Developing Digital Learning Media Based on Cognitive Style for Multimedia Technology in Practicum Learning

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Abstract. Cognitive style refers to how a person processes, stores or uses the information to respond to a task or respond to various environmental situations. Cognitive style becomes one of the influential aspects in improving learning outcomes of student practicum. The increase in psychomotor abilities of students is certainly influenced by factors of the cognitive style of each student. This research aims to develop cognitive style-oriented digital learning media for practicum learning. Learning media products were described and implemented through this research following the scientific process. Digital style-oriented is cognitive to the psychomotor abilities of students. The method in this study was R&D by adopting the ADDIE model. It has successfully developed and implemented cognitive style-oriented learning media on practicum learning. Implementation results stated that this learning medium was effectively used in the practicum learning process with a high level of effectiveness.

Keyword: Digital Learning Media, Cognitive Style, Multimedia Technology Course

1 Introduction

The rapid development of technology demands the need for an education system that can provide human resources (HR) that are able to compete globally [1][2]. The demands in this education system require national education policies that need to be directed to prepare human resources that can face future challenges effectively and efficiently from school age by utilizing technological advances, including advances in communication and information technology. The increase in the education sector means increasing human capacity to compete with developed countries [3].

Education is one form of the realization of a dynamic and development-laden human culture. The change and development of education align with the cultural change of life [4]. Changes in the improvement of education at all levels need to be done continuously. One of the changes made by the government in the field of education is to make improvements to the existing education curriculum. Innovative and creative learning in the classroom is expected to apply a learning model that motivates students to think creatively-productively [5][6].

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Learning media has an important role in transferring subject matter from teachers to students [7]. Nowadays, digital learning media as one of the digital learning media is growing rapidly and has managed to steal the attention of many parties both in the world of education and industry [8]. Self-study that an individual carries out can be grown from the awareness of the importance of learning. In self-study, a person has confidence that what is learned will benefit his life. The level of independence that each learner has in receiving information is not the same. The difference in student independence level is influenced by the characteristics of each learner. The learners' characteristics in learning are divided into three, namely Cognitive Style, Learning Style, and Learning Motivation. These three characteristics will greatly determine the success of students in the learning process later [9].

Based on preliminary studies that have been conducted related to the development of learning materials in data communication subjects, it has been successfully developed printed teaching materials of data communication modules [10]. The product was currently distributed in several schools and used as a supplementary in the learning process. Based on the current conditions, the learning process tends to be centered on students and the utilization of digital media that connects learners with teachers remotely. However, the existing learning media is no longer relevant to the learning process. Students in the learning process were more interested in the presentation of material digitally [11].

Various digital media have been raised by adopting from the source of learning teaching books that have been prepared before. In fact, the development of teaching materials with digital media has not been fully able to improve the quality of the learning process. Digital media developed so far does not have elements that can increase student learning motivation and have not increased students' independence in learning [12]. The presentation of material in a medium that is still monotonous and less interesting and interactive so that learning outcomes become less maximal. Moreover, in today's digital age, digital learning media that have been available still cannot contribute optimally to the learning process. The low contribution of digital media in today's digital era impacts the lack of maximum achievement of learners' learning achievements.

The gap between effort and reality was caused by learning media that have not matched the characteristics of student learning motivation. The use of digital media in learning that merely refers to the conformity of content with conventional subject matter might sometimes make students less competent to interpret the subject matter. This is due to the fact that students' interpretations of the material differ from one another, particularly in low student learning motivation situations. Motivation to learn is the overall driving force in students that gives rise to learning activities, which ensures the continuity of learning activities and provides direction to learning activities so that the desired goals of the learning subject can be achieved.

Many factors lead to low student motivation. In the learning process, an important factor that influences low learning motivation is the presentation of less interesting material. Many learning media are still conventional and prioritize the presentation of complete material without regard to innovative elements, and the excitement of the learning media presented. This condition becomes increasingly difficult when faced with the current learning situation that relies heavily on presenting material with interactive online media and without reducing the quantity of material presented in the learning process. Learning media that are the cause of low student learning motivation directly impact the quality of material acceptance by students. Low student learning motivation leads to low student learning outcomes in a learning process [13].

Based on those problems, it is necessary to have attractive and interactive digital learning media to increase students' learning motivation in the class to understand learning concepts requiring rigor and imagination. One of them is digital learning media that is packaged attractively and interactively. With digital learning media packaged attractively and interactively, it is expected that students' learning motivation can increase and understand and receive the subject matter and will have an impact on improving student learning understanding. Independently, students can also understand the lesson by learning to explore the material at home in accordance with the characteristics of each student.

2 Literature review

2.1 Digital learning media

The development of information and communication technology has shifted into the digital age. Information and publications that were previously only documented and disseminated through the usage of printed sheets of paper are now starting to be documented and disseminated through the use of electronic media as an alternative substitute. In the world of education, the use of technology and information in learning is known as e-learning. E-learning refers to learning using the services of electronic devices. One form of presentation of learning materials in a digital or electronic format that introduces content more interestingly and interactively is the e-module [14].

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 viewer or e-book reader). Digital learning media is a teaching material arranged systematically and interestingly 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.

2.2 Cognitive styles

Each individual has distinctive characteristics, which other individuals do not share. Therefore it can be said that each individual is different from the others. In addition to differing in problem-solving prowess, level of intelligence, or thinking ability, students can also differ in how to acquire, store, and apply knowledge. They can differ in the way they approach learning situations, how they accept, organize, and relate their experiences, in how they respond to certain teaching methods. The differences between sedentary individuals in structuring and processing information and these experiences are known cognitive styles.

Cognitive style refers to how a person processes, stores, or uses the information to respond to a task or respond to different environmental situations. It is referred to as style and not as an ability because it refers to how a person processes information and solves problems and instead refers to how the process of solving is best.

Cognitive styles are divided into two: dependent field cognitive style and independent field cognitive style. In learning activities, each individual can be distinguished into two groups, namely global and analytical. An international individual accepts something more globally and has difficulty separating himself from his surroundings or is more influenced by the environment. Individuals of this nature are called cognitively styled Field Dependent (FD). The

analytic individuals tend to express something loose from the picture's background and can distinguish objects from the surrounding context. They look at the surroundings more analytically. Individuals of this nature are called independent field cognitive styles (FI).

3 Methodology

3.1 Research design

The study applied Research and Development (R&D) methods or research and development methods adapted from the ADDIE development model. The ADDIE model is a development model popularized by Reiser and Molenda that consists of analysis, design, development, implementation, evaluation. The ADDIE model focused on iteration and reflection, so continuous improvements can be made to focus on feedback.

3.2 Participation

Informative evaluation section, the *expert appraisal* was conducted through one-to-one expert judgment by two experts related to the justification of conformity (validity) of content implemented in digital learning media based on cognitive style. Furthermore, two design and media experts were also required to justify the application's accuracy and functionality and test the effectiveness and success of the research. Lastly, a response test was conducted on 30 students to get responses and their learning experience during the treatment/trial.

3.3 Data collection

The data obtained were grouped according to the nature into two parts, namely qualitative and quantitative data analysis. Data classified in qualitative data was in the form of inputs, comments, and written suggestions either from expert judgment or validators involved, while qualitative data were obtained from student responses related to the practicality of the response questionnaire using Linkert scale and effectiveness through N-gain score

3.4 Data analysis

The collected data were descriptively analyzed. The data analysis from the results of the expert test was based on Table 1. The conversion guidelines are used.

Table 1. Conversion guidelines of validity and practicality test.

Interval	Validity Criteria	Practicality Criteria
75,00 – 100,0	Valid	Practical
50,00 – 74,99	Quite Valid	Quite Practical
25,00 – 49,99	Less Valid	Less Practical
00,00 – 24,99	Invalid	Impractical

A normalized gain test (N-Gain) to determine the improvement of students' cognitive learning outcomes after being treated. The result was taken from comparing the pretest and posttest scores obtained by students. N-Gain test is a comparison of the actual gain score with the maximum gain score. The actual gain score is the gain score obtained by the student, while the maximum gain score is the highest possible gain score for the student. Data from students'

cognitive learning outcomes were collected and analyzed based on the following table of criteria in Table 2 below.

Table 2. Conversion guidelines of N-Gain test.

Interval	Effectiveness Criteria
$[g] \geq 0,7$	High effectiveness
$0,3 \leq [g] < 0,7$	Medium effectiveness
$[g] < 0,3$	Low effectiveness

To ensure that the digital learning media is effectively used and able to improve the understanding of student concepts, the average posttest results compared to the minimum completion criteria in the class were used as a pilot project.

4 Result and discussion

This research was conducted based on the ADDIE research design. The results of the study are presented following the stages in the ADDIE research design.

4.1 Analyze stage

The results from the needs analysis revealed that the 3rd-semester learners of the informatics engineering education program were happy with the learning delivered with interactive learning content through images, videos, sounds, and practicum exercises in this pandemic period. The results of questionnaires given to 30 students stated that in this pandemic period, learners found it difficult to learn Multimedia Technology independently because multimedia technology courses are programming materials that they just got to be strengthened. Unlimited but unstructured learning resources made students confused in the learning process and understanding of this course. In addition, the background of students was also different from their cognitive style in receiving subject matter. The results of the analysis of student needs showed that the creation of digital learning media could help and guide students in understanding the Multimedia Technology lectures presented online and in accordance with the cognitive style conditions of learners.

4.2 Design stage

The result of the design process was digital learning media designed to conform to learners' cognitive style. The presentation of material in accordance with the characteristics of cognitive style could facilitate the process of receiving the material presented. Students who studied in the field dependent style got material that presents visualizations in images and videos and examples of explanations given. While students who studied with the field-independent cognitive style were presented with theoretical and conceptual material and presented in the form of problems of a scientific nature, then analyzed the problem solving. It also aims to know the ability of students to implement theory into practicum. So students were trained in hard skills, especially in Multimedia. Evaluations conducted at the design stage only ensured conformity between the cases given to the basic concepts given before.

4.3 Development stage

Digital learning media was developed on the e-learning platform Undiksha. It began with creating a Multimedia Technology course and was attended by 50 participants from the informatics engineering education study program. The participants are 3rd-semester students who take Multimedia Technology courses. Digital learning media was designed by applying the concept of learning, in, applying, evaluation. First, the students were presented with modules or 12 videos containing basic materials/concepts. Second, to further explore the material, students were given the freedom to explore the materials freely and will be provided a forum to conduct online discussions on e-Learning. The three students were given a case in the form of practicum to apply the studied material. Finally, the student's understanding was evaluated at the end of the semester.

Validation was required to test the feasibility of the product used in the learning process based on the substance aspect of the content according to the syllabus currently in use. While the design/media related to the suitability of learning content with display (visual communication). Summary of expert test results of content and design and media obtained an average result of 90.08%, belongs to the Valid criteria, as seen in Table 3 below.

Table 3. Validity test results.

No.	Assessment aspects	Score in percentage by the validator (%)
1	Substance of content	93.14
2	Learning design	87.23
3	Display(visual communication)	90.86
4	Software utilization	94,32
Percentage of average score		**94,32**
Criteria for the validity of the whole aspect		**Valid**

The results from the practicality and effectiveness test flipbook completed by 30 students who participated in the study revealed that 56% felt that it was practical, 29% stated it quite practical because the content was easy to understand, but 15% stated it less practical, as in **Figure 1** below.

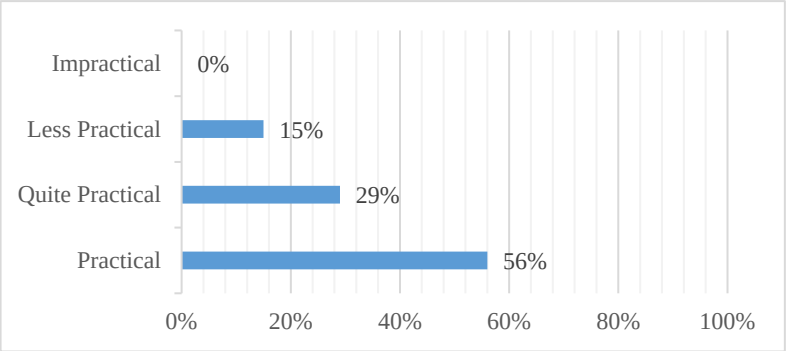

Fig. 1. Practicality test results

It is possible that students' devices have varying capabilities, making it less practical to use them because the video access featured in the flipbook loads slowly.

4.4 Implementation Stage

Several tests were carried out in the implementation phase, including individual tests, small group tests, and limited field tests. The goal was to find out how well the product was being developed. The test process was carried out by distributing the questionnaire to students. Individual tests were conducted by spreading test questionnaires to 3 students with low, medium, and high ability. While, the small group test was conducted by spreading the questionnaire to 9 students with low, medium, and high ability. Field trials were conducted by distributing test questionnaires to 30 students with low, medium, and high abilities. The subject's overall scoring score was 279. The calculation of the percentage shows the overall achievement rate of the subject was 92% and belonged to the category of "Very Good." The results of the individual test questionnaire obtained the total assessment score of the subject of 843. From the score, the overall achievement rate percentage of the subject was 94.2% and belonged to the category "Excellent." The results of the field trial questionnaire obtained results of 22 respondents received a very good response with a percentage of 73%. Eight respondents received a good response with a percentage of 27%. The result of the field trial questionnaire showed in **Figure 2** below.

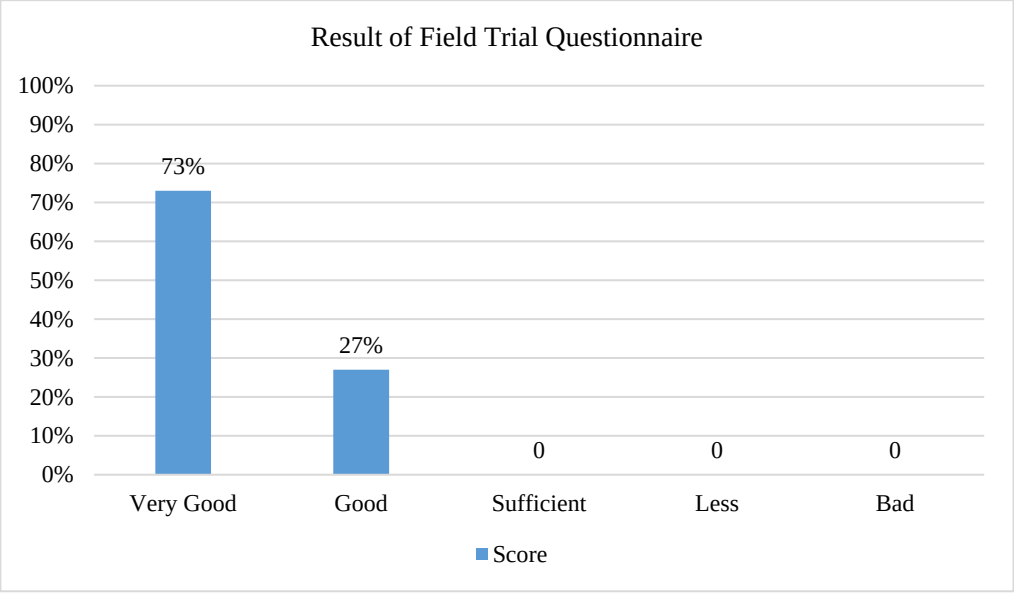

Fig. 2. The result of the field trial questionnaire.

4.5 Evaluation Stage

This stage was done to test the effectiveness of interactive content by giving pretest and posttest to assess the increase in learners' learning outcomes after using digital learning media. The N-gain formula was used, which is 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 3** below.

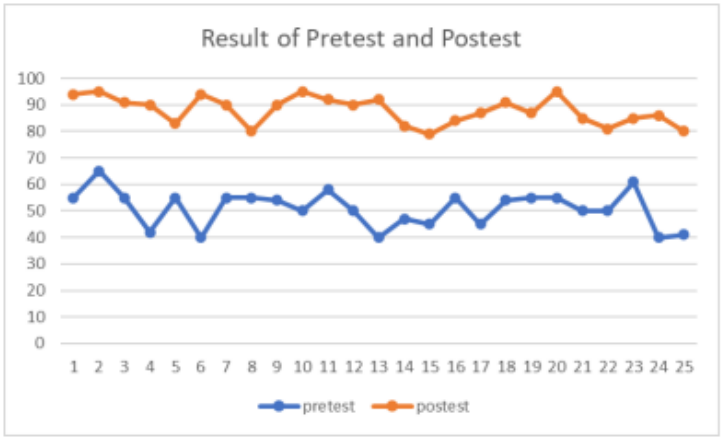

Fig. 3. Result of pretest and postest

The result of the pretest and posttest calculations that have been done was 0.754, obtained from the value of N-Gain. The N-gain value was then converted based on Table 3 so that the rate of increase in posttest results belongs to the criteria "Effective" and is proven with learners' ability to improve learning outcomes.

Table 3. Interpretation on the Value of g.

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

The learning effectiveness using digital learning media was said to be effective or classified on very practical criteria. This is in line with several learning theories, including: First, the theory of learning zone of proximal development where this theory states that the development of one's abilities is based on actual and potential developments, where the actual development of a person can solve tasks and problems independently, While the potential development of a person can solve tasks and problems when under the guidance of others. This theory is in line with the

application of digital learning media, where every student material is required to learn independently but purposefully. Each topic will be presented as a case that must be resolved with the provision of the material provided.

Both applications of digital learning media are in line with scaffolding theory. In this theory, 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. From this theory, with digital learning media in which the material is designed in a structured manner ranging from low to high difficulty levels, the learner can master the material gradually and solve cases from low to high difficulty levels.

5 Conclusion

Digital learning media based on the cognitive style in practicum multimedia has been successfully developed using the ADDIE development model approach. This media can be declared valid, practical, and highly effective for learning in vocational high schools. The learning experience obtained by students has been able to instill the multimedia practicum.

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