



# Game Based Learning Design and Development for Effective Instructional Process at Senior High School Level

Budi Setiawan<sup>1\*</sup> 

<sup>1,2</sup>Department of Curriculum and Educational Technology, Universitas Pendidikan Indonesia, Bandung, Indonesia

## ARTICLE INFO

### Article history:

Received February 07, 2023

Accepted September 21, 2023

Available online October 25, 2023

### Kata Kunci :

Multimedia, game based learning, grammar.

### Keywords:

Multimedia, game based learning, grammar.



This is an open access article under the [CC BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) license.

Copyright ©2023 by Author. Published by Universitas Pendidikan Ganesha

## ABSTRAK

*Teknologi Informasi dan Komunikasi (TIK) yang membantu manusia belajar menjadi semakin umum dalam proses pengajaran. Hal ini memungkinkan pelajar terus belajar dengan menggunakan perangkat seluler mereka untuk mengakses alat pembelajaran mereka. Di sisi lain, guru bahasa yang seringkali menjadi pengguna sekaligus pencipta kegiatan belajar mengajar tidak selalu mengetahui cara menggunakan dan menerapkan langkah-langkah merancang pembelajaran dengan menyusup ke dalam teknologi. Tujuan dari penelitian ini adalah untuk mengembangkan efektivitas multimedia pembelajaran berbasis permainan dalam meningkatkan hasil belajar siswa di kelas yang berkaitan dengan tata bahasa Inggris. Penelitian pengembangan multimedia pembelajaran berbasis permainan menggunakan prosedur Raiser dan Demsey. Uji coba pengembangan produk telah melewati beberapa proses, antara lain: review dari ahli media yang meliputi perubahan software dan komunikasi visual; review dari pakar konten, termasuk materi dan desain pembelajaran; tanggapan siswa terhadap kegunaan dan daya tarik produk; dan review dari pakar konten. Implikasi dari penelitian ini adalah desain pembelajaran bahasa dengan pendekatan ICT mampu memenuhi kebutuhan dan keterampilan siswa. Gamifikasi dapat meningkatkan proses pembelajaran karena dapat melibatkan dan memotivasi siswa dengan permainan.*

## ABSTRACT

Information and Communication Technology (ICT) helps people learn is becoming more and more common in the teaching process. This lets learners keep learning by using their mobile devices to access their learning tools. On the other hand, language teachers, who are often both users and creators of teaching and learning activities, do not always know how to use and apply the steps on designing the lesson by infiltrating technology. The purpose of this study is to develop the efficacy of game-based learning multimedia in enhancing student-learning outcomes in the classroom with regard to English grammar. The research development of multimedia game-based learning using the Raiser and Demsey procedure. The trial of product development had passed multiple processes, including: the review from a media expert, which included software changes and visual communication; the review from a content expert, which included material and instructional design; the responses of students to the product's usability and attractiveness; and the review from a content expert. The implication of this study is that the language learning design with the ICT approach is able to fulfil the needs and skills of students. Gamification can enhance the learning process because it can engage and motivate students with games.

## 1. PENDAHULUAN

Along with the rapid development of the period, which demands that everything be done effectively and efficiently, human resources must be able to satisfy the requirements and adapt to these changes comprehensively. Education, which is the precursor to the creation of a person's personality in the emotive, cognitive, and psychomotor domains, is not an exception. Education is an essential component of human life and plays a crucial role in advancing a nation (Greipl et al., 2021; Hui et al., 2015). The very rapid development of science and technology at this time has necessitated the availability of qualified and competitive human resources (Hattie et al., 2020; Hidi & Renninger, 2006; Howard et al., 2021). In an increasingly aggressive global competition, the education sector plays a vital role in national development initiatives. The government is intensifying development, diffusion, and innovation in

\*Corresponding author

E-mail addresses: [budi.setiawan@upi.edu](mailto:budi.setiawan@upi.edu) (Budi Setiawan)

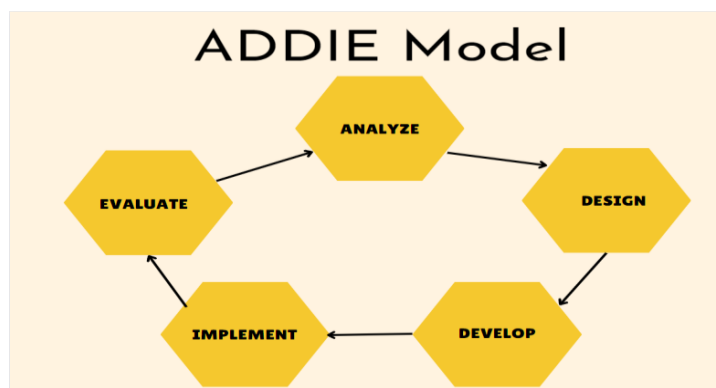
particular domains for teaching and learning activities (Kiili et al., 2014, 2021). Changing the curriculum will have a logical effect on altering and revising the numerous standards that exist in a created and established curriculum, including competency requirements (Koskinen et al., 2023; Kraft, 2020). The policy has both direct and indirect effects as unintended consequences. Based on its role, the aims of teaching English Subject include: (1) Developing oral and written communication skills in the language. These abilities include listening, speaking, reading, and writing; (2) a growing awareness of the nature and importance of English as a foreign language as the primary learning tool; (3) the development of an understanding of the relationship between language and culture and the expansion of cultural horizons. Thus, kids develop cross-cultural awareness and engage with cultural variety (Krapp, 2017; Kriegbaum et al., 2018; Liu et al., 2020). The subject of English is no exception. According to the distribution of curriculum-related information, there appears to be a difference, mainly the presence of grammar skills in English class X SMA. Different grammatical patterns exist in English depending on the context of time. This will create issues for students if a significant amount of basic concept comprehension is not aided by teacher-centered learning activities (Hurtado et al., 2019; Mayer, 2013; Mills et al., 2013). On the other hand, the current curriculum requires students to be more involved in all aspects and to interact with fewer teachers during teaching and learning activities. The immediate results include confusion and a lack of comprehension of the fundamental concepts underlying English sentence patterns. This can have significant repercussions for the cognitive or academic success of these students (Ninaus et al., 2017; Ninaus & Nebel, 2021).

The teacher's role in selecting and determining learning materials or instructional materials is crucial for overcoming student difficulties in learning activities. Until now, it has virtually become an inherited culture for many instructors. In this instance, teachers continue to employ conventional methods or strategies in teaching and learning activities (Orvis et al., 2008; Plass et al., 2015; Plass & Pawar, 2020). The lack of inventiveness displayed by the majority of instructors extended to the usage of teaching materials and learning media. The inclination is to see books as the primary source for these instructional resources. In the meantime, if you consider how rapidly science and technology are advancing and evolving, there are numerous alternatives to books that might serve as a source of instructional resources (Renninger et al., 2019; Ronimus et al., 2014). Computerization has expanded to practically all facets of human life in today's era of the millennial generation and the generation of global citizens. Computers, or what we commonly refer to as the "digital world," have even made their way into the classroom (Ryan et al., 2006; Ryan & Deci, 2020). The trend towards using computers as a learning resource in addition to books is gaining momentum. Previous study found that CAL improved student mastery across all grade levels, but was particularly beneficial in the elementary school setting; this trend was maintained in the secondary and higher education settings (Sajjadi, 2022). Previous study confirms that learning created or aided by a computer does have the potential to boost students' enthusiasm and assimilation of the subject matter (Miarso, 2009). This is due to the fact that students are more likely to respond to subject matter and improve their learning achievement when using computer-assisted learning, which in turn increases their drive to focus on the content being presented.

The use of computers and the development of learning multimedia in term of game-based learning have the potential to significantly improve students' academic performance and engagement in classroom activities. This is possible because today's society has become increasingly dependent on technological equipment, including personal computers, smartphones, and other electronic tools that are used in daily life. It is shown that games can enhance motivation and are thus an important part of children and teenagers' lives. Several instructors incorporate games into learning environments and have converted learner engagement and energy from games to instructional activities. Learners improve higher-order cognitive skills using educational games. Based on the background of the study and literature review of similar research above, the goal of this study is to develop instructional design for English learning through game-based multimedia usage as teachers for language acquisition in completing rarely or occasionally apply it or reaching intended learning outcomes.

## 2. METODE

This research falls under the category of research and development (Research and Development). Research and Development is a procedure or series of activities used to create a new product or enhance an existing one. In this usage, the term product includes both hardware and software. R & D is an intentional, systematic research method that aims to discover, formulate, improve, develop, produce, and test the efficacy of products, models, methods, services, and specific procedures that are superior to new, effective, efficient, productive, and meaningful (Putra, 2012; Raiser, R.A & Dempsey, 2007). ADDIE Model according to Raiser & Demsey is show in Figure 1.



**Figure 1.** ADDIE Model According to Raiser & Demsey

This study was carried out at SMA Negeri 3 Sragen, which can be found on Jl. Dr. Sutomo No. 2 in the city of Sragen, Indonesia, 57213. Students who were enrolled in class X IPS 2 during the even semester of the academic year 2022 were the focus of the subjects that were investigated in this study. It was found, based on initial observations of English learning process activities in class X IPS pupils at SMA Negeri 3 Sragen, that students tended to be passive and less interested in their studies. The questionnaire was utilised both before and after the product testing for evaluation. Before the tryout, media experts and material experts will be provided an evaluation questionnaire, which will serve as a reference for whether or not media adjustments are required before the audition. While the student questionnaire is used to assess students' and teachers' reactions to the generated media. The test was administered to students following the use of learning multimedia based on Game Based Learning in the learning process. The results of the tests are used to assess the effectiveness of the created multimedia.

In this study, both qualitative and quantitative data were collected, necessitating the use of descriptive quantitative and qualitative data analysis approaches. Prior to being evaluated, the results from the questionnaire were quantified, and then descriptive statistics were used to analyse the data. Interview and observational data were examined using qualitative analysis. Descriptive statistical analysis is utilised to examine and characterise obtained data. In the form of descriptive narratives, qualitative data derived from implementation-stage observations are given. Quantitative data derived from questionnaires/questions administered to material experts, media experts, and students are presented as tables and narrative descriptions. The results of a descriptive statistical analysis are utilised to establish the product's viability.

### 3. HASIL DAN PEMBAHASAN

#### Hasil

##### *Analyze Stage*

At the stage of analysis, researchers conducted literature reviews and field research. Relevant theories and research findings are reviewed in order to conduct a literature review. Additionally, researchers examined curriculum documents, course outlines, and learning program plans for English subjects. Through field observations and interviews with instructors and students, a need analysis is conducted. The researcher gathered the following data during the analysis phase. Based on initial observations of class X IPS students' English learning process activities, it was determined that students tended to be passive and less passionate about studying. This is because, during learning activities, the teacher still employs the lecture style and does not involve pupils in active participation. Based on the results of these interviews, it was determined that English teachers in particular had not maximized and developed their use of media. The media utilized is video playing that is immediately downloaded from the internet, causing pupils to become bored and disinterested in class. In class, the instructor delivers English subject matter on the topic of grammar, but the learning methods are not yet diverse. It still burdens pupils totally to seek information without offering balanced checks and balances. Students become confused, passive, and insecure as a result. In this case, students desire a change to a different learning model by incorporating learning media in the form of multimedia, which possesses several characteristics, including practicality, interactivity, and an edutainment component. They do not require internet access for operation, and can be implemented on portable computers so that students are not required to be in the computer laboratory for its purpose.

### **Design Stage**

The first step of this methodology is to identify the desired outcomes so that students can achieve them upon completion of the learning program. The ultimate objective of a lesson is to accomplish the learning objectives. In designing goods that are utilized as learning media, one must therefore pay special attention to the creation of learning objectives. The intended learning objectives refer to the requirements assessment, namely the course outline and learning implementation plans. Creating a lesson plan is one of the teacher's responsibilities in facilitating student learning. According to the national education policy outlined in Permendiknas RI No. 52 of 2008 regarding process standards, one of the components in preparing a learning implementation plan (RPP) is the existence of learning objectives that describe the process and learning outcomes that students are expected to achieve according to their level of competence- base.

### **Develop Stage**

In generating media for use in multimedia learning, researchers follow various processes, including production, validation of media experts, validation of material experts, and product testing. The flowchart offers researchers with a directing roadmap for establishing the topic or content that has been formulated so that it is cohesive and sustainable while being consistent and united. Storyboards also serve a significant part in ensuring that the narratives of previously produced media will eventually correspond. Adobe Flash, which is capable of integrating audiovisual and video content into a single, compact file, is used as a supporting tool in the creation of this learning multimedia. Games feature of multimedia that was created is show in [Figure 2](#).



**Figure 2. Games Feature**

Validation is the process of testing the validity and practicability of a certain item through an integrated approach. Validation also serves as a stage for correcting and refining a product, which is carried out by knowledgeable professionals in the industry. Before the researcher tests the media on a larger scale, this step is performed so that a media that is suitable for usage can be obtained. The product or medium will be validated by two experts, comprising of media specialists and material experts with expertise in their respective domains.

### **Implementation Stage**

The purpose of the field implementation test is to determine whether Game-Based Learning Multimedia is effective at improving student learning outcomes. This field test was conducted utilizing a Pretest-posttest Control Group Design with a True Experiment Design. There are two classes in this design: the experimental class and the control class. The identical instrument was used to administer a pretest (pretest) and posttest (posttest) to both the experimental and control groups. The validity, reliability, level of difficulty, and differential effectiveness of the pretest and posttest questions that will be utilized are initially evaluated.

### **Evaluation Stage**

The experimental class and the control class can then administer pre- and post-tests using questions that have been evaluated for validity, reliability, level of difficulty, and different types of

questioning power. Prior to learning activities for both the experimental class and the control class, pre-test questions were administered in order to assess students' basic knowledge of past elementary grammar concepts. After passing the validity, reliability, level of difficulty, and differential power of the questions, the pretest consists of 35 questions. After administering the pretest, each class received a separate treatment; the experimental class utilized multimedia game-based learning medium, while the control class utilized traditional learning. During the field trials, class X IPS 3 and X IPS 4 items were utilized. Class X IPS 3 with 32 students served as the experimental class, whilst class X IPS 4 with 32 students served as the control class. Students in the experimental class were briefed on the game-based learning activities that will be implemented prior to the treatment meeting. In order to meet timeliness in the game-based learning-based multimedia development stage, the material used in this implementation test is limited to Basic Competency 3.6, which focuses on analyzing social functions, text structures, and linguistic elements in statements and questions about actions/events that have occurred in the past, according to the context of their use. Each of the experimental and control classes received treatment over the course of three meetings. Game-based technical learning exercises focus and support student enthusiasm and activity, both individually and in groups, so that they can learn to solve challenges in the game together. From there, learning will be achieved with a greater emphasis on the student-centered pattern, in which the portion depends more on the students themselves and the teacher relies more on the facilitator role. After completing all treatment activities, students were administered a final test (posttest) using the same instrument as the pretest. The posttest findings of the two classes, the experimental class and the control class, were statistically analyzed using the t-test, with the normality and homogeneity tests serving as analysis prerequisites. According to the findings of the research, there are data on the learning outcomes of students in the experimental class and the control class, including pre- and post-test scores.

## Pembahasan

Instructional design is largely comprised of the systematic development of a learning program. It focuses on developing strategies to engage students so that they comprehend and can apply the content being taught. Development of educational program entails dividing a substantial amount of content into more manageable learning units. Instructional design principles can facilitate the users' systematic execution of this task (Oostendorp et al., 2014; Vanbecelaere et al., 2019). In the context of using instructional design as the guide or principle for learning media development, this research has several advantages. It provides them with the structure to learn more about who their students are and how they learn. It also assists them in identifying the knowledge and skills that students must demonstrate at the conclusion of the sequence or program: the learning objectives or outcomes. As they progress through the instructional design procedure, they also develop strategies for delivering the learning experience in the most relevant and efficient manner possible.

Establishing guidelines for assessing the program's achievement of its objectives is another method for ensuring that students spend their time on the most valuable and pertinent concepts. Instructional design provides the means to enhance the quality of learning program from beginning to end. A quality learning experience is centered on well-defined learning objectives. Devoting time to the design of these objectives ensures that they are effective for the students and the subject matter (Fatimah & Santiana, 2017; Papadakis, 2020). In addition, compared to similar prior research, the results of this study demonstrated that the use of ADDIE instructional design as a method for learning multimedia development was more systematic, procedural, detailed, and understandable for the users to achieve or complete the stated learning goals (Sampayo-vargas et al., 2013; Shute et al., 2020). The researcher also did requirements analysis based on the difficulties students had in teaching and learning activities, particularly those involving the past tense in English. Based on the results of the needs analysis, it was determined that teachers continue to use a limited selection of instructional material in their learning activities. Educators continue to rely mostly on traditional lecture-based models of instruction. Once upon a time, the instructor utilized visual graphics or videos downloaded from the internet with the premise of seeing and listening solely (Alrwele, 2017; Ozdamli & Ozdal, 2018). The lack of interactive activities has a detrimental effect on students' enthusiasm and motivation to participate in learning activities. In contrast, schools have introduced the 2013 curriculum, which places an emphasis on student-centered learning practices. With the above-described learning approach, pupils grow more reliant on direct instruction and receive less assistance in acquiring an aptitude for independent study. After completing a theoretical and factual study of what is of concern based on the problem's context, the researcher begins designing the initial multimedia design to be built. Several basic standards or foundations must exist in the media that will be created later on the multimedia design when creating a multimedia product (Tapola et al., 2013; Tian et al., 2021). Identification of key competencies and fundamental competences, selection and

gathering of materials, the creation of flowcharts, and the development of storyboards are some of the steps involved in developing the initial design for a multimedia product with seamless integration.

The third phase entails continuing the development of multimedia products based on the preliminary designs created in the previous phase. This phase of development consists of three steps: media production, validation by media and material experts, and product testing. The researcher chooses the most appropriate computer software program to meet the goals of the to-be-created media during the production stage. Here, Adobe Flash CS.6 is utilized, which is capable of combining music, video, and movement animation into a single program (Hamidi, 2018; Ningrum et al., 2021; Syafriatma & Amini, 2021). After the developed product has been manufactured, it is validated by media and material experts who evaluate the product's material composition and internal appearance. The descriptive and qualitative findings of the validator's evaluation of multimedia game-based learning products were studied. The expert judgement scores are translated into a value range, which is quite good (75% < score 100%) with acceptable information without correction, good (75% score 50%) with inadequate information, and poor (0% score 25%) with inappropriate information. Based on the qualifying criteria for game-based learning multimedia goods, the evaluation results from media specialists were 97% with very good criteria, 95% with very good criteria, and 96% with very good criteria from students. Implementation is the fourth step after the product has been validated by experts, revised, and tested on students outside the sample. Here, the investigator will test the multimedia output with pupils (Wigfield & Koenka, 2020; Wilson et al., 2019; Zhang & Begum, 2021). Previously, the researcher had selected two distinct groups, the experimental group and the control group. In the experimental class, the use or application of the student-centered learning model employing multimedia game-based learning is discussed, whereas in the control class, the teacher conducts learning activities using only student books and lectures, without the use of other media support, particularly multimedia.

The findings of the above-mentioned research data have a positive correlation or link with the theory and or findings of earlier studies on the use of media to increase student learning outcomes or achievements. It is possible to conclude that the multimedia products employed are effective in assisting and supporting students' academic progress in the cognitive, emotional, and psychomotor domains. According to previous study multimedia has several characteristics that allow it to provide integrated learning tools for students, including being self-instructional (self-learning), self-contained (integration of competencies and sub-competencies), stand-alone (ability to stand alone), and user friendly (easy to operate) (Susilana, R., & Riyana, 2009). This is acceptable, the usage of multimedia can shift students' attitudes towards teaching and learning activities from passive-learners to active-learners with learning experiences. The teacher's position is also more likely to be that of a guide or facilitator in learning, with students serving as the primary focus of learning activities (student-centered).

#### 4. SIMPULAN DAN SARAN

This development research was conducted in stages, including; doing needs analysis through preliminary research, creating learning multimedia designs, product development, implementation, and evaluation. The process of designing media comprises the identification of core competencies and fundamental competencies, as well as learning objectives, the selection and collecting of materials, and the creation of flowcharts and storyboards. The development phase consists of media production, verifying material experts, media experts, and student responses to the tested products, followed by design adjustments and enhancements. The implementation phase involves product trial activities validated by professionals and students through limited and large-scale trials with classes outside the sample. The evaluation phase concludes a series of analyses by examining, among other things, the test instrument's validity.

#### 5. DAFTAR RUJUKAN

- Alrwele, D. N. S. (2017). Effects of Infographics on Student Achievement and Students' Perceptions of the Impacts of Infographics. *Journal of Education and Human Development*, 6(3), 104–117. <https://doi.org/10.15640/jehd.v6n3a12>.
- Fatimah, A. S., & Santiana, S. (2017). Teaching in 21st Century: Students-Teachers' Perceptions of Technology Use in the Classroom. *Script Journal: Journal of Linguistic and English Teaching*, 2(2), 125. <https://doi.org/10.24903/sj.v2i2.132>.
- Greipl, S., Klein, E., Lindstedt, A., Kiili, K., Moeller, K., Karnath, H., Bloechle, J., Ninaus, M., Greipl, S., Klein, E., Lindstedt, A., Kiili, K., & Moeller, K. (2021). When the brain comes into play: Neurofunctional correlates of emotions and reward in game-based learning To cite this version : HAL Id : halshs-

- 03344056 Computers in Human Behavior and reward in game-based learning. *Computers in Human Behavior*, 125, 106946. <https://doi.org/10.1016/j.chb.2021.106946>.
- Hamidi, N. (2018). Pengembangan Media Pembelajaran Interaktif Pendidikan Agama Islam Berbasis Adobe Flash Professional Cs6 Untuk Mendukung Implementasi Kurikulum 2013. *Jurnal Pendidikan Agama Islam*, 14(1), 109–130. <https://doi.org/10.14421/jpai.2017.141-07>.
- Hattie, J., Hodis, F. A., & Kang, S. H. K. (2020). Theories of motivation: Integration and ways forward. *Contemporary Educational Psychology*. *Contemporary Educational Psychology*, 61, 101865. <https://doi.org/10.1016/j.cedpsych.2020.101865>.
- Hidi, S., & Renninger, K. A. (2006). The Four-Phase Model of Interest Development. *Educational and Psychologist*, 41(2), 111–127. [https://doi.org/10.1207/s15326985ep4102\\_4](https://doi.org/10.1207/s15326985ep4102_4)
- Howard, J. L., Bureau, J., Guay, F., Chong, J. X. Y., & Ryan, R. M. (2021). Student motivation and associated outcomes: A meta-analysis from self-determination theory. *Perspectives on Psychological Science*, 16(6), 1300–1323. <https://doi.org/10.1177/1745691620966789>.
- Hui, C., Ho, C., & Lin, J. (2015). The development of an augmented reality game-based learning environment. *Procedia - Social and Behavioral Sciences*, 174, 216–220. <https://doi.org/10.1016/j.sbspro.2015.01.649>.
- Hurtado, C. M., Madariaga, L., Nussbaum, M., Heller, R., Bennett, S., Tsai, C., & Braak, J. Van. (2019). Editorial: Educational technology and addictions. *Computers & Education*, 103730. <https://doi.org/10.1016/j.compedu.2019.103730>.
- Kiili, K., Lainema, T., Freitas, S. De, & Arnab, S. (2014). Flow framework for analyzing the quality of educational games q. *Entertainment Computing*, 5(4), 367–377. <https://doi.org/10.1016/j.entcom.2014.08.002>.
- Kiili, K., Lindstedt, A., Koskinen, A., & Halme, H. (2021). Flow Experience and Situational Interest in Game-Based Learning : Cousins or Identical Twins. *International Journal of Serious Games*, 8(3), 93–114. <https://doi.org/10.17083/ijsg.v8i3.462>.
- Koskinen, A., McMullen, J., Ninaus, M., & Kiili, K. (2023). Does the emotional design of scaffolds enhance learning and motivational outcomes in game-based learning? *Journal of Computer Assisted Learning*, 39(1), 77–93. <https://doi.org/10.1111/jcal.12728>.
- Kraft, M. A. (2020). Interpreting Effect Sizes of Education Interventions. *Educational Researcher*, 49(4), 241–253. <https://doi.org/10.3102/0013189X20912798>.
- Krapp, A. (2017). An educational – psychological conceptualisation of interest An educational-psychological conceptualisation of interest. *International Journal for Educational and Vocational Guidance*, 7, 5–21. <https://doi.org/10.1007/s10775-007-9113-9>.
- Kriegbaum, K., Becker, N., Spinath, B., & Becker, N. (2018). Author Note. *Educational Research Review*. <https://doi.org/10.1016/j.edurev.2018.10.001>.
- Liu, Z., Moon, J., Kim, B., & Pu, C. (2020). Integrating adaptivity in educational games: a combined bibliometric analysis and meta - analysis review. *Educational Technology Research and Development*, 0123456789. <https://doi.org/10.1007/s11423-020-09791-4>.
- Mayer, R. E. (2013). Incorporating motivation into multimedia learning. *Learning and Instruction*, 3–5. <https://doi.org/10.1016/j.learninstruc.2013.04.003>.
- Miarso, Y. H. (2009). *Menyemai Benih Teknologi Pendidikan*. Kencana Prenada Media Group.
- Mills, C., Mello, S. D., Lehman, B., Bosch, N., Strain, A., & Graesser, A. (2013). What Makes Learning Fun ? Exploring the Influence of Choice and Difficulty on Mind Wandering and Engagement during Learning. *In Artificial Intelligence in Education: 16th International Conference*, 71–72. [https://link.springer.com/chapter/10.1007/978-3-642-39112-5\\_8](https://link.springer.com/chapter/10.1007/978-3-642-39112-5_8).
- Ninaus, M., Kiili, K., McMullen, J., & Moeller, K. (2017). Computers in Human Behavior Assessing fraction knowledge by a digital game. *Computers in Human Behavior*, 70, 197–206. <https://doi.org/10.1016/j.chb.2017.01.004>.
- Ninaus, M., & Nebel, S. (2021). A Systematic Literature Review of Analytics for Adaptivity Within Educational Video Games. *In Frontiers in Education*, 5(January). <https://doi.org/10.3389/feduc.2020.611072>.
- Ningrum, A. S., Muslim, S., & Siregar, E. (2021). Multimedia Simulation Model on Basic Electrical and Electronics Subjects for Vocational Secondary School. *Journal of Educational Research and Evaluation*, 6(1), 72–79. <https://doi.org/10.23887/jere.v6i1.38783>.
- Oostendorp, H. Van, Spek, E. D. Van Der, & Linssen, J. (2014). Adapting the Complexity Level of a Serious Game to the Proficiency of Players. *EAI Endorsed Transactions on Serious Games*, 1(2), 1–8. <https://doi.org/10.4108/sg.1.2.e5>.
- Orvis, K. A., Horn, D. B., & Belanich, J. (2008). The roles of task difficulty and prior videogame experience on performance and motivation in instructional videogames. *Computers in Human Behavior*, 24,

- 2415–2433. <https://doi.org/10.1016/j.chb.2008.02.016>.
- Ozdamli, F., & Ozdal, H. (2018). Developing an instructional design for the design of infographics and the evaluation of infographic usage in teaching based on teacher and student opinions. *Eurasia Journal of Mathematics, Science and Technology Education*, 14(4), 1197–1219. <https://doi.org/10.29333/ejmste/81868>.
- Papadakis, S. (2020). Evaluating a game-development approach to teach introductory programming concepts in secondary education. *International Journal of Technology Enhanced Learning*, 12(2), 127–145. <https://doi.org/10.1504/ijtel.2020.106282>.
- Plass, J. L., Homer, B. D., & Kinzer, C. K. (2015). Foundations of Game-Based Learning. *Educational Psychologist*, 50(4), 258–283. <https://doi.org/10.1080/00461520.2015.1122533>.
- Plass, J. L., & Pawar, S. (2020). Toward a taxonomy of adaptivity for learning. *Journal of Research on Technology in Education*, 52(3), 275–300. <https://doi.org/10.1080/15391523.2020.1719943>
- Putra, N. (2012). *Metode penelitian kualitatif pendidikan*. Rajawali Pers.
- Raiser, R.A & Dempsey, J. V. (2007). *Trends and Issues in Instructional Design and Technology*. Pearson Merrill Prentice Hall.
- Renninger, K. A., Bachrach, J. E., & Hidi, S. E. (2019). Learning , Culture and Social Interaction Triggering and maintaining interest in early phases of interest. *Learning, Culture and Social Interaction*, 23(December 2018), 100260. <https://doi.org/10.1016/j.lcsi.2018.11.007>.
- Ronimus, M., Kujala, J., Tolvanen, A., & Lyytinen, H. (2014). Computers & Education Children ' s engagement during digital game-based learning of reading : The effects of time , rewards , and challenge. *Computers & Education*, 71, 237–246. <https://doi.org/10.1016/j.compedu.2013.10.008>.
- Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology*, 61, 101860. <https://doi.org/10.1016/j.cedpsych.2020.101860>.
- Ryan, R. M., Rigby, C. S., & Przybylski, A. (2006). The Motivational Pull of Video Games : A Self-Determination Theory Approach. *Motiv Emot*, 30, 347–363. <https://doi.org/10.1007/s11031-006-9051-8>.
- Sajjadi, P. (2022). Individualization in serious games: a systematic review of the literature on the aspects of the players to adapt to. *Entertainment Computing*, 41, 100468. <https://doi.org/10.1016/j.entcom.2021.100468>.
- Sampayo-vargas, S., Cope, C. J., He, Z., & Byrne, G. J. (2013). Computers & Education The effectiveness of adaptive difficulty adjustments on students ' motivation and learning in an educational computer game. *Computers & Education*, 69, 452–462. <https://doi.org/10.1016/j.compedu.2013.07.004>.
- Shute, V., Smith, G., & Kuba, C. D. R. (2020). Maximizing learning without sacrificing the fun: Stealth assessment, adaptivity and learning supports in educational games. *Journal of Computer Assisted Learning*, 37(1), 127–141. <https://doi.org/10.1111/jcal.12473>.
- Susilana, R., & Riyana, C. (2009). *Media Pembelajaran*. CV Wacana Prima.
- Syafriatma, W., & Amini, R. (2021). Pengembangan Bahan Ajar Tematik Terpadu Berbasis Value Clarification Technique (VCT) Example di Kelas V SD. *Jurnal Pendidikan Tambusai*, 5, 1127–1133. <https://jurnal.unimed.ac.id/2012/index.php/handayani/article/view/34172>.
- Tapola, A., Veermans, M., & Niemivirta, M. (2013). Predictors and outcomes of situational interest during a science learning task. *Instructional Science*, 41, 1047–1064. <https://doi.org/10.1007/s11251-013-9273-6>.
- Tian, J., Bartek, V., Rahman, M. Z., & Gunderson, E. A. (2021). Learning Improper Fractions with the Number Line and the Area Model Learning Improper Fractions with the Number Line and the. *Journal of Cognition and Development*, 22(2), 305–327. <https://doi.org/10.1080/15248372.2021.1890603>.
- Vanbecelaere, S., Berghe, K. Van Den, Cornillie, F., Sasanguie, D., Reynvoet, B., & Depaepe, F. (2019). The effectiveness of adaptive versus non-adaptive learning with digital educational games. *Journal of Computer Assisted Learning*, 36(4), 502–513. <https://doi.org/10.1111/jcal.12416>.
- Wigfield, A., & Koenka, A. C. (2020). Where do we go from here in academic motivation theory and research? Some reflections and recommendations for future work. *Contemporary Educational Psychology*, 101872. <https://doi.org/10.1016/j.cedpsych.2020.101872>.
- Wilson, R. C., Shenhav, A., Straccia, M., & Cohen, J. D. (2019). The Eighty Five Percent Rule for optimal learning. *Nature Communications*, 10(1), 1–9. <https://doi.org/10.1038/s41467-019-12552-4>.
- Zhang, K., & Begum, A. (2021). Computers and Education : Artificial Intelligence AI technologies for education : Recent research & future directions. *Computers and Education: Artificial Intelligence*, 2, 100025. <https://doi.org/10.1016/j.caeai.2021.100025>.