



Integration of Articulate Storyline with MERN Stack Technology for Gamified E-Learning Instructional Media Development

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ABSTRACT

Learning media is any form of tool or means used in the learning process to help learners obtain, understand, and remember information provided by the teacher. Learning media must be designed to suit the needs of learners and can facilitate effective and interactive learning. This article discusses the integration of Articulate Storyline with MERN (MongoDB, Express, React, Node.js) stack technology to develop gamified e-learning media. The gamification approach is used to enhance the interactivity and engagement of e-learning content, while the MERN stack provides a powerful platform for developing dynamic and scalable web applications. This article describes the development process, including the design of game mechanics, integration of MERN stack with Articulate Storyline, and implementation of gamified learning media. The results show that the use of MERN stack technology in combination with Articulate Storyline can produce highly interactive and engaging gamified e-learning media, which is effective in improving learners' knowledge acquisition and retention. The article concludes by discussing the potential of the proposed approach to improve e-learning effectiveness and suggests future research directions.

Keywords: *Articulate storyline, MERN stack, Gamified e-learning, Instructional media, Interactivity.*

1. INTRODUCTION

The use of learning media can help students to understand concepts or ideas that are difficult to understand, increase student involvement in the learning process, and facilitate interaction between students and teachers. In addition, learning media also helps teachers to present material in a more interesting way and easily understood by students, as well as increase the efficiency of time and energy in the teaching process.

One of the learning media options that can be used is website learning, which is a form of e-learning or online learning. E-learning is a learning system based on information technology that allows students to learn anytime and anywhere without having to be in the classroom. In principle, an e-learning environment is an online platform used in technology-based education. This aspect of the e-learning environment involves the use of digital tools in the learning process, such as tools, assignments, and the interaction between the course structure and new assessments introduced at various stages [1]. By providing visualization and ease in delivering material, the use of appropriate learning media

can assist teachers in facilitating effective learning. Therefore, the utilization of learning media is expected to provide benefits for students in understanding and understanding the material presented [2].

The use of e-learning software such as Articulate Storyline can be a solution to develop learning media with the criteria mentioned above. Articulate Storyline can be used to create innovative and interactive learning that presents information in an engaging format [3]. Although Articulate Storyline can help in online learning, it is not enough to fulfill all the needs and challenges. Therefore, it needs to be combined with other technologies. The combination will make a remarkable contribution to talent development in the information era [4]. The combination can be referred to as technology integration in learning, which aims to improve the quality of learning that can be done by teachers.

MERN Stack Technology can be one of the technology options that can be integrated with Articulate Storyline in online learning. MERN Stack according to [5] is a combination of technology used to build web applications, consisting of MongoDB, Express, React,

and Node.js. This technology is ideal for building web applications that require high interactivity [6]. Overall, the integration of Articulate Storyline and MERN Stack technology in learning media development has great potential to improve the quality and effectiveness of learning in today's digital era.

The learning model that can be applied to the learning media resulting from the integration of these two technologies is gamification. Implementation of gamification in the learning process, there was an increase in student motivation, especially in intrinsic and extrinsic motivation [7]. This learning model is proven to be effective in increasing students' interest in learning and their understanding of the material taught.

SMK Ibu Kartini was used as the research subject because it fulfills the necessary criteria. Based on observation, it was found that the learning method used still relies on an oral approach with the support of powerpoint, but it is less able to attract students' interest in learning. This results in less effective learning and affects students' understanding of the material which is less than optimal. Therefore, it is necessary to develop learning media that can overcome these problems so that the implementation of an independent learning curriculum can run more optimally, namely supporting the creation of effective learning [8]. Researchers will focus on developing learning media for class X Software and Game Development Fundamentals (PPLG) subjects using Structured Programming elements.

Based on the previous explanation, the author wants to innovate by developing gamified e-learning media from the integration of Articulate Storyline with MERN Stack Technology, especially on structured programming elements of Software and Game Development subjects. This research aims to develop learning media, determine its feasibility, and user responses to the developed learning media.

2. METHOD

This research is a Development Research or Research and Development (R&D). [9] explains that the research and development (R&D) method is a research method that aims to produce a product and test the effectiveness of the product. The learning media development process is carried out using the ADDIE model, a development model commonly used in creating learning designs. The ADDIE model development process is very structured and systematic so as to produce learning products that are ready to use and in accordance with product testing standards [10]. According to [11], the development steps with the ADDIE model consist of:

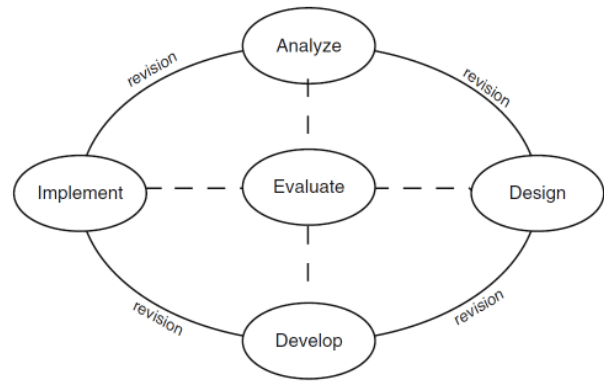


Figure 1 ADDIE Development Method.

In the ADDIE development concept diagram shown above, evaluation is conducted at each stage to get feedback and make revisions if needed. This research design will support researchers in developing learning media integrated with Articulate Storyline and MERN Stack Technology systematically and effectively.

2.1. Development Model

The sequence of systematic activities in the ADDIE model is through the stages of Analysis, Design, Development, Implementation, and Evaluation. The following are the stages of the process in the ADDIE model:

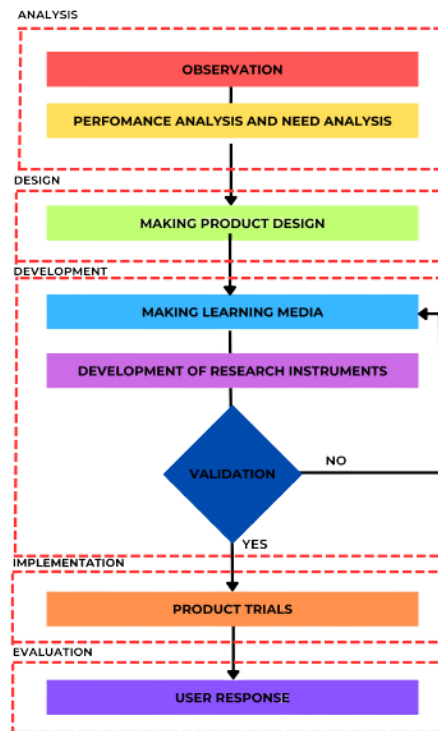


Figure 2 Stages of ADDIE Model Development.

An explanation of the ADDIE development stages that will be carried out by researchers is as follows:

1. Analysis

The analysis step consists of two stages, namely performance analysis and need analysis. The first stage, namely performance analysis, is carried out to identify and categorize problems that arise in schools related to the use of current learning media, and find solutions to improve or improve existing learning media.

The second stage, needs analysis, aims to determine the type of learning media needed by students to improve the quality of learning seen from students' interest in learning and understanding.

2. Design

After the analysis stage, the next step is the design stage. At this stage, researchers will design learning media that will be developed based on the results of the analysis that has been done previously. The following is a summary of the steps of the design stage in general:

a. Preparation of Learning Materials

In the design stage, the first step is to organize the learning materials that will be used in the learning media. The main materials that are the focus of this research include:

- 1) programming language (javascript),
- 2) variables,
- 3) data types,
- 4) arrays,
- 5) looping control, and
- 6) branching control.

b. Media Type Selection

In the next stage, the researcher selects media that is in accordance with the characteristics of the material and the needs of students, namely website-based learning media. The use of the website was chosen because it has advantages in accessibility, so it can be accessed by students anywhere and anytime, and using any device. Thus, the learning media to be developed can be used by students effectively.

c. Format Selection

At this stage, researchers choose the format of learning media that is suitable for the material to be delivered to increase the effectiveness of learning. Some of the things considered in format selection include learning content design, appropriate learning approaches, relevant learning resources, as well as content design that includes layout, images, and writing. All these elements are carefully designed to ensure that learners can gain maximum benefit from the developed learning media.

d. Preliminary Design

For the last stage in the design, researchers make the interface design of the learning media that has been selected previously. Here the researcher makes a wireframe made with figma software. Wireframe is an initial skeleton or rough scribble to arrange or organize items on a web page where this process is carried out before the actual design process begins [12].

The following is a wireframe of the learning media made at this stage:

1) Home Page

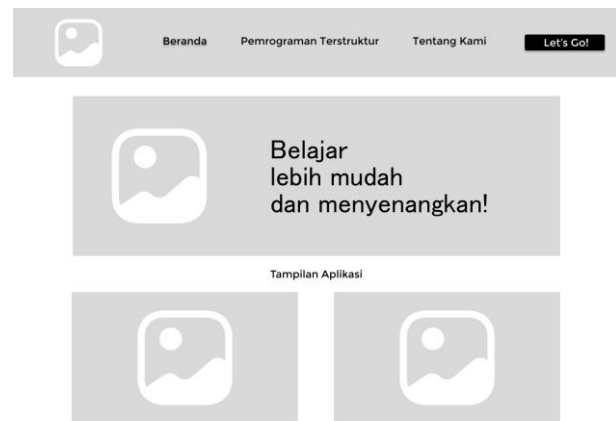


Figure 3 Home Page Design.

2) Structured Programming Menu Page



Figure 4 Structured Programming Menu Page Design.

3) About Us Menu Page

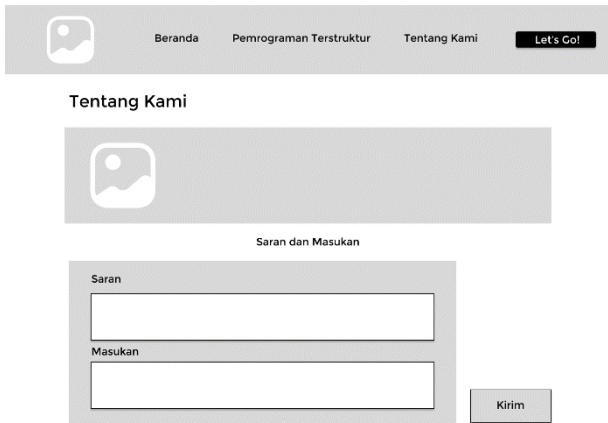


Figure 5 About Us Menu Page Design.

4) Welcome Page (Articulate Storyline)



Figure 6 Welcome Page Design (Articulate Storyline).

5) Login Page (Articulate Storyline)



Figure 7 Login Page Design (Articulate Storyline).

6) Menu Pages (Articulate Storyline)

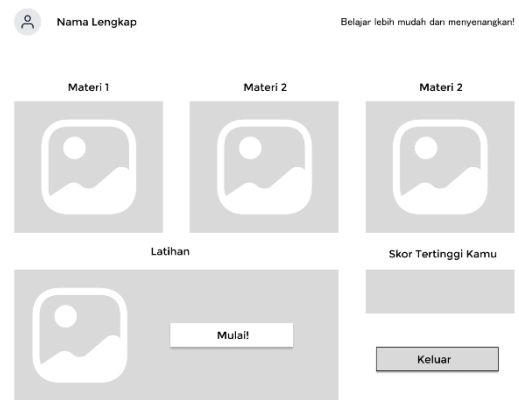


Figure 8 Menu Pages Design (Articulate Storyline).

7) Materials Menu Page (Articulate Storyline)

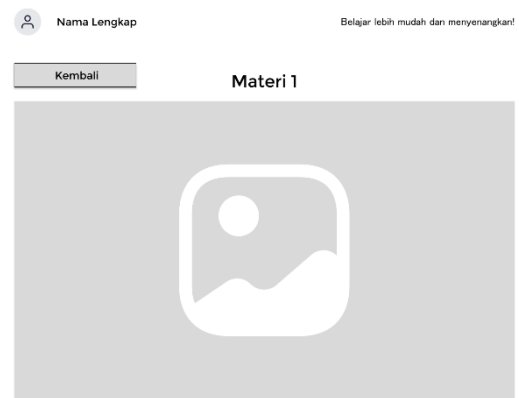


Figure 9 Materials Menu Page Design (Articulate Storyline).

8) Exercise Menu Page (Articulate Storyline)

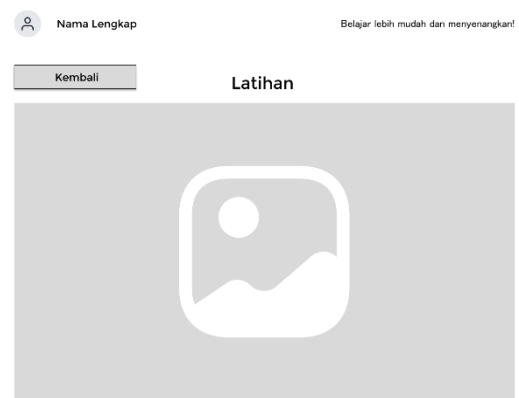


Figure 10 Exercise Menu Page Design (Articulate Storyline).

3. Development

At the development stage, researchers began to make research instruments and learning media based on the designs that had been made previously. In this research, the design that has been made is implemented into a website. Before the products that have been made are tested by experts, researchers need to test the validity and reliability of the research instruments first. After the research instrument is validated, the next step is to test the product by material experts and media experts before the product is tested at the research site.

4. Implementation

At this stage, the implementation of the product that has been limited tested in the school that has been determined as the research site is carried out. The product will be given to students as part of the learning process of structured programming elements. This implementation stage aims to evaluate the product performance in more detail and identify whether the product can be used effectively in the actual learning context. During this stage, the researcher will collect data through observations and interviews to obtain feedback from product users, so that evaluation and improvement can be made if necessary.

5. Evaluation

At the evaluation stage, researchers will conduct an assessment of the learning media that has been developed by giving a questionnaire to students. The questionnaire will be used to evaluate the effectiveness of learning media in helping the learning process and how much students feel helped by using the media. The results of this evaluation will be used as input for the development and improvement of learning media in the future.

2.2. Data Collection Techniques

This research involves several data collection techniques, which are then analyzed and processed to get conclusions. There are three data collection techniques used in this study, namely observation, interviews, and questionnaires.

2.2.1. Observation

In this study, observation techniques were used to obtain the information needed. Observation is done directly to get information about the learning process seen from the learning media and learning models used because it affects students' interest in learning and understanding.

2.2.2. Interviews

Interviews were conducted as a process of identifying problems that later became the focus of research. The interview was conducted with Mr. Ign. F. Bayu Andoro

S, ST. M.Kom, who is a productive subject teacher in the PPLG department. In addition to obtaining permission for the research process, the purpose of this interview was to find out problems related to learning media at school. The interview was conducted before making the media to obtain information about problems that occur in teaching materials or teaching media that already exist in schools.

2.2.3. Materials Expert Validation

In the material expert validation technique, the researcher shows the learning media along with the validation sheet given to the material expert validator, this material expert validation is in the form of a questionnaire assessing the material in the learning media that has been developed. In this case, the material expert validation was carried out by the teacher of the Basics of Software and Game Development subject or one of the Semarang State University lecturers who is an expert lecturer in the field of learning devices. In conducting validation techniques, instruments are needed to help the data collection process.

2.2.4. Media Expert Validation

In the media expert validation technique, the learning media that has been developed will be shown to the media expert validator along with the validation sheet provided. In this case, media expert validation is carried out by Semarang State University lecturers who are expert lecturers in the field of learning media development. Through this technique, data in the form of suggestions and criticisms will be collected from media experts regarding the learning media that has been developed. Just like material expert validation, media expert validation also requires instruments to help the data collection process.

2.2.5. User Response Questionnaire

Questionnaire is a data collection technique that is done by giving a set of questions or written statements to respondents to answer [9]. In this study, the questionnaire was used to obtain information about user responses to the learning media that had been developed. The users are students who are the research subjects of the learning media that have been developed. On the questionnaire sheet, users will be asked to give a check mark (√) in the column provided. This research is in accordance with the views of [13] which state that the minimum number of respondents for questionnaire trials is 30 people.

2.3. Data Analysis Techniques

Data analysis was carried out after collecting data at the validation stage of material experts, material experts, and user response questionnaires. In this study, two data analysis techniques were used, namely quantitative

descriptive analysis and qualitative descriptive analysis. [9] explains that descriptive data analysis techniques are used to analyze data by providing an overview or description of the data that has been collected, without the intention of making general conclusions or generalizations. Qualitative descriptive analysis techniques are used to evaluate learning media products after implementation and test the level of product feasibility. The qualitative data obtained will then be converted into quantitative data using a Likert scale.

Likert Scale is used to evaluate the attitudes, opinions, and perceptions of individuals or groups towards an event or social phenomenon [14]. In this study, the Likert Scale was used to measure each aspect of the assessment and media assessment items from each assessor, thus facilitating the process of analyzing data from the assessment results from experts and users. The Likert scale is used to measure the attitudes, opinions, and perceptions of a person or group of people towards certain social phenomena specifically defined by the researcher as research variables. Variable indicators are described and used as a starting point for compiling instrument items in the form of statements or questions. Each instrument item has answers that are graded from very positive to very negative [9].

To collect data in this study, researchers used a questionnaire with a positive Likert scale consisting of 4 levels. This is done to avoid the possibility of respondents choosing answer options in the middle category if using a Likert scale with odd levels. The Likert scale is used at all stages of validation by experts and user response (students). The data collected through the questionnaire will be converted into values using several value scales that have been compiled by researchers. The details can be seen in Table 1.

Table 1. Validator Rating Scale and User Questionnaire.

Scale	Assesment	Description
1	SD	Strongly Disagree
2	D	Disagree
3	A	Agree
4	SA	Strongly Agree

After obtaining the data, the next step is to evaluate the feasibility of the product (Fungsonality Test). To find out the weight of each response and calculate the average score, it is done using the following formula:

$$X = \frac{\sum x}{n}$$

- X = Average score
- $\sum x$ = Total score of each
- n = Number of Validators/Respondents

The Likert scale is used to assess each aspect of the developed product, where the product will be considered feasible if the average assessment meets at least good criteria, using the calculation formula according to [15] as follows:

$$P = \frac{f}{N} \times 100\%$$

- P = Percentage
- f = Gain score
- N = Maximum score

$$\bar{P} = \frac{\sum P}{n}$$

- \bar{P} = Average percentage
- $\sum P$ = Total percentage
- N = Respondent

After the average percentage value is obtained, the next step is to determine the predicate of the quality of the product made using the Rating Scale measurement scale. This measurement scale is a quantitative criterion that produces a scale division based on a range of numbers according to a predetermined size. The ideal condition expected is 100%. If researchers use four categories according to the Likert scale used, then the range of values between 0% and 100% will be divided equally to produce feasibility categories. Table 2 below is used to see the feasibility category based on the percentage obtained.

Table 2. Distribution of Media Feasibility Category Ranges.

Category	Percentage (%)
Very Feasible	76 % - 100 %
Feasible	51 % - 75 %
Not Feasible	26 % - 50 %
Very Not Feasible	< 25 %

The assessment criteria above will be used as a reference to the assessment results used to determine the criteria for whether the product developed is feasible or not. If the learning media obtains a validation value of more than 50% (Feasible and Very Feasible), it is categorized as feasible to be tested on students.

After being tested, then you can see the results of the implementation through the usefulness of the learning media that has been developed (Usability Test). These results are taken from the user response questionnaire (students). The percentage calculation is the same as the formula for calculating the results of media feasibility. Table 3 shows the category of media implementation results.

Table 3. Category Range Distribution of Media Implementation Results.

Category	Percentage (%)
Very Useful	76 % - 100 %
Useful	51 % - 75 %
Not Useful	26 % - 50 %
Very Not Useful	< 25 %

Gamified E-Learning instructional media development products from Articulate Storyline integration with MERN Stack Technology are said to be useful as learning media according to the criteria if the results of the user test assessment are at least included in Helpful or Very Helpful.

3. RESULT AND DISCUSSION

Based on the research that has been conducted regarding the development of Gamified E-Learning learning media from Articulate Storyline Integration with MERN Stack Technology, the following results are obtained:

1. Development of Gamified E-Learning Media

This research results in gamified e-learning media consisting of interactive modules, learning videos, games, and collaborative activities designed using Articulate Storyline and MERN Stack. This learning media can increase engagement, attract learning interest, improve learners' material understanding and facilitate more interactive and interesting learning.

2. Articulate Storyline Integration with MERN Stack

This research successfully integrates Articulate Storyline with MERN Stack technology, utilizing MongoDB as database, Express as web framework, React as UI library, and Node.js as runtime environment. This integration allows developers to utilize the rich features of Articulate Storyline in developing learning content that can be integrated upstream with MERN Stack.

3. Effectiveness of Gamified E-Learning Media

The test results of the developed gamified e-learning media show a high level of learner engagement, increased understanding of learning materials, and a good level of user satisfaction. The gamified e-learning media developed with the integration of Articulate Storyline and MERN Stack is able to improve the learning experience of learners and facilitate a more effective learning process.

4. Pros and Cons of Articulate Storyline and MERN Stack Integration

The advantages of Articulate Storyline and MERN Stack integration include flexibility in learning content development, high interactivity, and good scalability. However, the disadvantages include the difficulty of implementation that requires sufficient technical understanding, the cost of using Articulate Storyline software that can be an obstacle, and technological limitations in terms of internet connection that can affect the accessibility of learning media.

5. Implications and Recommendations

The results of this study can have implications in the development of gamified e-learning media that is more interactive and interesting for learners. Recommendations for learning media developers are to explore more deeply the potential of Articulate Storyline and MERN Stack integration in developing more innovative learning media. For teachers, recommendations can involve training and technical skill development related to the use of Articulate Storyline and MERN Stack. For researchers and practitioners, the recommendation is to conduct further research in this area, including exploring the potential use of gamified learning media in effective learning approaches.

4. CONCLUSION

Based on the results and discussion of the research on the integration of Articulate Storyline with MERN Stack Technology for the development of gamified e-learning media, the following conclusions can be drawn:

1. The integration of Articulate Storyline with MERN Stack Technology can be used as an effective approach in the development of gamified e-learning media. The results show that the use of these two technologies can produce learning media that are

interesting, interactive, and increase motivation and interest in learning.

2. Gamified e-learning media has advantages in increasing learners' motivation, engagement, and learning outcomes. It can be an effective alternative in improving the quality of online learning, especially in the growing context of e-learning.
3. However, the development of gamified e-learning media also faces several challenges, such as the technical understanding required in integrating Articulate Storyline with MERN Stack, the cost of using Articulate Storyline software which can be an obstacle for educational institutions with limited budgets, and limited accessibility for learners who have unstable internet connections.
4. This research has limitations, such as focusing on the development of gamified e-learning media using Articulate Storyline and MERN Stack, as well as limiting the scope of testing and validation of learning media. Therefore, future research can expand the scope of research, consider other factors that can affect the learning experience of learners, and develop a framework or guidelines for gamified e-learning media developers.

Thus, the integration of Articulate Storyline with MERN Stack Technology for gamified e-learning media development has great potential to improve the quality of online learning. However, the existing challenges and limitations need to be considered in further development. This research is expected to contribute to the development of innovative and effective learning approaches in the context of e-learning, as well as being the basis for further research in the development of gamified e-learning media.

REFERENCES

- [1] M. Alkaragole, S. M. Karim, and S.R. Ahmed, A New Approach To Study The Challenges Of E-Learning Advantages And Disadvantage, In *Journal of Physics: Conference Series*, IOP Publishing 1963(1),2021, p. 012135. DOI: <https://doi.org/10.1088/1742-6596/1963/1/012135>
- [2] T. Abdulah, L. Widaningsih, and R. Minggra, Puzzle game development as a learning media in learning outcomes of building construction basics, In *IOP Conference Series: Materials Science and Engineering*, 830(4), 2020, p. 042061, DOI: <https://doi.org/10.1088/1757-899X/830/4/042061>
- [3] I. G. P. Sindu, G. S. Santyadiputra, and A. A.J. Permana, Designing learning object using articulate storyline 3 for supporting indonesia online learning system (spada), In *Journal of Physics: Conference Series*, 1810(1), 2021, p. 012058. DOI: <https://doi.org/10.1088/1742-6596/1810/1/012058>
- [4] C. Yang, Integration of Information Technology and PE Teaching Process, In *Journal of Physics: Conference Series*,1881(2), 2021, p. 022100. DOI: <https://doi.org/10.1088/1742-6596/1881/2/022100>
- [5] R. Triandy, and N. Santoso, Pengembangan Aplikasi Web Reservasi Paket Wisata menggunakan MERN Stack (Studi Kasus: Zona Tamasya Tour Organizer), *Jurnal Pengembangan Teknologi Informasi dan Ilmu Komputer e-ISSN*, 2548, 964X, 2020.
- [6] V. Subramanian, *Pro MERN Stack*, 13, Apress, 2017 DOI: <https://doi.org/10.1007/978-1-4842-4391-6>
- [7] N. Razali, N. A. Nasir, M. E. Ismail, N. M. Sari, and K. M. Salleh, Gamification elements in Quizizz applications: Evaluating the impact on intrinsic and extrinsic student's motivation, *IOP Conference Series, Materials Science and Engineering* 917(1), 2020, p. 012024. DOI: <https://doi.org/10.1088/1757-899X/917/1/012024>
- [8] Kemendikbud RI, *Merdeka Belajar Episode 15, Kurikulum Merdeka Dan Platform Merdeka Mengajar*, 2021.
- [9] D. Sugiyono, *Metode penelitian kuantitatif, kualitatif, dan tindakan*, 2013.
- [10] N. Sugihartini, and K. Yudiana, ADDIE sebagai model pengembangan media instruksional edukatif (MIE) mata kuliah kurikulum dan pengajaran. *Jurnal Pendidikan Teknologi Dan Kejuruan*, 15(2), 2018. DOI: <https://doi.org/10.23887/jptk-undiksha.v15i2.14892>
- [11] R. M. Branch, *Instructional Design: The ADDIE Approach*, In *Encyclopedia of Creativity, Invention, Innovation and Entrepreneurship*, 2009. DOI: https://doi.org/10.1007/978-3-319-15347-6_300893
- [12] A. Julianto, *Perancangan Ulang Desain Antarmuka Aplikasi Berbasis Web Dengan Menggunakan Metode User Centered Design (Studi Kasus: Petshopgrosir)*, Doctoral dissertation, Universitas Komputer Indonesia, 2020.
- [13] M. Singarimbun and Efendi, *Metode Penelitian Survey*, PT. Pustaka LP3ES, Jakarta,1995.
- [14] Sudaryono, et al, *Pengembangan instrumen penelitian pendidikan*, Graha Ilmu, Yogyakarta, 2013.
- [15] N. Sudjana and A. Rivai, *Media pembelajaran (penggunaan dan pembuatannya)*, Sinar Baru Algesindo, Bandung, 2001.

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