*Development of Gamification and Live Coding-Based Programming Learning Platform to Foster Learning Motivation of Vocational Students*

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***Abstract—*** The current utilization of e-learning has not been able to increase participation and learning experience and motivate students to achieve educational goals. This research focuses on developing gamification-based learning media in Object-Oriented Programming (OOP) subjects to increase student learning motivation, determine the feasibility level of learning media, and determine the increase in student learning motivation. The method of the research is design thinking It is used to identify and better understand users in the use of applications, find problems faced by users, and can explore new ideas in the creation of appropriate application features in accordance with user needs. The results of expert media validation from the teacher, lecturer, and programmer amounted to 89.78% in the good category, for the material validation results of 91.33% in the very good category. Media use was implemented by 23 students of class XI RPL SMKN 12 Malang. The user trial results showed a percentage of 83.48% with good criteria. The student learning motivation test results showed a percentage of 81.26% with very high criteria. This shows the effect of gamification implementation in fostering student learning motivation. Gamification-based media has been tested for feasibility by media experts, material experts, and students. Therefore, the media is feasible and can be used as a learning support media in object-oriented programming subjects in Vocational High School.

***Keywords: Gamification, Live Coding, Programming Learning Platform, Learning Motivation, Vocational Student***

# Introduction

E-learning, in essence, means using ICT as a medium to facilitate the learning process and enhance the interaction between educators and learners [1]. E-learning-based learning can be done in or outside the classroom. During the pandemic, learning is carried out online using e-learning to reduce the spread of the virus. With e-learning, innovation in learning is increasingly developing and adaptive to the times. E-learning has advantages compared to conventional systems such as geographic reach, student control (in terms of flexibility and comfort), cost-effectiveness in delivery and management, and many educational institutions and professional organizations embrace e-learning systems by applying them to various technology-supported platforms [2][3]. However, apart from the advantages of e-learning mentioned, e-learning also has some drawbacks that often occur from the user's side, namely the lack of learner motivation and engagement [4][5]. The lack of motivation to use e-learning may reduce motivation to learn.

Efforts must be made to create motivation in learning by designing appropriate learning to stimulate learner motivation to strive, work hard, persevere, and achieve desired goals [6]. One technique that can overcome the problem of lack of motivation by fulfilling human needs is by applying game design elements in the information system design for e-learning, known as gamification. The main goal of gamification is to increase participation [7], motivate and stimulate interest [8], provide an engaging experience [9], encourage learning and problem-solving skills [10], and build skills through every game level [11]. Combining e-learning and gamification can make learning more interesting and interactive and bring learners into a state of flow. Learners will feel happy and comfortable learning, and it eventually leads to achieving the main goal of learning.

Each SMK has a particular competency so that learners can focus on the competency they pursue, including Software Engineering (RPL) competence. RPL competence prepares learners to become skilled workers in the field of programming, database processing and computer software. One of the subjects in the RPL competence program is Object-Oriented Programming (OOP). OOP is a subject in XI grader RPL course that focuses on object-oriented programming, in which all data and functions are wrapped in classes or objects [12]. OOP provides convenience in making a program and is very much needed in the industry. Until now, it can still be said that the OOP paradigm is the most applied programming paradigm. This is because this paradigm presents many advantages, especially in developing software and applications needed by the industry, both in terms of features and project deadlines. In addition, programming languages that support this OOP paradigm are very many and have numerous users, including Java, PHP, Python, Laravel, etc.

Based on initial observation in three vocational schools in Malang, researchers found problems in OOP learning, where 72% of learners experienced obstacles, including (1) learners less liked learning with conventional media such as power points and Google classrooms, (2) low interest in learning when using conventional media and prefers to learn through attractive information systems, (3) learners have difficulty understanding the material because the teaching materials used are unattractive and less motivating, (4) lack of availability of attractive and easy-to-understand teaching materials that can increase learner motivation, and (5) still a lack of gamification teaching materials for Object-Oriented Programming subjects. These problems cause low learning motivation, inactive student participation in learning, and difficulty in understanding the subject matter.

Therefore, an innovation is needed in the learning process for SMK students. It needs a medium that can help learners learn algorithms and basic object-oriented programming concepts. In addition, the appropriate learning model is crucial to facilitate the learning process, so it can achieve optimal results. Thus, the learning model used in the Object-Oriented Programming subject is Game-Based Learning (GBL). GBL refers to the use and application of game principles in the learning process to increase user engagement. GBL allows learners to be more active and creative in learning with educational materials, in a fun and dynamic way. GBL not only creates games to be played by learners but also gradually introduces concepts and guides learners towards the final goal [13]. The interactive media developed in this study is a website that provides learning materials, instructional videos, quizzes, live coding sessions, discussions, and educational games for learners, both in the classroom and in remote learning.

# LITERATURE REVIEW

# **A. Gamification**

Gamification is a method of applying game elements and mechanics in non-game environments to increase user motivation, engagement, and involvement with an activity [14]. This concept is often used in various fields, including education, business, and healthcare. Through the use of elements such as points, levels, challenges, and rewards, gamification encourages users to achieve goals, improve skills, and encourage healthy competition. By transforming activities that may be perceived as monotonous or less enjoyable into more fun and challenging experiences, gamification can motivate individuals to actively engage and achieve desired outcomes. Gamification in this learning media is used as a website system approach.

# **B. Live code**

Live code is a method of teaching programming lessons where the teacher writes program code on a computer connected to a classroom projector without the help of design or boilerplate [15]. Live code itself has several benefits, namely: (1) making the programming learning process easier to understand, and (2) helping students learn the process of debugging or finding bugs. To use live code, we need a code editor and compiler that we can use without installing the application first through website media. Live code in this learning media is used as an approach to learning method of programming practice.

# METHOD

# **A. Design Thinking**

Design Thinking is an approach used to identify and better understand users in the use of applications, find problems faced by users, and can explore new ideas in the creation of application features that are appropriate and in accordance with user needs*.*[16].

**Fig 1.** Design Thinking Method

1. Emphatize

At this stage it will be necessary to gain an empathetic understanding of the problem that is trying to be solved.

1. Define

Here observations will be made and synthesized to determine the core problems that have been identified in a human centered way. In the defined stage, information will be obtained about the features and functions needed by users, this information is useful for designing the system [16].

1. Ideate

Ideate is the stage to identify new solutions to the problem statement made and look for alternative ways to look at the problem. At this stage, brainstorming will be carried out to get ideas as a solution that will be used as a guide in system development [17].

1. Prototype

At this stage, the ideas and designs in the brainstorming method are then implemented directly in an application or test product that can interact with users.

1. Test

a. Implementation and Test

Product Validation, Expert validation is carried out by media expert validators and material experts. Media experts are people who are competent in the field of learning media development, while material experts are people who master and understand learning materials in this case Object Oriented Programming (OOP) lessons. Prospective user trials were conducted on SMKN 12 Malang Class XI Software Engineering Expertise Competency (RPL) students who took Object-Oriented Programming (OOP). In one class there are ± 30 students.

b. Data Collection Method

The data obtained from this study are quantitative and qualitative data. Quantitative data is data in the form of numbers and is obtained from a questionnaire given to the test subjects. While qualitative data is data in the form of sentences, words, or images and is obtained from suggestions, criticisms, comments, and interviews with media experts and material experts related to product feasibility.

c. Data Analysis

Quantitative data from the data collection process is calculated using the following formula [18].

A math equation with numbers

Description automatically generated with medium confidence

(1)

The results of the data processing carried out will be compared with the validation criteria table as follows [19].

**Table 1.** Media Feasibility Criteria

|  |  |  |
| --- | --- | --- |
| Percentage (%) | Feasibility Level | Description |
| 90% - 100% | Very Good | Feasible with no revision |
| 75% - 89% | Good | Feasible and need a little revision |
| 65% - 74% | Average | Less feasible and needs moderate revision |
| 55% - 64% | Bad | Not feasible and need some revision |
| 0% - 54% | Very Bad | Not feasible and need big revision |

Then, the processed data on learning motivation is compared with the following criteria [20].

**Table 2.** Motivation Level Criteria

|  |  |
| --- | --- |
| Percentage (%) | Description |
| 81 – 100 | Motivation is Very High |
| 61 – 80 | Motivation is High |
| 41 – 60 | Motivation is Average |
| 21 – 40 | Motivation is Low |
| 0 – 20 | Motivation is Very Low |

# Results and Discussions

A. *Emphatize*

1. Learning Analysis

At this stage, data collection will be carried out by exploring user problems using the interview method [21][22]. Interviews were conducted with teachers of OOP subjects at SMKN 12 Malang to further explore the ongoing learning process, learning media, and the percentage of achievement of learning objectives. Interviews were also conducted with several students who had taken OOP subjects to find out the outline of existing problems from the point of view of students and explore students' expectations of the OOP learning process.

1. Problem Analysis

Through the learning analysis, the results show that there are several problems including: (1) students dislike learning with conventional media such as power point and google classroom, (2) students' interest in learning is low when using conventional media and prefer to learn through interesting information systems, (3) students have difficulty understanding the material because the teaching materials used are less interesting and less motivating, (4) the lack of availability of interesting and easy-to-understand teaching materials that can increase students' learning motivation, (5) the lack of development of gamification teaching materials in Object-Oriented Programming subjects.

1. Requirement Analysis

From the analysis of the problems that have been carried out, the objectives of this study can be formulated, namely, to develop interactive learning media based on websites with gamification content in Object-Oriented Programming (OOP) subjects to increase the learning motivation of vocational students and make it easier for students to access learning anywhere and anytime.

# B. Define

Determination of Problem-Solving Techniques The solution to the problems previously described is determined through problem solving techniques. The problem-solving technique in this research is to develop learning media in the form of a gamification-based website to support the learning process that can be accessed anywhere and anytime and increase student learning motivation.

# C. Ideate

In the ideate stage, a use case diagram is created. Use Case Diagram is a tool for describing applications used to describe interactions between users or actors and software systems [23]. The purpose of this use case diagram is to describe the functionality of the system from the user's point of view and shows how the user interacts with the system in a scenario.

A screenshot of a computer

Description automatically generated

**Fig 2.** Use Case Diagram Website Clearn

D. *Prototype*

There are two types of media developed, namely gamification-based website media and educational game media. This website and educational game media are multiplatform so that they can be accessed via desktop (PC, Laptop, Chromebook) or mobile (Smartphone, Tablet) devices online anywhere and anytime. The development of this website aims to be utilized as a learning resource that can facilitate students in learning theory and practice in Object-Oriented Programming subjects.

The website was created using the Laravel 9 PHP framework base with the help of Visual Studio Code text editor software. For image assets and designs on the website are made using Adobe Illustrator. The website also requires a web-based educational game platform using itch.io. The game that has been developed using Construct is uploaded to itch.io so that it can be played online. The learning media developed has four main features, namely material classes, live code, discussions, and educational games.

A cartoon character sitting on a moon

Description automatically generated

**Fig 3.** Landing Page

The landing page contains a description, media headlines and features, developer information, and a guide to using the media.

A screenshot of a computer

Description automatically generated

**Fig 4.**  Dashboard Page

The student dashboard page contains general information and user achievements consisting of the user's name and avatar, levels and points/XP that have been achieved, missions/challenges to be completed, badges that have been earned, and the number of classes attended, as well as access to live code features, discussion forums, and educational games.

A screenshot of a game

Description automatically generated

**Fig 5.** CLearn Game

In each material there are 3 levels or 3 different games consisting of platformer games, puzzles, and shooters. The game has a level lock feature, where when just running the game, the choice of levels that can be played is only level 1. Learners must complete the game gradually.

# E. Test

To find out the level of feasibility of learning media [24], the validation process was carried out on several validators, namely OOP subject teachers at SMKN 12 Malang, Informatics Engineering Lecturers and professional programmers with trials of media experts and material experts. Then the learning media products that had been developed were then tried out in the form of pretest and posttest on research subjects, namely students of Class XI RPL SMKN 12 Malang, with 23 students. From this process the following data results were obtained.

1. Data of media expert validation results on the website

**Table 3.** Media Validation Data

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Media Validation** | | |  |
| **Aspect** | **Score** | **Max** | **Validation(%)** | **Criteria** |
| Attractiveness | 58 | 60 | 96.67 | Very Good |
| Clarity | 83 | 90 | 92.22 | Very Good |
| Efficiency | 77 | 90 | 85.56 | Good |
| Accuracy | 63 | 75 | 84.00 | Good |
| Stimulation | 56 | 60 | 93.33 | Very Good |
| Novelty | 67 | 75 | 89.33 | Good |
| **Average** | 404 | 450 | 89.78 | Good |

From Table 3, media validation tests that have been carried out by Teachers, Lecturers, Programmers, and Developers. It can be seen that the Clearn learning media developed meets the good criteria. This can be seen from the total media validation score of 89.78% which is included in the good criteria. This means that Clearn learning media is feasible and can be included in the trial phase in terms of media.

1. Data of material expert validation

**Table 4.** Material Validation Data

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Material Validation** | | |  |
| **Aspect** | **Score** | **Max** | **Validation (%)** | **Criteria** |
| Content | 57 | 60 | 95.00 | Very Good |
| Language | 42 | 45 | 93.33 | Good |
| Presentation | 80 | 90 | 88.89 | Very Good |
| Evaluation | 95 | 105 | 90.48 | Very Good |
| **Average** |  |  | **91.33** | **Very Good** |

From Table 4, material validation tests that have been carried out by Teachers, Lecturers, Programmers, and Developers. It can be seen that the learning material in Clearn developed meets the criteria of excellent. This can be seen from the total material validation score of 91.33% which is included in the excellent criteria. This means that the learning material in Clearn is very feasible and can be included in the trial stage in terms of its material.

1. User trial

**Table 5.** User Test Data

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **User Test** | |  |
| **Aspect** | **Score** | **Max** | **Validation(%)** | **Criteria** |
| Material | 293 | 345 | 84.93 | Good |
| Learning Design | 486 | 575 | 84.52 | Good |
| Learning Media | 668 | 805 | 82.98 | Good |
| Implementability | 473 | 575 | 82.26 | Good |
| **Average** |  |  | **83.48** | **Good** |

User validation tests that have been carried out by Teachers, Lecturers, Programmers, and Developers. From the results of the user trial process in Table 5, it can be concluded that. This can be seen from the total material validation score of 83.48% which is included in the good criteria. This means that the learning material in Clearn as a whole is good and can be used as a learning media for OOP subjects in SMK.

1. Learning Motivation Test

**Table 6.** Learning Motivation Test

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **Motivation Test** | |  |
| **Aspect** | **Score** | **Max** | **Persentage** | **Criteria** |
| Attention | 557 | 690 | 80.72 | High |
| Relevance | 378 | 460 | 82.17 | Very High |
| Confidence | 645 | 805 | 80.12 | High |
| Satisfaction | 289 | 345 | 83.77 | Very High |
| **Average** |  |  | **81.26** | **Very High** |

From Table 6, learning motivation validation tests that have been carried out by Teachers, Lecturers, Programmers, and Developers. It can be seen that student learning motivation after using Clearn learning media has a percentage of 81.26% and included in the very high criteria. The relevance and satisfaction aspects are the aspects with the highest percentage with a total criterion score of 82.17% and 83. which are included in the very high criteria.

# Conclusions

In this study, several conclusions can be drawn, namely: (1) Clearn learning media products are produced, namely websites that are integrated with gamification methods and live code features to help the learning process for OOP subjects in class XI SMK, (2) from the media validation process of learning media products is included in the good criteria, for material validation is included in the criteria very valid, and in the process of user trials of learning media products the feasibility level of the product is included in the good criteria so that it is suitable for use as a learning media for OOP class XI SMK subjects, and (3) the stages of learning motivation tests conducted on students after using learning media products get the results of learning motivation with very high criteria.

Gamification and live code provide stimulation and challenges that increase user motivation and engagement in the learning process. In this case, users responded positively to the use of learning media with gamification elements such as rewards, challenges, and progress monitoring, as well as using live code features to practice OOP programming [25]. Good results on the learning motivation test also show that users feel the need to continue learning and achieve the desired results. From this stage, it will improve more about integration of educational games with evaluation, educational games, material integration, live coding, and evaluation.

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