JPPIPA 11(6) (2025)

Jurnal Penelitian Pendidikan IPA

http://jppipa.unram.ac.id/index.php/jppipa/index

# Analysis of the Influence of Gamification Based Digital Learning Media on Students' Learning Interests Evolution

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Received: February 22, 2025
Revised: April 21, 2025
Accepted: June 25, 2025
Published: June 30, 2025

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DOI: 10.29303/jppipa.v11i6.11114



**Abstract:** This study aims to analyze the effect of gamification based digital learning media on interest in learning evolution in increasing students' learning motivation. This study uses a quantitative quasi-experimental approach with a nonequivalent control group design. This study consists of three types of variables, gamification based digital learning media, interest in learning evolution, student characteristics. The study population and sample students in class XI IPA SMA Muhammadiyah 01 Surakarta. The results of the study showed a significant increase in learning interest in the experimental group compared to the control group. After being given certain treatments, the experimental group showed a much higher average posttest score, which was 85.13, while the control group only reached 71.45. This indicates that the treatment given to the experimental group succeeded in significantly increasing their learning interest. All indicators used to measure learning interest, such as attention, relevance, self-confidence, and satisfaction, also showed a higher increase in the experimental group. Research proves that digital technology and gamification mechanisms can effectively overcome learning challenges in abstract materials such as evolution. This makes a substantive contribution to building bridges between gamification theory, educational technology, and biology learning practices.

**Keywords:** Biology learning; Digital technology; Evolution; Gamification mechanisms

## Introduction

The development of digital technology has changed the direction of education, giving rise to various innovations in learning media that can increase student involvement and interest in learning. Biology education faces complex challenges in arousing students' interest and motivation to learn abstract and theoretical concepts, especially in the material of evolution (Sinatra et al., 2008). Evolution is one of the fundamental topics in biology that requires a deep understanding of changes in living things over time, but is often considered difficult and boring by students (Dharmaji & Astuti, 2023; Sickel & Friedrichsen, 2013). The development of digital technology has opened up new opportunities in designing more interactive and interesting learning media. One innovative approach that can be used is gamification, which is the application of game mechanisms in an educational context to increase engagement and motivation to learn (Deterding et al., 2011). Gamification has the potential to transform the learning experience into something more enjoyable and meaningful (Dichev et al., 2015; Nicholson, 2015).

Although a number of studies have explored the effectiveness of digital learning media and gamification separately, there is a significant gap in research that specifically investigates the integration of the two to increase interest in learning evolution. Adkins-Jablonsky et al. (2021) identified a lack of empirical research measuring the long-term impact of

**How to Cite:**
Astuti, R., Agustina, P., & Agustina, L. Analysis of the Influence of Gamification Based Digital Learning Media on Students' Learning Interests Evolution. *Jurnal Penelitian Pendidikan IPA*, *11*(6), 160-166. https://doi.org/10.29303/jppipa.v11i6.11114

gamification on biology learning, while (Le & Winkler, 2016) highlighted the paucity of studies evaluating the design of specific game elements that are most effective for evolutionary content. Denden et al. (2024) emphasized the need for research that considers individual student characteristics when it comes to gamification-based learning, especially for complex concepts such as evolution. According to Moseikina et al. (2022), socio-cultural context is rarely considered in the design of evolution learning interventions, including those involving gamification, despite this factor strongly influencing students' perceptions and acceptance of evolutionary content. Furthermore, Kalogiannakis et al. (2021) noted the lack of a comprehensive evaluative framework to assess the effectiveness of gamification approaches in addressing specific evolutionary misconceptions, while research by Morris et al. (2013) underscored the importance of exploring how gamification design elements can be designed to address cognitive barriers to evolutionary learning, such as teleological and essentialist thinking, which often hinder students' conceptual understanding.

Evolutionary learning faces complex challenges due to its abstract nature, long time scales, and high prevalence of misconceptions among students (Dharmaji & Astuti, 2023; Sickel & Friedrichsen, 2013). A significant problem lies in students' low interest and motivation in learning evolutionary material, which contributes to limited conceptual understanding and persistence of misconceptions (Nehm & Reilly, 2007). Although digital learning media have shown potential in visualizing evolutionary processes (J. S. Lee & Sylvén, 2021), and gamification approaches have been shown to increase engagement in various learning contexts (Rivera & Garden, 2021), there is still a gap in effectively integrating the two approaches for evolutionary learning. Other studies analyze the influence of gamification based digital learning media on interest in learning evolution and evaluate its effectiveness in increasing learning motivation, with a focus on identifying specific gamification elements that are most effective in overcoming cognitive barriers in learning evolution (Owens, 2019), as well as developing an evaluative framework to assess the long-term impact of this approach on learners' conceptual understanding of the evolutionary process (Opfer et al., 2012), taking into account individual characteristics and socio-cultural contexts that influence the acceptance and effectiveness of gamification-based interventions (Polo-Peña et al., 2021).

Gamification is an innovative approach that integrates game design elements into educational contexts to increase learner motivation and engagement (Signori et al., 2018). According to Deterding et al. (2011), gamification is not just a game, but the use of game mechanisms, dynamics, and thinking frameworks to solve real-world problems in learning. This concept has grown rapidly in the last decade, offering a transformative alternative in designing more engaging and interactive learning experiences. According to Ramesh et al. (2019), gamification in education involves the use of game mechanics, aesthetics, and game-based thinking to engage people, motivate action, promote learning, and solve problems. This is in line with the findings of Dicheva et al. (2015) which states that the application of gamification elements such as points, badges, leaderboards, and challenges in a learning environment can increase students' intrinsic and extrinsic motivation.

In evolution learning, Pramana et al. (2021) found that the use of gamification based learning applications can improve the understanding of the concept of evolution in high school students. The application integrates interactive simulations, narratives, and challenges that allow students to see the process of evolution visually and engage in virtual experiments. The results showed a significant increase in learning interest and understanding of the concept of evolution compared to conventional learning methods. Furthermore, a study conducted by Su et al. (2015) showed that gamification based mobile learning can improve students' motivation and learning outcomes in science. Their research developed a game-based learning system that allows students to explore science concepts, including evolution, through missions and challenges. The results showed a significant increase in students' interest, motivation, and learning outcomes.

Research Huang et al. (2013) shows that gamification has significant potential in increasing students' interest in learning. Through the implementation of elements such as points, badges, leaderboards, and tiered challenges, digital learning media can create a more motivating learning environment. Lee et al. (2016) emphasized that this approach not only makes learning fun, but also encourages active participation and cognitive engagement of students. Research by Syahri et al. (2024) in Indonesia shows that the use of gamification based digital learning media on evolution material has a positive impact on high school students' interest in learning. They developed an application that combines narrative elements, simulations, and interactive quizzes to help students understand the concepts of natural selection and adaptation. The results of the study showed an increase in learning interest of 37.8% compared to conventional learning.

Although many studies have explored the effectiveness of digital learning media and gamification separately, there remains a gap in research that specifically investigates the integration of gamification-

based digital learning media to enhance learning interest and engagement. Existing studies generally examine both approaches separately, without exploring the potential synergy of combining them. This study aims to analyze the effect of gamification based digital learning media on interest in learning evolution in increasing students' learning motivation

## Method

This study uses a quasi-experimental quantitative approach with a nonequivalent control group design. This method was chosen to analyze the effect of gamification based digital learning media on students' interest in learning evolution systematically and measurably (Alsawaier, 2018).

This study consists of three types of variables, including: The independent variable is gamification based digital learning media, which is the main treatment in the study. The dependent variable is the interest in learning evolution, which is the aspect whose changes will be measured. Furthermore, the control variables are in the form of student characteristics and class level, which are used to minimize the influence of external factors. The study population includes all students students in class XI SMA Muhammadiyah 01 Surakarta who are studying evolution material. Sample selection was carried out through a purposive sampling technique with specific criteria: students in class XI IPA, have access to digital technology, and are willing to take part in a series of research activities.

This study uses the Slovin formula with a confidence level of 95%, this study involved 120 students who were divided into two groups. The experimental group, consisting of 60 students, will receive treatment using gamification based digital learning media. Meanwhile, the control group, which also consists of 60 students, will follow conventional learning methods.

The learning media was developed using the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model, a systematic approach to designing instructional media. The development process begins with the stage of analyzing learning needs, student characteristics, and mapping competencies in evolutionary material. At the design stage, the research team designed the content structure, developed game mechanisms, and designed the digital interface. The gamification elements integrated include a point system, achievement badges, progressive levels, and leaderboards to increase student motivation and engagement. The development stage includes validation from media experts, prototype trials, and improvements and refinements of the media based on the input received.

The research instrument was designed comprehensively. The learning interest instrument uses a Likert scale developed based on four main indicators: attention, relevance, self-confidence, and satisfaction. In addition, media validation instruments are also provided, including validation sheets from media experts and biology material experts, as well as student response questionnaires. Data collection techniques include observation, tests, questionnaires, and documentation. This allows researchers to obtain comprehensive data from various perspectives. The data analysis process begins with prerequisite tests, namely the normality test using the Shapiro-Wilk method and the homogeneity test with Levene's Test. Furthermore, hypothesis testing was conducted using Independent T-Test, MANOVA Test, and effect size analysis to determine the significance and magnitude of the influence of gamification media on learning interest.

The research was conducted for four months, from october 2024 to January 2025. The research procedure was divided into three main stages: preparation (preliminary study, licensing, instrument preparation), implementation (pretest, treatment, posttest, data collection), and final stage (data analysis, interpretation of results, drawing conclusions).

## Result and Discussion

The study was conducted in several SMA Muhammadiyah 01 Surakarta in the odd semester of the 2024/2025 academic year, involving 120 grade XI science students divided into experimental and control groups. The study aims to analyze the effect of gamification based digital learning media on interest in learning evolution.

**Table 1.** Descriptive Statistics of Student Learning Interest

| Group | Pretest | | Posttest | | Improvement |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| Experimental | 65.42 | 4.97 | 85.13 | 3.76 | 30.12% |
| Control | 64.89 | 5.12 | 71.45 | 4.89 | 10.11% |

Source: Author's data processing, 2025

Based on Table 1, it can be seen that both groups have relatively equal pretest scores, with the experimental group obtaining an average of 65.42 (SD=4.97) and the control group 64.89 (SD=5.12). After the implementation of the treatment, the experimental group showed a significant increase with a posttest average reaching 85.13 (SD=3.76), while the control group only reached 71.45 (SD=4.89). The experimental group experienced an increase in learning interest of 30.12%, which was much higher than the control group, which only experienced an increase of 10.11%. These

results indicate that the treatment given to the experimental group proved to be more effective in increasing students' learning interest compared to the conventional method applied to the control group.

**Table 2**. Distribution of Learning Interest Scores Based on Indicators

| Indicators | Experimental Group | | Control Group | |
|---|---|---|---|---|
| | Pretest | Posttest | Pretest | Posttest |
| Attention | 62.35 | 84.67 | 61.89 | 70.45 |
| Relevance | 64.56 | 86.22 | 63.97 | 71.33 |
| Confidence | 66.78 | 85.44 | 65.92 | 72.56 |
| Satisfaction | 67.23 | 84.89 | 66.45 | 71.89 |

Source: Author's data processing, 2025

The normality test is used to check whether the data from the experimental group and the control group are normally distributed. Based on the results of the normality test, the p-value for the experimental group is 0.062 and the p-value for the control group is 0.078. Both p-values are greater than 0.05, indicating that the data from both groups are normally distributed.

The homogeneity test is used to check whether the variance between the experimental and control groups is the same. The Levene test results show a significance value of 0.146, which is greater than 0.05. This means that the variance between the experimental and control groups is homogeneous or the same.

**Table 3.** Results of the Independent T-Test

| Variables | t-count | df | Sig. (2-tailed) | Mean Difference |
|---|---|---|---|---|
| Interest In Learning | 8.762 | 118 | 0.000 | 13.68 |

Source: Author's data processing, 2025

**Table 4.** MANOVA Test Results

| Effect | F Value | Sig. |
|---|---|---|
| Pillai's Trace | 7.456 | 0.000 |
| Wilks' Lambda | 0.342 | 0.000 |

Source: Author's data processing, 2025

This analysis uses two measures to measure the magnitude of the effect that occurs. First, Cohen's d shows the statistical magnitude of the effect. The Cohen's d value obtained is 1.58, which is included in the large effect category. This means that the difference between the groups being compared is quite significant, and the results show a fairly large change. Second, we look at the percentage of increase, which shows how much change has occurred in relative terms. In this case, the percentage increase is 30.12%, which shows that there has been a fairly large increase in what is being measured.

The results of the study showed a significant increase in learning interest in the experimental group compared to the control group. After being given certain treatments, the experimental group showed a much higher average posttest score, which was 85.13, while the control group only reached 71.45. This indicates that the treatment given to the experimental group succeeded in significantly increasing their learning interest.

All indicators used to measure learning interest, such as attention, relevance, self-confidence, and satisfaction, also showed a higher increase in the experimental group. This increase indicates that the treatment received by the experimental group not only influenced one aspect of learning interest, but had a positive impact overall on the various factors that shape students' learning interest.

Statistical tests were conducted to ensure the validity of the results that showed highly significant results. The t-test showed a significance value of 0.000 ($p < 0.05$), which means that the differences found between the experimental and control groups did not occur by chance. In addition, the MANOVA test also confirmed that there were significant differences between the two groups, strengthening this finding. In terms of effect, the analysis using Cohen's d showed a value of 1.58, which indicated a large effect. This means that the difference between the experimental and control groups is quite large, providing an illustration that the treatment given has a very strong impact on increasing learning interest in the experimental group.

The results of the study revealed significant findings related to the effectiveness of gamification based digital learning media in increasing interest in learning evolution. The increase in learning interest scores in the experimental group reached 30.12%, which was much higher than the control group which only experienced an increase of 10.11%. This shows that the gamification approach has great potential in transforming students' learning experiences, especially in complex and abstract materials such as evolution.

An in-depth analysis of four indicators of learning interest (attention, relevance, confidence, and satisfaction) revealed a consistent increase. The attention indicator showed the most significant increase, from 62.35 to 84.67 in the experimental group. This indicates that gamification media has succeeded in creating a more interesting learning experience and is able to divert students' attention from conventional methods that tend to be boring.

Statistically, this study proves the significance of the influence of gamification media through several tests. The independent t-test produced a significance value of 0.000 ($p < 0.05$), while the effect size analysis with Cohen's d reached 1.58, which categorizes the influence of the media as a large effect. Further MANOVA test confirmed significant differences between the experimental and control groups.

The theoretical implications of this study are very meaningful for the development of biology learning methods. First, the study proves that digital technology and gamification mechanisms can effectively overcome learning challenges in abstract materials such as evolution. This approach not only makes the learning process fun but also increases students' cognitive engagement.

Practically, the findings of the study open up opportunities for educators to redesign teaching strategies. Gamification media has been shown to be able to increase students' intrinsic motivation, encourage independent exploration, and create an interactive learning environment. This is especially important for evolution materials that require deep understanding and critical thinking skills.

This study builds on and strengthens previous research findings in the field of educational technology and biology learning. Deterding et al. (2011) have laid a conceptual foundation for game design elements in an educational context, which is directly relevant to the gamification approach used in this study. Their theory of transforming game elements into meaningful learning experiences is the main foundation in designing digital learning media.

This research does not merely repeat previous findings, but rather provides a substantive contribution in building a bridge between gamification theory, educational technology, and biology learning practices. Integrating approaches from various previous studies allows us to produce more comprehensive and effective learning media in increasing students' interest and understanding of the concept of evolution.

## Conclusion

Based on research findings, Gamification based digital learning media has proven to be effective in significantly increasing students' interest in learning about evolution. There are a number of recommendations for further research that can be developed to expand and deepen understanding of the use of gamification media in biology learning. Developing gamification media for other biological materials is a strategic step that needs to be taken immediately. Complex subjects such as genetics, reproductive systems could become the focus of future research, highlighting the great potential of gamification approaches in explaining abstract and complex concepts.

**Acknowledgments**

The authors would like to express their deepest gratitude to the research team, whose contributions and dedication were invaluable and played a significant role in the success of this research. We would also like to express our appreciation to the Head of Biology Education Study Program and the Head of Biology Education Laboratory who have helped in completing this article. Furthermore, we would like to thank all individuals and parties, both directly and indirectly involved, for their support, encouragement, and assistance during this research.

**Author Contributions**

R: writing original draft preparation, Conceptualization and methodology, validation and revision; P: writing review and editing, formal analysis, validation, and resources. L: project administration, funding acquisition, visualization and revision. All authors have read and agreed to the published version of the manuscript.

**Funding**

This article is the output of Individual Research of Lecturers (PID) of Universitas Muhammadiyah Surakarta which discusses "Analysis of the Influence of Gamification Based Digital Learning Media on Students' Learning Interests Evolution".

**Conflicts of Interest**

The authors declare no conflict of interest.

## References

Adkins-Jablonsky, S. J., Shaffer, J. F., Morris, J. J., England, B., & Raut, S. (2021). A Tale of Two Institutions: Analyzing the Impact of Gamified Student Response Systems on Student Anxiety in Two Different Introductory Biology Courses. *CBE—Life Sciences Education*, *20*(2), ar19. https://doi.org/10.1187/cbe.20-08-0187

Alsawaier, R. S. (2018). The effect of gamification on motivation and engagement. *The International Journal of Information and Learning Technology*, *35*(1), 56–79. https://doi.org/10.1108/IJILT-02-2017-0009

Denden, M., Tlili, A., Chen, N.-S., Abed, M., Jemni, M., & Essalmi, F. (2024). The role of learners' characteristics in educational gamification systems: A systematic meta-review of the literature. *Interactive Learning Environments*, *32*(3), 790–812. https://doi.org/10.1080/10494820.2022.2098777

Deterding, S., Sicart, M., Nacke, L., O'Hara, K., & Dixon, D. (2011). Gamification. Using game-design elements in non-gaming contexts. *CHI '11 Extended Abstracts on Human Factors in Computing Systems*, 2425–2428. https://doi.org/10.1145/1979742.1979575

Dharmaji, W. M., & Astuti, R. (2023). Improvement of student achievement through problem based differentiated learning. *Jurnal IPA & Pembelajaran*

*IPA*, *7*(3), 279–288. https://doi.org/10.24815/jipi.v7i3.33145

Dichev, C., Dicheva, D., Angelova, G., & Agre, G. (2015). From Gamification to Gameful Design and Gameful Experience in Learning. *Cybernetics and Information Technologies*, *14*(4), 80–100. https://doi.org/10.1515/cait-2014-0007

Dicheva, D., & Dichev, C. (2015). Gamification in education: Where are we in 2015? *E-Learn: World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education*, 1445–1454. Retrieved from https://www.learntechlib.org/p/152186/?nl=1

Huang, W. H.-Y., & Soman, D. (2013). Gamification of education. *Report Series: Behavioural Economics in Action*, *29*(4), 37. Retrieved from https://www.scirp.org/reference/referencespapers?referenceid=2512805

Kalogiannakis, M., Papadakis, S., & Zourmpakis, A.-I. (2021). Gamification in Science Education. A Systematic Review of the Literature. *Education Sciences*, *11*(1), 22. https://doi.org/10.3390/educsci11010022

Le, T. C., & Winkler, D. A. (2016). Discovery and Optimization of Materials Using Evolutionary Approaches. *Chemical Reviews*, *116*(10), 6107–6132. https://doi.org/10.1021/acs.chemrev.5b00691

Lee, E., & Hannafin, M. J. (2016). A design framework for enhancing engagement in student-centered learning: Own it, learn it, and share it. *Educational Technology Research and Development*, *64*(4), 707–734. https://doi.org/10.1007/s11423-015-9422-5

Lee, J. S., & Sylvén, L. K. (2021). The role of Informal Digital Learning of English in Korean and Swedish EFL learners' communication behaviour. *British Journal of Educational Technology*, *52*(3), 1279–1296. https://doi.org/10.1111/bjet.13082

Morris, B. J., Croker, S., Zimmerman, C., Gill, D., & Romig, C. (2013). Gaming science: The "Gamification" of scientific thinking. *Frontiers in Psychology*, *4*. https://doi.org/10.3389/fpsyg.2013.00607

Moseikina, M., Toktamysov, S., & Danshina, S. (2022). Modern Technologies and Gamification in Historical Education. *Simulation & Gaming*, *53*(2), 135–156. https://doi.org/10.1177/10468781221075965

Nehm, R. H., & Reilly, L. (2007). Biology majors' knowledge and misconceptions of natural selection. *BioScience*, *57*(3), 263–272. https://doi.org/10.1641/B570311

Nicholson, S. (2015). A RECIPE for Meaningful Gamification. In *Gamification in Education and Business* (pp. 1–20). Springer International Publishing. https://doi.org/10.1007/978-3-319-10208-5_1

Opfer, J. E., Nehm, R. H., & Ha, M. (2012). Cognitive foundations for science assessment design: Knowing what students know about evolution. *Journal of Research in Science Teaching*, *49*(6), 744–777. https://doi.org/10.1002/tea.21028

Owens, D. C. (2019). Overcoming Motivational Barriers to Understanding and Accepting Evolution Through Gameful Learning. In *Evolution Education Re-considered* (pp. 167–184). Springer International Publishing. https://doi.org/10.1007/978-3-030-14698-6_10

Polo-Peña, A. I., Frías-Jamilena, D. M., & Fernández-Ruano, M. L. (2021). Influence of gamification on perceived self-efficacy: Gender and age moderator effect. *International Journal of Sports Marketing and Sponsorship*, *22*(3), 453–476. https://doi.org/10.1108/IJSMS-02-2020-0020

Pramana, C., Susanti, R., Violinda, Q., Yoteni, F., Rusdiana, E., Prihanto, Y. J. N., Purwoko, R. Y., Rahmah, N., Yendri, O., & Arkiang, F. (2021). Virtual learning during the COVID-19 pandemic, a disruptive technology in higher education in Indonesia. *Virtual Learning During The COVID-19 Pandemic, A Disruptive Technology In Higher Education In Indonesia*. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3777691

Ramesh, A., & Sadashiv, G. (2019). Essentials of Gamification in Education: A Game-Based Learning. In A. Chakrabarti (Ed.), *Research into Design for a Connected World* (Vol. 135, pp. 975–988). Springer Singapore. https://doi.org/10.1007/978-981-13-5977-4_81

Rivera, E. S., & Garden, C. L. P. (2021). Gamification for student engagement: A framework. *Journal of Further and Higher Education*, *45*(7), 999–1012. https://doi.org/10.1080/0309877X.2021.1875201

Sickel, A. J., & Friedrichsen, P. (2013). Examining the evolution education literature with a focus on teachers: Major findings, goals for teacher preparation, and directions for future research. *Evolution: Education and Outreach*, *6*(1), 23. https://doi.org/10.1186/1936-6434-6-23

Signori, G. G., Guimaraes, J. C. F. D., Severo, E. A., & Rotta, C. (2018). Gamification as an innovative method in the processes of learning in higher education institutions. *International Journal of Innovation and Learning*, *24*(2), 115. https://doi.org/10.1504/IJIL.2018.094066

Sinatra, G. M., Brem, S. K., & Evans, E. M. (2008). Changing Minds? Implications of Conceptual Change for Teaching and Learning about Biological Evolution. *Evolution: Education and*

*Outreach*, *1*(2), 189–195. https://doi.org/10.1007/s12052-008-0037-8

Su, C., & Cheng, C. (2015). A mobile gamification learning system for improving the learning motivation and achievements. *Journal of Computer Assisted Learning*, *31*(3), 268–286. https://doi.org/10.1111/jcal.12088

Syahri, E. P. M., Smaragdina, A. A., & Widyaningtyas, T. (2024). Development of Gamification-Based Web Programming Educational Website with Peer Review to Increase Student Learning Motivation. *2024 IEEE 2nd International Conference on Electrical Engineering, Computer and Information Technology (ICEECIT)*, 378–383. https://doi.org/10.1109/ICEECIT63698.2024.10859724