Development of Interactive Web-Based Learning Media with the Discovery Learning Model to Increase Student Learning Motivation in Object-Oriented Programming XI Vocational High Schools

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Article Info

ABSTRACT

Students have difficulty understanding object-oriented programming material. Because the learning process carried out still uses the lecture method and the learning media used in the form of PowerPoint and even textbooks, resulting in a lack of understanding and a lack of student learning motivation. Other problems arise, such as drowsiness due to boring learning and difficulty understanding due to a lack of interaction between students and teachers. An interactive web is today's technology that can support the learning process in solving these problems. This study uses the Hannafin and Peck development model, which goes through 3 phases, namely (1) needs analysis, (2) design, and (3) development and implementation. Data collection techniques were carried out through observation and questionnaires. The learning media developed is an interactive web application with a discovery learning model that contains learning and evaluation videos. The results of the feasibility analysis of learning media obtained the results of media expert validation of 96.3%, material expert validation of 93%, and group trials of 85.4%. The analysis of all feasibility data obtained an average of 91.6%, with the qualification "very valid." They declared it feasible to be used in assisting students' learning process. At the same time, the analysis of increasing learning motivation obtained the results of group trials of 0.37. Based on these results, it is stated that learning media can improve students' learning motivation in the learning process with "moderate" qualifications

I. INTRODUCTION

Technology in the current era is developing very rapidly. This technology aims to facilitate and provide benefits in carrying out daily activities, especially in the digitalization era, as technology is currently needed to help community activities that can be carried out online. One of the benefits of technological developments at this time is the internet. Therefore, the Internet can be used to help people in the field of education to access or manage information [1].

One of the applications of technology in education is the manufacture of learning media; learning is an activity everyone carries out. Therefore, digital-based learning media can facilitate and support teaching and learning [2]. Website-based technology is a collection of pages with various information in text, images, sound, or video [3]. In this era of digitalization, website technology is considered adequate and efficient because of the ease of management and densely packaged information, which is very helpful in learning.

One of the materials in the Software Engineering major is object-oriented programming, or PBO. This PBO material aims to

enable students to solve the complexity of various program problems that continue to increase. This PBO material discusses encapsulation, which discusses how to hide detailed information from a class. This encapsulation material is essential because it includes the first material in the PBO method and becomes an impression on students in learning subsequent material. Therefore, it is necessary to give a first impression by providing an easy and pleasant understanding to maintain and increase the motivation of these students.

Based on observations at SMK Negeri 8 Malang, SMK Negeri 3 Tuban, and SMK Brantas Karangkates in the Software Engineering department, these three schools have facilities (devices and Wi-Fi networks) that are capable of supporting this learning media research with the available facilities and infrastructure to access the developed learning media. Still, there are problems with students, such as less than 40% of students understand the concept of class, method, object, and encapsulation in object-oriented programming. The results of observations regarding the learning devices used by students show that 36% of students use smartphone devices, 38% use laptops, and 20% use computers; the rest of the students use all of these devices. Other results show that the learning process in this subject is the delivery of material using media in the form of PowerPoint slides, with data acquisition of 53% and 22% using textbooks. In the learning process, the teacher uses the lecture method and assignments to students; this method is considered less effective for describing an understanding of the concept of encapsulation in object-oriented programming. In this case, it impacts students' ability to solve problems in the program they will make because there is no foresight toward analyzing the program's needs. This causes a lack of understanding and learning motivation in students.

Interactive web can be used as a solution in overcoming student problems because it can facilitate students in learning activities; website technology is considered adequate and efficient because of the ease of management and information-packed tightly, which is very helpful in learning. Apart from only displaying information, on the other hand, many websites are dedicated to providing additional services in education, such as websites for discussion forums, online quizzes, and so on. Using the website as a learning medium will save costs because you don't need to buy textbooks, modules, worksheets, and so on [4].

Learning motivation can not only be increased through cognitive guidance but can also be formed from the learning model used. Discovery Learning is a learning model that can increase student motivation. The Discovery Learning model can create exciting learning variations; students can be more independent by exchanging opinions, discussing, or trying to learn on their own according to their own expectations, but also by the learning target [5]. Technological developments cause changes in learning styles. Several factors that affect changes in learning styles include transferring knowledge and the availability of information sources [6]. A learning style that focuses on student independence can make it easier to understand and remember material; one of the technologies that can accommodate this learning model is a website, where the related material must be neatly structured so that it is not confusing and easy to understand.

Based on the problems described in this study, an interactive web-based learning media was developed with a discovery learning model for object-oriented programming material for class XI Software Engineering. This learning media was created as a website, an innovation from other similar websites; this website contains material and is equipped with learning videos. In addition, concept maps and evaluation questions are integrated with the Google form so students can immediately see the value of the evaluation questions they are working on. This website was created using the Bootstrap framework for front-end web development. On this website, learning videos are taken from the YouTube platform by embedding the code in the video that will be displayed. This website can be used independently by students so that they can adjust to the learning needs of each student. The developed learning media is expected to help students increase their learning motivation in overcoming the complexity of problems in object-oriented programming.

II. METHODS

The Hannafin and Peck development model is used to develop instructional media in this research and development. The Hannafin and Peck development model was chosen because the stages used are efficient and effective. After all, each stage contains an evaluation process. In addition, the Hannafin and Peck model can be adapted to the characteristics of research on media, especially learning videos. The Hannafin and Peck model has 3 phases, namely the needs assessment phase, the design phase, and the development/implementation phase, as well as evaluation in each phase [7]. Hannafin and Peck's development model with the phases described as follows: 1) analysis phase, 2) design phase, and 3) development and implementation phase.

A. Analysis Phase

This phase is the first phase in designing the learning model of Hannafin and Peck. This phase is needed to identify a need for developing learning media. Matters related to this phase include a) the purpose of the learning media created, b) the knowledge and skills needed to match the learning objectives, and c) the facilities and infrastructure needed for the learning media.

B. Design Phase

This design phase aims to identify and document the best method for achieving the goals of manufacturing in the media. One of the documents obtained in this phase is the storyboard document, which follows the sequence of pedagogical activities according to the needs of the lesson and the objectives of the learning media, for example, those obtained in the needs analysis phase [8].

C. Development and Implementation Phase

Activities in the third phase of this model are flowcharts, tests, formative assessments, and total assessments. The storyboard document will be used later as the basis for making a flowchart that can support the process of making learning media. Implementation is also carried out in this phase; the development results are applied later in learning. The impact on the quality of learning, including the effectiveness, attractiveness, and efficiency. The Hannafin and Peck model emphasizes the evaluation process with the review process. The evaluation of learning media includes three consistent stages at once [9].

The trials were carried out by validating media experts, material experts, and group trials. The instrument used in this research and development is a questionnaire using a Likert [10] scale of 1-4. The validation assessment qualification scale table is described in Table I. Meanwhile, the gain assessment qualification scale table is described in Table II.

TABLE I. SCALE OF VALIDATION QUALIFICATION ASSESSMENT

Percentage	Qualification	Description
85,01% - 100,00%	Very valid	Can be used without revision
70,01% - 85,00%	Valid enough	Usable with small revision
50,01% - 70,00%	Not valid	It is recommended not to use it because needs major revision
01,00% - 50,00%	Invalid	Should not be used

TABLE II. GAIN ASSESSMENT QUALIFICATION SCALE

Gain Value	Qualification
G > 0,7	High
$0,3 \le G \le 0,7$	Medium
G < 0,3	Low

III. RESULTS

A. Needs Analysis Phase

Based on observations at SMK Negeri 8 Malang, SMK Negeri 3 Tuban, and SMK Brantas Karangkates in the Software Engineering department, these three schools have facilities (devices and Wi-Fi networks) that are capable of supporting this learning media research with the available facilities and infrastructure to access the developed learning media. Still, there are problems with students, such as less than 40% of students understand the concept of class, method, object, and encapsulation in object-oriented programming. The results of observations regarding the learning devices students use show that 36% of students use smartphone devices, 38% use laptops, and 20% use computers; the rest of the students use all of these devices. Other results show that the learning process in this subject is the delivery of material using media in the form of PowerPoint slides, with data acquisition of 53% and 22% using textbooks. In the learning process, the teacher uses the lecture method and assignments to students; this method is considered less effective for describing an understanding of the concept of encapsulation in object-oriented programming.

In the learning process, other problems arise, such as computer/laptop devices that often die suddenly due to application processing that is too heavy. Other problems occur, such as drowsiness due to boring learning and difficulty understanding due to a lack of interaction between students and teachers. Based on this, students become less active and less interested in learning because they only listen to material from the teacher without any two-way interaction [11].

B. Design Phase

The design phase is carried out to design instructional media as needed. The design of learning media is made according to the analysis phase results. Before the learning media is created, an analysis of the learning material is needed to detail and systematically arrange the learning material contained in the learning media. The material that will be loaded in this research learning media is encapsulated in object-oriented programming, so in this phase, a detailed and systematic arrangement of computer network installation material will be carried out in the developed learning media [12].

The ontology design of encapsulated learning materials in protecting data and information in object-oriented programming contained in the developed learning media is shown in Figure 1.
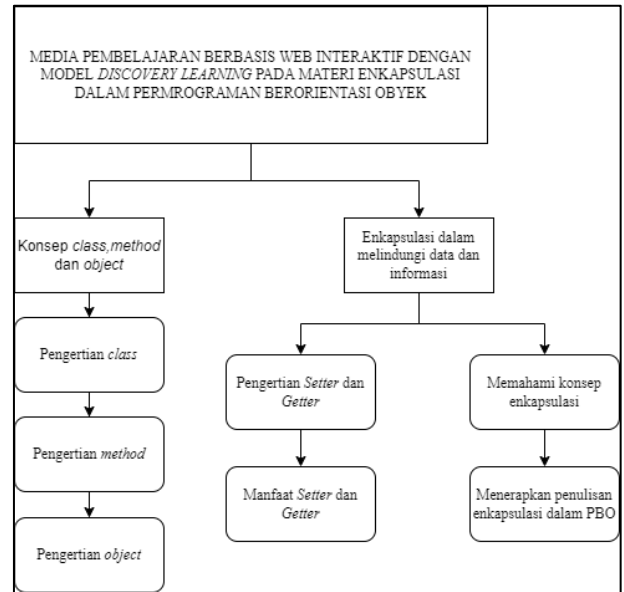

Fig. 1. Learning Material Ontology Design

The design of learning media design developed in this research and development will be displayed in the learning media storyboard in Figures 2 and 3.

C. Development and Implementation Phase

In the development and implementation phase, interactive web-based learning media is developed based on the designs made in the planning/design phase [13]. Learning media was created with the help of XAMPP software as a local server trial, Sublime Text, which was used as a programming language text editor, and UI/UX design using Adobe Illustrator tools.
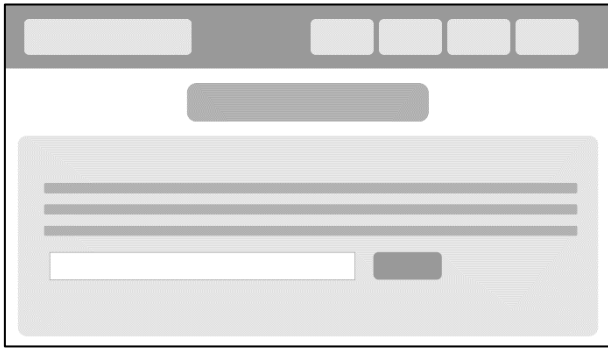

Fig. 2. Slider page design
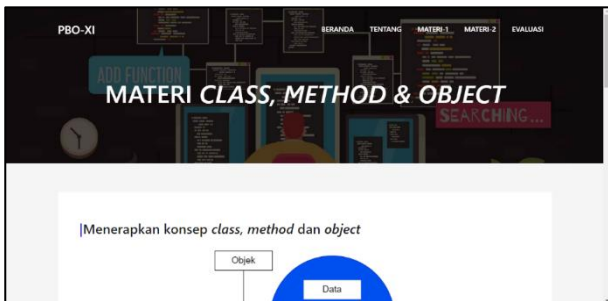
Fig. 3.   Material page design

Fig. 4.   Page sliders
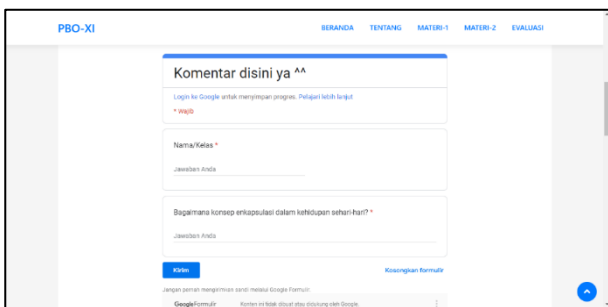

Fig. 5.   Learning Material Page

Fig. 6.   Interactive comments page.

IV. DISCUSSION

The average learning media assessment results were 91.6% from completing the text edit. Based on this, it can be said that the learning media developed are very valid and can be used in the learning process [14]. So, it can be concluded that interactive web-

based learning media with the developed discovery learning model can be used as an alternative teacher in the learning process to help deliver material to students, as presented in Table III.

TABLE III.   OVERALL, TRIAL RESULTS

No.	Assessment Aspects	%
1.	Media Expert Validation Results	96,3
2.	Material Expert Validation Results	93
3.	Trial Results	85,4
Average		91,6

The average learning media assessment results obtained a value of 91.6%. Based on this, it can be said that the learning media developed are very valid and can be used in the learning process. So, it can be concluded that interactive web-based learning media with the discovery learning model developed can be used as an alternative teacher in the learning process to help deliver material to students.
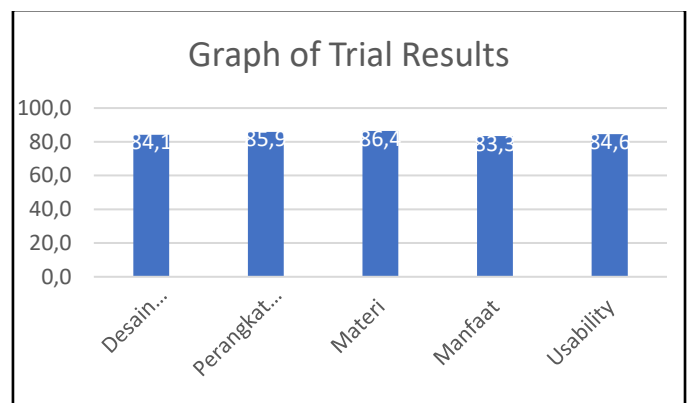

Fig. 7.   Graph of trial results

Based on Figure 7, the test results are divided into five aspects. The learning design aspect obtained a score of 84.1%, with details of the highest score indicator received from the flexibility indicator with a score of 87.9% and the lowest score obtained from the grammar indicator with 82.6%. The aspect of the software that the indicator that gets the highest score is display design, with a score of 86.9%, and the indicator that receives the lowest score is interactive, with a score of 83.3%. The material aspect of the learning media obtained an indicator of the material content of 85.7%, which became the indicator with the lowest score, and evaluation obtained 88.3%, the score obtained with the highest indicator on the material aspect. The benefits aspect of the media got an indicator of benefits for students of 83.3% as well as the highest and lowest scores on this aspect of benefits. The last is the usability aspect, where it is found that in this usability aspect, the indicator that gets the highest score is the errors indicator, with a score of 89.4%. The indicator with the lowest score is the efficiency of 78.8%.

The trial of students' learning motivation has eight indicators which are assessed by students, including being diligent in doing assignments, being tenacious in facing difficulties, having an interest in learning material, happy working independently, quickly getting bored in doing assignments, confident in opinions, and satisfied in results. Own work and enjoy solving problems. The

results of the learning motivation trial showed that the gain score was 0.37. So, it can be concluded that interactive web-based learning media with discovery learning models can increase students' learning motivation [15].

V. CONCLUSION

The resulting product is learning media on object-oriented programming material that can be used in various devices such as laptops, tablets, and smartphones. These are packaged in an interactive website integrated with discovery learning models. The material in this media encapsulates classes, methods, and objects. This medium was designed to help students to understand the material with their learning style. The extended learning media can be operated on all devices without a minimum specification; this interactive web-based learning media requires an internet connection (online) to work. The results of the feasibility trial obtained an average of 91.6%. These results indicate that the learning media developed are valid and can assist students in learning. The result of increasing group learning motivation is 0.37. These results suggest that the developed learning media can improve students' learning motivation in the learning process with moderate qualifications. So, it can be concluded that teachers can use the generated interactive web-based learning media as an alternative learning media to help deliver learning material and increase students' learning motivation."

References

[1] E. Januarisman and A. Ghufron, "Pengembangan media pembelajaran berbasis web mata pelajaran ilmu pengetahuan alam untuk siswa kelas VII," *J. Inov. Teknol. Pendidik.*, vol. 3, no. 2, pp. 166–182, 2016.

[2] A. A. Cholid, H. Elmunsyah, and S. Patmanthara, "Pengembangan model web based learning pada mata pelajaran jaringan dasar paket keahlian tkj pada smkn se-kota malang," *J. Pendidik. Teor. Penelitian, Dan Pengemb.*, vol. 1, no. 5, pp. 961–970, 2016.

[3] D. G. H. Divayana, P. W. A. Suyasa, and N. Sugihartini, "Pengembangan media pembelajaran berbasis web untuk matakuliah kurikulum dan pengajaran di jurusan pendidikan teknik informatika Universitas Pendidikan Ganesha," *J. Nas. Pendidik. Tek. Inform. JANAPATI*, vol. 5, no. 3, pp. 149–157, 2016.

[4] S. Rahman, W. Munawar, and E. T. Berman, "Pemanfaatan media pembelajaran berbasis website pada proses pembelajaran produktif di SMK," *J. Mech. Eng. Educ.*, vol. 1, no. 1, 2014.

[5] A. A. Putra, H. H. S. Suryanti, and S. Sarafuddin, "Pengaruh Model Pembelajaran Discovery Learning Terhadap Prestasi Belajar Peserta Didik Pada Pembelajaran Tematik Kelas V SD Negeri 01 Nangsri Kebakkramat Karanganyar Tahun Pelajaran 2022/2023," *J. Educ.*, vol. 6, no. 1, pp. 657–664, 2023.

[6] W. N. Hidayat, M. Muladi, and M. A. Mizar, "Studi integrasi tik dalam pembelajaran di sekolah menengah kejuruan," *J. Pendidik. Teor. Penelitian, dan Pengemb.*, vol. 1, no. 12, pp. 2281–2291, 2016.

[7] D. P. Perwita and P. S. Kandika, "Analisis Model Pengembangan Bahan Ajar (4D, Addie, Assure, Hannafin Dan Peck)," 2019.

[8] T. Sangsawang, "Instructional design framework for educational media," *Procedia-Social Behav. Sci.*, vol. 176, pp. 65–80, 2015.

[9] G. W. S. Bawono, "Designing Interactive Learning Multimedia for Scaffolding English for Junior High School Students Grade VIII." Yogyakarta State University, 2012.

[10] E. Priyambodo, A. Wiyarsi, and L. Permanasari, "Pengaruh media pembelajaran interaktif berbasis web terhadap motivasi belajar mahasiswa," *J. Kependidikan Penelit. Inov. Pembelajaran*, vol. 42, no. 2, 2012.

[11] E. Supriyadi, "Penyelenggaraan Penilaian Hasil Belajar Smk Rujukan Program Keahlian Teknik Ketenagalistrikan Di Daerah Istimewa Yogyakarta," *J. Edukasi Elektro*, vol. 3, no. 2, 2019.

[12] A. D. Salam, "Pengembangan media pembelajaran berbasis web interaktif (blog) untuk meningkatkan motivasi belajar pada mata pelajaran pemasaran online sub kompetensi dasar merancang website (studi pada siswa kelas X tata niaga SMK Negeri 2 Nganjuk)," *J. Pendidik. Tata Niaga*, vol. 3, no. 2, 2015.

[13] N. I. Cintia, F. Kristin, and I. Anugraheni, "Penerapan model pembelajaran discovery learning untuk meningkatkan kemampuan berpikir kreatif dan hasil belajar siswa," *Perspekt. ilmu Pendidik.*, vol. 32, no. 1, pp. 67–75, 2018.

[14] Y. I. Wulandari and S. A. Totalia, "Implementasi model discovery learning dengan pendekatan saintifik untuk meningkatkan kemampuan berfikir kritis dan hasil belajar siswa mata pelajaran ekonomi kelas XI IIS I SMA Negeri 6 Surakarta Tahun Pelajaran 2014/2015," *J. Pendidik. Bisnis dan Ekon.*, vol. 1, no. 2, 2016.

[15] A. Emda, "Kedudukan motivasi belajar siswa dalam pembelajaran," *Lantanida J.*, vol. 5, no. 2, pp. 172–182, 2018.