based on Table 1 falls into "Very Good" category.

4.5. Evaluation

This stage was aimed at testing the effectiveness of interactive content done by giving pretest and posttest to learners to assess the increase in learners' learning outcomes after using digital learning media. In the calculation of this effectiveness test using the N-gain formula, which was an increase in the ability possessed by learners who have carried out a process of learning activities. The results of pretest and posttest learners are presented in **Figure 2**.

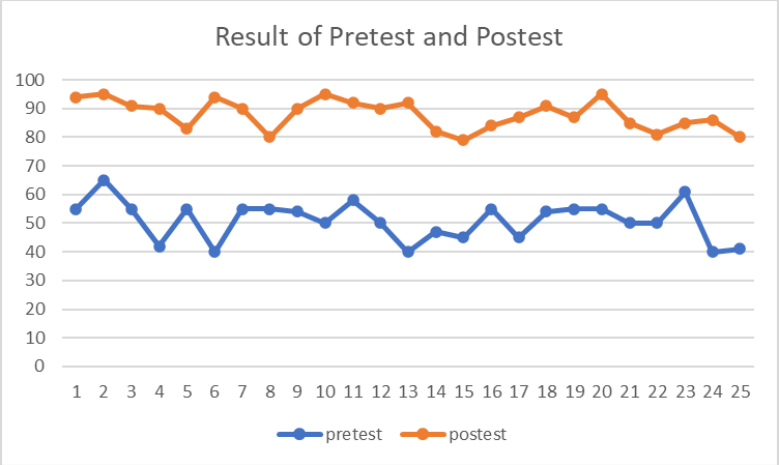

Fig. 2. Result of pretest and post-test.

The result of the pretest and posttest calculations obtained the N-Gain 0.754. The N-gain value was then converted based on Table 2 so that the rate of increase in posttest results belongs to the criteria "Effective" and proven with learners able to improve learning outcomes.

Table 2. Interpretation on the value of g [17].

Range of value	Description
$0.7 < g \leq 1$	Effective
$0.3 < g \leq 0.7$	Effective enough
$0.0 < g \leq 0.3$	Effective less

Learning effectiveness in using digital learning media is said to be classified on very practical criteria. This is in line with several learning theories, including:

First, the theory of the learning zone of proximal development. It says that the development of one's abilities is based on actual and potential development. The actual development of a person can complete tasks and problems independently, while the potential development of a person can solve tasks and problems under the guidance of others [18]. This theory was in line with the application of digital learning media in which every student's material is required to learn independently but purposefully. Each topic presented a case that must be resolved with the provision of the provided material.

Second, the applications of digital learning media were in line with scaffolding learning theory in which the help and support of educators to learners is very influential so that learners can do tasks and problems that are higher in complexity than the actual level of cognitive development of the child concerned [19]. This theory, with the existence of digital learning media where the

material was designed in a structured manner ranging from low to high difficulty levels so that they can master the material gradually and solve cases from low to high difficulty levels.

Third, digital learning media was in line with Edgar Dale's learning theory, known as "Edgar Dale Experience Cone." It is a learning theory that changes in attitudes and skills occur due to the interaction of new experiences with previously acquired experiences. This theory refers to learners' learning experience gained in observing, exploring, doing, and experiencing for themselves from what has been learned. The theory was in accordance with digital learning media applying a case-based learning model that can facilitate students to apply their knowledge directly to the given case so that it can quickly help absorb information and remember it. Learners have an overview of the process that occurs in the material.

5 Conclusion

Based on the research results that have been done, it can be concluded that the digital learning media products made were very good. It can be seen from the results of individual tests, small group tests, and large group tests that reached over 90% of the category of excellent. The effectiveness of using digital learning media with case-based learning models in mobile programming subjects was categorized into the effective category based on the results of the normality gain test calculation of 0.754.

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