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The implementation of gamification with video media variations to improve students' concept mastery in science learning

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ABSTRACT

This study examines the effectiveness of ICT-based gamification combined with different video presentation types in improving students' concept mastery of earthquakes and disaster mitigation. A quasi-experimental design was employed involving 50 eighth-grade students from a junior high school in West Halmahera Regency, North Maluku, who were divided into three groups: gamification with dialogue video, gamification with monologue video, and conventional learning. Students' concept mastery was measured using a validated 25-item multiple-choice test administered before and after instruction. Data were analyzed using normalized gain scores and inferential statistics. The results indicate that students who learned through gamification supported by video media showed significantly higher concept mastery compared to those in conventional learning. Although the dialogue video group demonstrated higher gains than the monologue video group, the difference was not statistically significant. These findings suggest that gamification supported by video media is an effective instructional strategy, while highlighting the importance of interactivity in video design to support meaningful concept learning in science education.



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Introduction

Gamification is an approach that applies game design elements in non-game contexts to enhance user engagement, motivation, and [experience](#) (Deterding et al., 2011; Deterding, 2012; Mulyana et al., 2015). Rather than creating a complete game, gamification integrates selected game elements such as points, levels, challenges, feedback, and reward systems into goal-oriented activities. [Huotari and](#)

Hamari (2012) describe gamification as a process designed to improve user performance by providing experiences similar to play, while Kapp et al. (2014) emphasize its role in engaging individuals, motivating action, supporting learning, and facilitating problem solving. In contrast to serious games and playful design, gamification maintains a rule-based structure and clear instructional objectives, making it particularly suitable for formal learning environments.

Due to its motivational and psychological foundations, gamification has been widely adopted in various sectors, including transportation, healthcare, business, disaster risk management, and parenting (Olszewski et al., 2018; Pinto et al., 2018; Parapanos & Michopoulou, 2019; Frisiello et al., 2017; Love et al., 2016). However, among these domains, education represents the context in which gamification has been most intensively explored, given its potential to support student-centered learning and active engagement (Göksün & Gürsoy, 2019). In educational settings, gamification has been implemented in face-to-face learning to increase student participation through points, competition, and immediate feedback (Burkey et al., 2013; Iosup & Epema, 2014), in e-learning to address low motivation and completion rates (Hamzah et al., 2015; Gañán et al., 2017; Bernik et al., 2018; Hassan et al., 2019), and in blended learning to enhance learning effectiveness through integrated instructional experiences (Lam et al., 2018; Mese & Dursun, 2019; Poondej & Lerdpornkulrat, 2016; Saprudin et al., 2020). Gamification has also been increasingly applied in MOOCs to reduce dropout rates and improve learner retention through achievement systems and continuous feedback (Bakar et al., 2018; Chang & Wei, 2016; Ortega-Arranz et al., 2019; Vaibhav & Gupta, 2014; Zhu et al., 2017).

Previous studies consistently report that gamification positively influences students' motivation, engagement, and learning outcomes. The use of rewards, challenges, and measurable achievements has been shown to enhance learning motivation (Hursen & Bas, 2019; Kyewski & Krämer, 2018; Wardani et al., 2019), while increased cognitive, emotional, and behavioral engagement leads students to participate more actively and persistently in learning activities (Barata et al., 2013; Bartel & Hagel, 2014; Chen et al., 2015; Khalil et al., 2017; Kyewski & Krämer, 2018). These affective and behavioral improvements are closely associated with improved learning outcomes, particularly students' mastery of concepts and deeper understanding of subject matter (Ros-Morente et al., 2018; Ocsis et al., 2024).

Concept mastery is a critical component of meaningful learning, as concepts enable individuals to classify, interpret, and organize information systematically. Haladyna (1997) defines a concept as a group of objects or events that share specific defining characteristics, which form the basis for recognition and cognitive categorization. In science education, students' mastery of concepts is essential for understanding natural phenomena, especially those involving abstract processes and complex causal relationships. Without adequate conceptual understanding, students may struggle to transfer knowledge or apply it to real-world situations.

In technology-enhanced learning environments, multimedia elements play a crucial role in supporting concept mastery, particularly for abstract and dynamic phenomena. One of the most widely used multimedia elements is video, which combines moving visuals, audio, and narrative sequences to present information in a concrete and contextual manner (Binanto, 2010; Purba, 2013). Video-based learning has strong pedagogical potential because it can simultaneously engage visual and auditory channels, making complex processes easier to understand. In science learning, especially on topics such as earthquakes and disaster mitigation, video is highly relevant because the phenomena are dynamic, large-scale, and difficult or dangerous to observe directly. Video allows students to visualize earthquake processes, impacts, and mitigation strategies in a safe and meaningful way.

When video media are integrated into ICT-based gamification environments, learning experiences can become more interactive and engaging. However, existing research on gamification in education has largely focused on its general effects on motivation, engagement, and achievement, while studies examining the comparative influence of different multimedia presentation types within gamified learning environments remain limited. In particular, little attention has been given to how variations in video presentation, such as dialogue-based versus monologue-based videos, influence students' concept mastery. Dialogue videos, which involve interactions between characters, may offer higher levels of interactivity and contextualization, whereas monologue videos tend to be more informational

and one-directional. Despite their potential pedagogical implications, these differences have rarely been examined empirically within gamification-based learning contexts.

Based on this gap, the present study aims to investigate the impact of implementing ICT-based gamification with different types of video presentations on students' mastery of science concepts, specifically on the topic of earthquakes and disaster mitigation. This research is expected to contribute theoretically by enriching the literature on multimedia-supported gamification in science education, and practically by providing guidance for educators in designing more effective, interactive, and contextually relevant technology-based learning environments.

Accordingly, this study is designed to compare the effectiveness of gamification-based learning assisted by different video presentation types in improving students' concept mastery. The study focuses on three instructional conditions: gamification with dialogue videos, gamification with monologue videos, and conventional learning. By positioning video presentation type as a key variable within an ICT-based gamification framework, this research seeks to clarify how interactivity and narrative structure in multimedia influence conceptual understanding. The findings are expected to provide empirical evidence on the role of video interactivity in gamified science learning, while also offering practical insights for teachers in selecting and designing instructional media that better support students' understanding of complex and abstract science concepts, particularly in disaster-related topics.

Method

This experimental research involved 50 eighth-grade students at a junior high school in West Halmahera Regency, North Maluku, who were divided into three groups: the experimental group, control group A, and control group B (Saprudin et al., 2025; Sung & Hwang, 2013). The experimental group was a group of students who participated in learning by implementing gamification assisted by video dialogues. Control group A was a group of students who participated in learning by implementing gamification assisted by video monologues. While control group B was a group of students who participated in conventional learning.

Table 1. Research design

Group	Pre-test	Treatment	Post-test
Experimental Group	0_1	Application of Gamification + Dialogue video	0_2
Control Group A	0_3	Application of Gamification + Monologue video	0_4
Control Group B	0_5	Conventional learning	0_6

Data on student concept mastery was collected through a test technique with 25 multiple-choice questions. Prior to use, the instrument was validated to ensure its validity. Data analysis was performed using normalized gain scores and inferential statistics (Hake, 1998; Liu & Wang, 2021).

Results and Discussions

Overview of Gamification Implementation with Various Types of Presentation Videos

In this research, learning materials were presented in the form of video presentations packaged as video dialogues and video monologues designed using the Canva application. The gamification application used was a wordwall application with open-the-box, quiz, and spin-the-wheel template types. All media elements were integrated through the s.id platform in the form of a microsite. Figure 1(a) shows the appearance of the gamification microsite assisted by video dialogues, while Figure 1(b) shows the appearance of the gamification microsite assisted by video monologues.

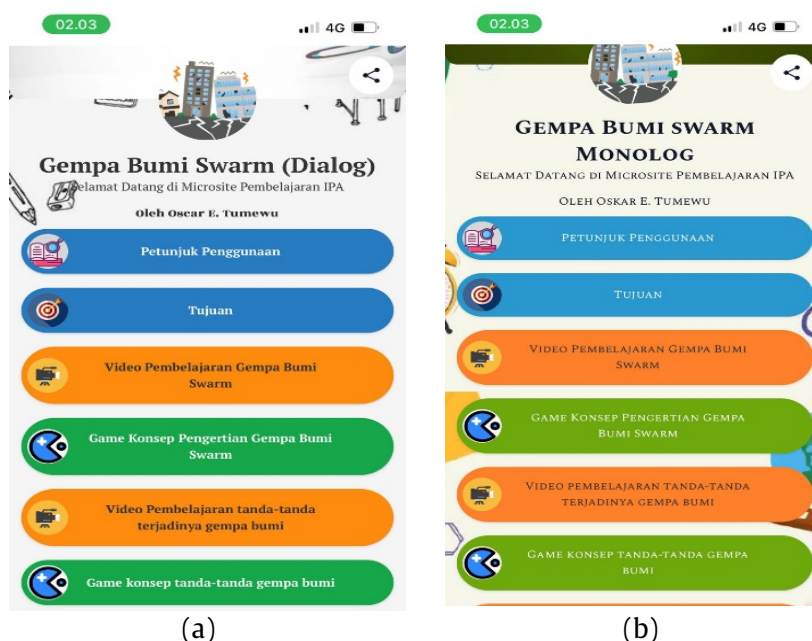


Figure 1. Display of the gamification microsite assisted by video dialogue and monologue

Description of Improving Students' Concept Mastery

The improvement in students' concept mastery across the three research groups is shown in Figure 1, which visually illustrates the comparison of pretest and posttest scores for each group. The graph shows that the average pretest scores across the three groups were within a relatively similar range and showed no significant differences. This indicates that students' initial abilities before being given the learning treatment were at a comparable level, thus it can be assumed that all research subjects began the research with a relatively equal baseline of understanding. Therefore, differences in learning outcomes that emerged at the end of the research can be more confidently attributed to the differences in the learning treatment, rather than differences in students' initial abilities. This equivalence of initial abilities also confirms that the grouping process for the research subjects was carried out proportionally and objectively, thus supporting the internal validity of the research results.

After being given the learning treatment according to each group's design, the average posttest scores across all groups showed a significant increase compared to the pretest scores. This finding indicates that each form of learning treatment, whether implementing a gamification approach or conventional learning, can essentially contribute positively to improving students' concept mastery. However, the magnitude of the increase was not uniform across all groups. The experimental group showed the highest increase in posttest scores compared to the other two groups, indicating that the implementation of gamification combined with video dialogues had a more optimal impact on students' concept mastery. This is likely because video dialogues provide more contextual interactions and a more lively flow of material delivery, thus facilitating students' deeper understanding of concepts.

Meanwhile, control group A, which implemented gamification with the aid of video monologues, also showed a significant increase in concept mastery, although this increase was still lower than that of the experimental group. This finding indicates that the use of gamification, even supported only by video monologues, still provides benefits in increasing student engagement and understanding. On the other hand, control group B, which implemented conventional learning, showed the lowest increase in posttest scores compared to the experimental group and control group A. This indicates that conventional learning tends to be less able to maximize active student engagement and is less effective in helping students develop deep conceptual understanding.

Overall, the differences in the level of improvement in students' concept mastery across the three groups indicate that the implementation of gamification with video media, whether in the form of video monologues or video dialogues, has proven more effective in improving students' concept

mastery than conventional learning. The integration of game elements with video media support can create a more engaging, interactive, and meaningful learning experience, encouraging students to actively engage in the learning process. This engagement ultimately makes it easier for students to understand and construct the concepts they are learning more comprehensively. The findings of this research further strengthen the role of gamification and multimedia as potential learning approaches to improve the quality of learning, particularly in materials that require in-depth conceptual understanding and higher-order thinking skills.

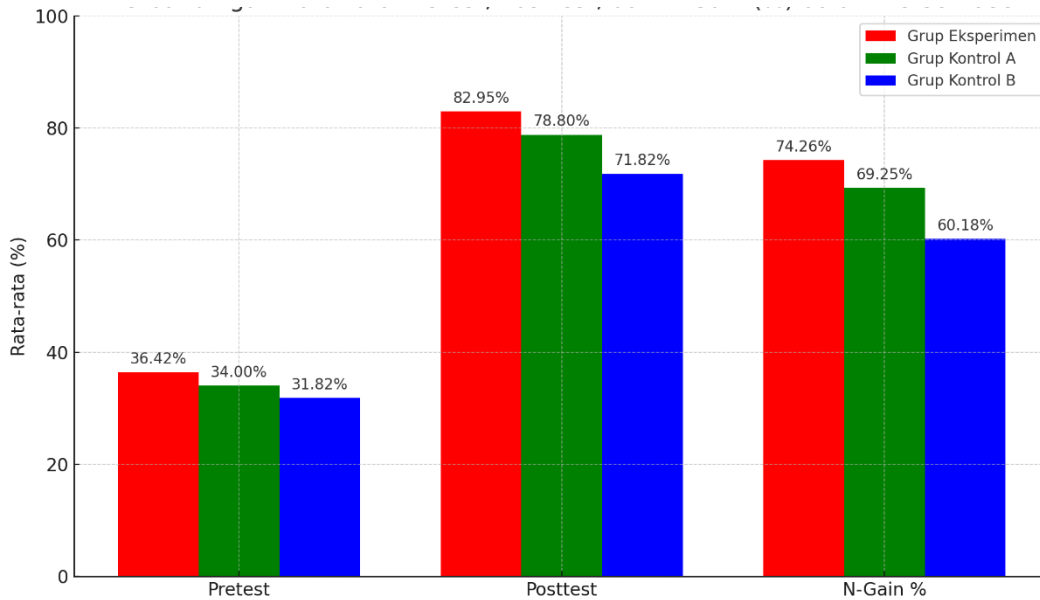


Figure 2. Improvement in Students' Concept Mastery

The results of statistical tests related to the differences in the increase in students' concept mastery in the three groups are shown in Table 2. This analysis was conducted to determine the extent to which the learning treatment applied to each group influenced the increase in students' concept mastery. Table 2 shows the average values of the increase in concept mastery in each group along with the supporting statistical parameters, which were used to test the hypothesis about the differences between group.

Table 2. Statistical Analysis of Data on Improvement of Students' Concept Mastery

Description	Group		
	Experiment	Control A	Control B
Average N-gain	0.743	0.693	0.602
Shapiro-Wilk Test (<i>Sig.</i>)	0.085	0.914	0.051
Homogeneity Test (<i>Sig.</i>)		0.110	
One-Way ANOVA (<i>Sig.</i>)		0.037	
Post-Hoc test (<i>Sig.</i>)	• Experiment – Control A	0.506	
(Tukey HSD)	• Experiment – Control B	0.028	
	• Control A – Control B	0.204	

Table 2 shows that the data on students' concept mastery improvement in the three research groups met the statistical assumptions, namely normal distribution and homogeneous variance. The fulfillment of these two assumptions indicates that the data are suitable for analysis using parametric statistical tests. The results of the One-Way ANOVA test indicate that there are statistically significant differences between the three groups in terms of improving students' concept mastery. This finding suggests that the learning treatment given to each group has a different impact on student learning outcomes, particularly in the aspect of concept mastery.

Based on the results of further tests using Tukey HSD, it was obtained that a significant difference occurred between the experimental group and the control group B. This indicates that the learning treatment in the experimental group was more effective in improving students' concept mastery

compared to the treatment given to the control group B. However, the results of further tests also showed that there was no significant difference between the experimental group and the control group A. Similarly, no significant difference was found between the control group A and the control group B. Although statistically the difference was not significant, the results of descriptive analysis through the N-gain score showed a tendency that the increase in students' concept mastery in the group that participated in learning with the application of gamification assisted by video dialogue was higher than that of students who participated in learning with gamification assisted by video monologue.

The findings of this study indicate that the implementation of gamification-based learning strategies combined with video presentation media contributes positively to improving students' concept mastery of earthquake phenomena and disaster mitigation. This improvement is reflected in the higher post-test scores of students who participated in gamified learning compared to those who experienced conventional instruction. These results suggest that integrating game elements into learning activities can support more active cognitive engagement, which is essential for understanding abstract and complex science concepts. Rather than functioning merely as motivational add-ons, gamification elements appear to structure learning experiences in ways that encourage sustained attention, goal orientation, and iterative knowledge construction.

The role of video media in this learning design is also central to the observed outcomes. Video enables the simultaneous presentation of visual and auditory information, which supports students in constructing mental representations of dynamic processes such as tectonic movements and earthquake impacts. This multimodal presentation is particularly relevant for science topics that cannot be directly observed in classroom settings due to safety, scale, or temporal constraints. In addition, video allows students to revisit learning content independently, providing opportunities for reinforcement and clarification according to individual learning pace, which may contribute to deeper conceptual understanding and improved learning outcomes (Ibáñez & Delgado-Kloos, 2018).

Beyond general video use, the comparison between dialogue and monologue video formats provides further insight into the importance of interactivity in multimedia-supported gamification. Although the difference in concept mastery between the two video formats was not statistically significant, students exposed to dialogue videos tended to show higher gains. This tendency suggests that interaction between characters, contextual storytelling, and simulated real-life situations embedded in dialogue videos may facilitate better cognitive and emotional engagement. Such engagement allows students to relate scientific concepts to familiar contexts, supporting meaning-making processes rather than rote information reception.

However, the absence of a significant difference between dialogue and monologue videos indicates that interactivity alone may not be sufficient to produce substantially different learning outcomes. Other factors, such as the quality of content explanation, alignment with learning objectives, and students' prior knowledge, may also play a crucial role in determining concept mastery. This finding highlights the need to view video interactivity as one component within a broader instructional system rather than as an isolated determinant of learning effectiveness.

The discussion of motivation in this study should also be interpreted cautiously. While gamification is widely associated with increased motivation through points, challenges, feedback, and reward systems (Surendeleq et al., 2019), motivation was not measured directly in this research. Therefore, claims regarding motivational improvement are based on established theoretical and empirical literature rather than on empirical data collected in this study. Nevertheless, increased engagement observed during gamified learning activities may indicate that motivational mechanisms contributed indirectly to improved conceptual understanding by encouraging students to participate more actively and persistently in learning tasks.

Several limitations of this study should be acknowledged. The sample size was relatively small and limited to a single school context, which may restrict the generalizability of the findings. In addition, the duration of the intervention was limited, making it difficult to assess long-term retention of concepts. The study also focused primarily on cognitive outcomes, without examining affective variables such as motivation or attitudes toward science, which could provide a more comprehensive understanding of the learning process in gamified environments.

Despite these limitations, the findings offer important implications for science education practice. The results emphasize that gamification supported by video media can serve as an effective instructional strategy for teaching complex and abstract topics such as earthquakes and disaster mitigation. Teachers are encouraged to consider not only the inclusion of game elements but also the level of interactivity and narrative structure of video media when designing gamified learning environments. Dialogue-based videos, in particular, may be useful for contextualizing scientific concepts and promoting meaningful engagement, even if their advantages over monologue videos are not always statistically pronounced.

In conclusion, this study underscores the importance of integrating pedagogical, technological, and multimedia considerations in gamification-based learning designs. By carefully selecting video presentation types and aligning them with instructional goals, educators can create learning environments that support deeper conceptual understanding and more meaningful learning experiences (Novitasari et al., 2025). Future research is recommended to explore longer intervention periods, larger and more diverse samples, and the inclusion of motivational and behavioral variables to further clarify the mechanisms through which gamification and multimedia interactivity influence student learning outcomes.

Conclusions

This study concludes that ICT-based gamification supported by video media is effective in improving students' concept mastery of earthquakes and disaster mitigation, with dialogue videos showing greater potential due to their interactive and contextual presentation. The interaction between characters in dialogue videos enhances student engagement and supports deeper conceptual understanding by connecting learning content to real-life contexts. Gamification elements such as challenges, feedback, and rewards also encourage active participation, learning motivation, and learning autonomy. Based on these findings, teachers are encouraged to integrate video-assisted gamification systematically, particularly for abstract and complex materials, while media developers should design interactive and meaningful multimedia content. Future studies are recommended to explore other video formats and examine the impact of gamification on higher-order thinking skills.

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