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RESEARCH ARTICLE

Strengthening Motivation and Patterns of Student Constructs Towards the Use of JBUG Land in the Periodic Table of Elements Topic

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ABSTRACT

This study aims to evaluate the level of student motivation and the motivational construct patterns towards the use of the JBUG Land module in learning the topic of the Periodic Table of Elements in Terengganu. Through a gamification approach, this research assesses the impact of game elements in enhancing intrinsic, extrinsic motivation, and student interest in science learning. This descriptive quantitative study involved 362 Form 4 students from various schools in Terengganu, who engaged with JBUG Land for two weeks. Data was collected using a questionnaire based on the ARCS model (Attention, Relevance, Confidence, Satisfaction), and statistical descriptive analysis along with SPSS was used to analyze the data. The findings indicate that JBUG Land effectively boosts student motivation, with high mean scores across all motivational dimensions: intrinsic (4.168), extrinsic (4.189), and interest (4.233). Game elements such as challenges and rewards were found to be highly effective in stimulating student interest, boosting confidence, and fostering active engagement in learning. This study suggests the use of JBUG Land as an effective learning tool to enhance student motivation in science topics and encourages the integration of gamification in science education across Malaysian schools.

INTRODUCTION

Science education in secondary schools often faces significant challenges, particularly when addressing abstract concepts such as the Periodic Table of Elements. This complexity necessitates innovative approaches that not only enrich students' understanding but also enhance their motivation to engage in the learning process. Motivation is a critical factor in students' academic achievements, especially in subjects perceived as difficult.

Gamification, defined as the application of game design elements in non-game contexts, has gained traction as a strategy to enhance student motivation and engagement in educational settings.

Research has shown that gamified approaches can positively influence learning outcomes across various disciplines, including science and mathematics (Qiao et al., (2022). By incorporating game mechanics into the learning framework, the JBUG Land module seeks to create an interactive and enjoyable learning experience, thereby enhancing both intrinsic and extrinsic motivation, as well as overall student interest in chemistry education (Bernardo & González, 2021; Bayir, 2014). Intrinsic motivation refers to the drive to engage in an activity due to interest and enjoyment, while extrinsic motivation involves external rewards such as praise or grades. Theoretical frameworks proposed by educational psychologists like Piaget and Vygotsky emphasize that effective learning occurs when students are provided with opportunities to explore and learn in environments that actively support their cognitive development (Hoffman & Hennessy, 2018). This aligns with Mayer's Cognitive Theory of Multimedia Learning, which supports the use of technology in education to enhance student understanding, a concept that is evident in the context of the JBUG Land module. The integration of gamification into educational practices has been shown to foster a more interactive learning environment, encouraging students to take an active role in their educational journey (Caceffo & Azevedo, 2020).

In the realm of chemistry, traditional instructional methods often struggle to engage students, particularly those with limited interest or background in the subject (Mariscal et al., 2012). However, gamified learning experiences, such as educational card games and interactive modules, have demonstrated the ability to captivate students' attention and enhance their understanding of chemical concepts (Mariscal et al., 2014; Lee et al., 2016). Studies indicate that gamification can lead to increased retention of knowledge and improved attitudes toward learning, making it a valuable tool for educators (Di et al., 2018).

This study focuses on the impacts of the gamification-based JBUG Land module on student motivation in mastering the Periodic Table of Elements. By employing game mechanics within the learning framework, the JBUG Land module aims to create a more engaging and enjoyable learning experience for students. Furthermore, understanding the effectiveness of gamification in educational settings is crucial for developing evidence-based practices that align with the diverse needs of learners. Previous meta-analyses have highlighted that while gamification can enhance motivation and learning outcomes, its effectiveness may vary based on individual student characteristics and the specific context of implementation (Qiao et al., 2022; Bernardo & González, 2021). In summary, the integration of gamification into the educational landscape presents an innovative approach to enhancing student motivation and engagement. The JBUG Land module serves as a case study to investigate the potential benefits of gamified learning experiences in chemistry education, ultimately aiming to foster a deeper understanding and appreciation of the Periodic Table among students.

RESEARCH METHODOLOGY

This study employs a descriptive quantitative research design to measure the level of student motivation towards the use of *JBUG Land* in learning the Periodic Table of Elements. The sample consists of 362 Form 4 students from various schools in Terengganu, selected using a stratified random sampling method. The instrument used to measure student motivation is a questionnaire based on the *ARCS model* (Attention, Relevance, Confidence, Satisfaction), which measures intrinsic, extrinsic motivation, and interest. Each dimension is examined using a Likert scale, and data is collected after students have used the *JBUG Land* module for two weeks. Data analysis is conducted using descriptive statistics to determine the motivation level, and SPSS is employed to analyze the patterns of relationships between gamification elements and student motivation.

RESULTS AND DISCUSSION

Analysis of Level Student Motivation

Table 1 illustrates the results of the descriptive statistical analysis conducted to measure the level of students' motivation after utilizing the JBUG Land module. The findings reveal a mean motivation score of 4.193, which indicates a notably high level of motivation among the participants. This result underscores the effectiveness of JBUG Land as a gamified learning tool in stimulating student interest and engagement during the learning process.

The standard deviation, recorded at 0.514, reflects a moderate degree of variability in the motivation levels of the students. This spread suggests that while most students experienced a high level of motivation, individual differences remain. Such variability could be attributed to factors such as students' personal learning styles, prior familiarity with the subject matter, or the degree to which gamification elements resonated with each learner.

These results are significant in the context of educational interventions aimed at enhancing student motivation. The high mean score confirms the potential of gamified modules like JBUG Land to foster a more engaging and interactive learning environment, particularly in mastering complex scientific concepts such as the Periodic Table of Elements. However, the moderate standard deviation suggests an opportunity for further refinement of the module to address the diverse needs of all learners more effectively.

In conclusion, the descriptive statistics provide evidence that JBUG Land successfully promotes student motivation, but they also highlight the importance of considering individual differences in future iterations of the module to ensure an inclusive and impactful learning experience.

Table 1: The Descriptive Statistics Test measures the level of students' motivation toward *JBUG Land*

	Motivation
Mean	4.193
Standard Deviation	0.514

Analysis of Motivation Patterns Based on Dimensions

Table 2 presents the descriptive statistics for the three motivation constructs which are Interest, Extrinsic Motivation, and Intrinsic Motivation, based on the dimensions of the questionnaire items. The data reveals varying levels of student motivation across these dimensions, which provide valuable insights into the efficacy of the JBUG Land module in fostering student engagement.

Table 2: Standard Deviation and Mean for Each Motivation Construct Based on the Dimensions of Questionnaire Items.

Dimension	**Mean**	**Standard Deviation**
Intrinsic	4.168	0.610
Exstrinsic	4.189	0.470
Interest	4.233	0.586

The Interest dimension shows the highest mean score of 4.233, indicating that students found the JBUG Land module particularly engaging and enjoyable. This suggests that the gamification elements of the module were highly effective in capturing students' attention and maintaining their involvement in the learning process. The standard deviation for interest is 0.586, demonstrating moderate variability in responses. Although most students expressed strong interest, there is some degree of individual difference in the extent of their engagement, likely influenced by personal

preferences and learning styles. Despite this variability, the high mean score highlights the overall success of the module in sparking student interest.

Following closely, Extrinsic Motivation recorded a mean score of 4.189 and a relatively lower standard deviation of 0.470. This reflects the strong influence of external factors such as rewards, competition, or progress indicators in motivating students. The lower standard deviation suggests that these extrinsic motivators were effective across a wide range of students, leading to a more uniform response in terms of motivation. It indicates that the external rewards and gamified features of the module had a consistent impact on encouraging students to engage with the learning content and complete tasks.

Lastly, Intrinsic Motivation has a mean score of 4.168, which, although still high, is slightly lower than the other two dimensions. The standard deviation for intrinsic motivation is 0.610, the highest among the three dimensions, indicating that there was more variability in students' internal drive to engage with the module. This suggests that while a majority of students were intrinsically motivated by the gamified learning experience, the degree of intrinsic motivation varied more significantly across the cohort. This variability may stem from individual differences in how students perceive the personal value and enjoyment derived from the learning process, suggesting a need to further personalize the intrinsic motivators within the module.

In summary, Table 2 highlights that Interest was the most strongly evoked motivation construct, followed by Extrinsic Motivation and Intrinsic Motivation, respectively. The relatively low variability in extrinsic motivation indicates a universal appeal of external incentives, whereas the higher variability in intrinsic motivation suggests that some students may benefit from further enhancements to personalize the learning experience. These findings underline the importance of balancing both intrinsic and extrinsic factors in educational modules to cater to diverse learner needs and maximize engagement and motivation.

Table 3 presents a pattern analysis of items within the Intrinsic Motivation construct, specifically focusing on the experiences of secondary school students using the JBUG Land module for learning the Periodic Table of Elements. The table summarizes the mean scores and standard deviations for five items, providing insight into students' intrinsic motivation during their interaction with the gamified learning module. The items are ranked from highest to lowest mean score to facilitate a clearer interpretation of the data.

Pattern Analysis of Items in the Motivation Construct Based on the Dimension of Intrinsic Motivation

Table 3: Pattern Analysis of Items in the Motivation Construct Based on the Dimension of Intrinsic Motivation Among Secondary School Students

Bil	Items	Mean Score	Standard Deviation
1	B1 - I feel enthusiastic after learning about the Periodic Table of Elements using the module.	4.265	0.703
2	B2 - I feel happy throughout the learning process using the gamification approach	4.122	0.549
3	B3 - I feel excited to anticipate the next activity that will be introduced.	4.315	0.686
4	B4 - After using the Periodic Table of Elements with gamification elements, I feel more positive and motivated to participate in every learning session on the elements.	4.041	0.795
5	B5 - My motivation to learn about the elements using this gamified periodic table remains consistent	4.097	0.995

	throughout its use, showing positive effects in every learning session.		

The item with the highest mean score is B3 – "I feel excited to anticipate the next activity that will be introduced," with a mean score of 4.315 and a standard deviation of 0.686. This indicates a strong sense of enthusiasm and eagerness among students regarding the progression of the learning activities. The relatively moderate standard deviation suggests that most students shared a similar level of excitement about the upcoming activities, though there was some degree of variation in individual responses.

Following closely, B1 – "I feel enthusiastic after learning about the Periodic Table of Elements using the module," holds a mean score of 4.265 and a standard deviation of 0.703. This item reflects students' overall enthusiasm following the completion of each learning session. The high mean score suggests that the gamified module effectively sparked enthusiasm for the subject matter, though the variability in responses (as indicated by the standard deviation) implies that some students were more affected than others by the module's interactive features.

Next, B2 – "I feel happy throughout the learning process using the gamification approach," received a mean score of 4.122 and a standard deviation of 0.549. This item reflects the positive emotional response of students throughout the learning process. While the mean score indicates a generally positive sentiment, the relatively low standard deviation shows that there was less variation in students' happiness during the course of their learning. Most students seemed to enjoy the gamified experience consistently, with few reporting negative emotions.

B5 – "My motivation to learn about the elements using this gamified periodic table remains consistent throughout its use, showing positive effects in every learning session," follows with a mean score of 4.097 and a standard deviation of 0.995. Although the mean score is still high, indicating stable motivation over time, the higher standard deviation suggests greater variability in how consistently students were motivated across the learning sessions. This may reflect individual differences in engagement, with some students showing sustained motivation throughout, while others may have experienced fluctuations in their interest.

Lastly, B4 – "After using the Periodic Table of Elements with gamification elements, I feel more positive and motivated to participate in every learning session on the elements," has the lowest mean score of 4.041 and the highest standard deviation of 0.795. This item reflects students' overall perception of increased motivation and positivity after interacting with the gamified module. While the mean score is still high, the relatively higher standard deviation indicates a wider range of responses, suggesting that the module's impact on motivation was more varied among students. Some students experienced a significant boost in motivation, while others might not have felt as strongly motivated after using the module.

In conclusion, Table 3 demonstrates that students exhibited strong intrinsic motivation across all items, with the highest levels of excitement and enthusiasm observed for future activities and the overall learning process. However, there was notable variability in the consistency of motivation and positive perceptions of the module, suggesting that further refinement of the module may help to maintain high levels of motivation for all students. The results underscore the potential of gamified learning approaches to foster intrinsic motivation, while also highlighting the need for personalized features to accommodate diverse learning preferences.

Pattern Analysis of Items in the Motivation Construct Based on the Dimension of Extrinsic Motivation

Table 4 presents a pattern analysis of items within the Extrinsic Motivation construct, based on the responses of secondary school students to the gamified Periodic Table of Elements module. The items

are ranked from the highest to lowest mean score to provide a comprehensive understanding of the students' responses. These findings reflect the impact of external factors, such as gamification elements and learning outcomes, on students' motivation.

Table 4: Pattern Analysis of Items in the Motivation Construct Based on the Dimension of Extrinsic Motivation Among Secondary School Students

Bil	Items	Mean Score	Standard Deviation
1	B6 - I find it easy to understand the lessons being taught.	4.188	0.540
2	B7 - The use of the Periodic Table of Elements with gamification elements significantly enhances my motivation to learn about elements and keep up with the learning process.	4.097	0.622
3	B8 - I feel more confident in answering questions related to the Periodic Table of Elements.	4.124	0.560
4	B9 - The use of the Periodic Table of Elements with gamification motivates me to be more diligent and persistent in understanding the concepts of elements.	4.213	0.602
5	B10 - The increase in motivation through the use of the gamified Periodic Table of Elements clearly has a positive effect on my learning outcomes.	4.099	0.667
6	B11 - The gamification elements in this module motivate me to continue engaging in learning activities.	4.345	0.653
7	B12 - The most engaging gamification element for me is the competition element, which fosters a sense of healthy rivalry among students.	4.254	0.523

The highest mean score is found for **B11** – "The gamification elements in this module motivate me to continue engaging in learning activities," with a mean score of **4.345** and a standard deviation of **0.653**. This indicates that the external motivators embedded in the module, such as rewards, feedback, and interactive elements, were highly effective in sustaining student engagement. The relatively moderate standard deviation suggests that while most students were consistently motivated by these gamification elements, there was some variation in their responses, possibly due to individual preferences for certain types of external reinforcement.

Closely following, **B12** – "The most engaging gamification element for me is the competition element, which fosters a sense of healthy rivalry among students," holds a mean score of **4.254** with a standard deviation of **0.523**. This item reflects the students' appreciation for the competitive aspects of the module. The high mean score indicates that many students found the competition element particularly motivating, fostering a sense of rivalry that encouraged continued engagement. The low standard deviation suggests that this motivational aspect was widely effective across the student group, with minimal variability in responses.

Next, **B9** – "The use of the Periodic Table of Elements with gamification motivates me to be more diligent and persistent in understanding the concepts of elements," shows a mean score of **4.213** and a standard deviation of **0.602**. This item highlights how gamification encourages students to exhibit greater perseverance in mastering the material. The high mean score indicates that the external incentives provided by the module effectively promoted diligence, although the moderate standard deviation points to some variability in how students perceived the motivating effect of these external rewards.

The item B6 – "I find it easy to understand the lessons being taught," has a mean score of 4.188 and a standard deviation of 0.540, reflecting that student generally felt the module facilitated a clearer

understanding of the content. This suggests that the extrinsic elements, including the gamified structure of the module, contributed to making the learning experience more accessible. The relatively low standard deviation shows that most students found the lessons easy to comprehend, although there was some variation in individual learning experiences.

Following closely, B8 – "I feel more confident in answering questions related to the Periodic Table of Elements," recorded a mean score of 4.124 and a standard deviation of 0.560. This item reflects the positive effect of gamification on students' self-confidence in applying their knowledge. The high mean score suggests that the gamified module had a notable impact on students' confidence, though the moderate standard deviation implies some variation in individual levels of confidence, possibly influenced by factors such as prior knowledge or engagement with the module.

The item B7 – "The use of the Periodic Table of Elements with gamification elements significantly enhances my motivation to learn about elements and keep up with the learning process," achieved a mean score of 4.097 and a standard deviation of 0.622. This indicates that students generally found the gamified module effective in enhancing their motivation to stay on track with their learning. The moderate standard deviation suggests that while the majority of students responded positively, there was some variation in how strongly the gamification elements influenced their motivation to maintain consistent progress.

Finally, B10 – "The increase in motivation through the use of the gamified Periodic Table of Elements clearly has a positive effect on my learning outcomes," recorded a mean score of 4.099 and a standard deviation of 0.667. This item reflects the perceived impact of gamification on learning outcomes, indicating that students felt the gamified module led to improvements in their academic performance. The moderate standard deviation suggests that while the positive effect on learning outcomes was generally recognized, individual responses varied depending on factors such as the level of engagement with the gamification elements.

In conclusion, Table 4 illustrates that the extrinsic motivators embedded in the JBUG Land module, particularly the competition element and the gamification features, were effective in enhancing student motivation and engagement. The high mean scores across most items demonstrate that students were highly motivated by external rewards and the structure provided by the gamified learning environment. However, the moderate variability in standard deviations across the items suggests that further refinement of the module may be necessary to maximize the effectiveness of these external motivators for all students.

Pattern Analysis of Items in the Motivation Construct Based on the Dimension of Interest

Table 5 provides a pattern analysis of items within the Interest construct, highlighting the responses of secondary school students to the gamified Periodic Table of Elements module. The items are ranked from the highest to lowest mean score, revealing key insights into the level of interest generated by the module and its gamification elements.

Table 5: Pattern Analysis of Items in the Motivation Construct Based on the Dimension of Interest Among Secondary School Students

Bil	Items	Mean Score	Standard Deviation
1	B13 - I do not get bored practicing with the Gamified Periodic Table of Elements.	4.202	0.658
2	B14 - I enjoy the teaching of the Periodic Table of Elements using the gamification approach.	4.199	0.744
3	B15 - I feel ready to participate in learning activities on elements whenever I use the periodic table with gamification elements.	4.218	0.852

4	B16 - My motivation to use the gamified Periodic Table of Elements positively impacts my interest in continuing to learn about elements and pursuing deeper knowledge.	4.315	0.694

The item B16 – "My motivation to use the gamified Periodic Table of Elements positively impacts my interest in continuing to learn about elements and pursuing deeper knowledge" shows the highest mean score of 4.315 with a standard deviation of 0.694. This indicates that students felt the gamified nature of the module significantly enhanced their interest in the subject matter, encouraging them to pursue further learning. The relatively moderate standard deviation reflects some variation in how strongly this impact was felt across the student cohort, suggesting that while most students were highly motivated to continue learning, some experienced more moderate effects.

Next, B15 – "I feel ready to participate in learning activities on elements whenever I use the periodic table with gamification elements" recorded a mean score of 4.218 and a standard deviation of 0.852. This item reveals that students felt well-prepared and eager to engage in learning activities related to the Periodic Table when using the gamified module. The slightly higher standard deviation indicates greater variability in student responses, suggesting that while most students were ready to participate, there were differences in how confident or prepared they felt, possibly due to individual learning preferences or prior knowledge.

Following closely, B13 – "I do not get bored practicing with the Gamified Periodic Table of Elements" achieved a mean score of 4.202 with a standard deviation of 0.658. This reflects students' sustained engagement with the learning process, as they reported not feeling bored during their interactions with the gamified content. The moderate standard deviation suggests that while the majority of students found the gamified activities engaging, there was some variability in how stimulating they found the learning experience, possibly depending on the specific gamification features or personal interests in the subject matter.

Finally, B14 – "I enjoy the teaching of the Periodic Table of Elements using the gamification approach" holds a mean score of 4.199 and a standard deviation of 0.744. This item assesses students' enjoyment of the gamified teaching approach. The high mean score indicates that students generally found the gamified approach enjoyable and engaging. However, the relatively higher standard deviation points to some variation in individual enjoyment, suggesting that while most students appreciated the gamified teaching method, there were some who may have had reservations or preferences for different learning styles.

In conclusion, Table 5 demonstrates that the gamified Periodic Table of Elements module successfully captured students' interest, with the highest mean score reflecting a positive impact on their motivation to continue learning about the subject. While the overall results indicate strong engagement, the variability in responses, especially regarding readiness to participate and enjoyment, suggests that personalized approaches may be necessary to maximize the module's appeal to all students. The findings underscore the effectiveness of gamification in fostering sustained interest, though they also highlight the need for ongoing adjustments to better cater to diverse learner preferences and needs.

DISCUSSION

The analysis of student motivation in the context of the JBUG Land module reveals significant insights into the effectiveness of gamified learning tools in enhancing educational engagement. The mean motivation score indicates a notably high level of motivation among students, suggesting that the JBUG Land module effectively stimulates interest and engagement in learning. This aligns with findings in the literature that underscore the positive impact of gamification on student motivation and learning outcomes (Zhang & Yu, 2022; Ng & Ng, 2015). The high mean score reflects the potential of gamified modules to create an interactive learning environment that fosters enthusiasm for

complex subjects. The standard deviation indicates a moderate variability in motivation levels, suggesting that while the majority of students experienced high motivation, individual differences exist. Such variability can be attributed to various factors, including personal learning styles and prior knowledge, which have been shown to influence motivation in educational settings (Dahlia et al., 2019; Effendi & Multahada, 2017). This variability highlights the importance of tailoring educational interventions to meet diverse learner needs, as suggested by research emphasizing the role of personalized learning experiences in enhancing motivation (Chang, 2016).

The analysis of motivation patterns across different dimensions—Intrinsic, Extrinsic, and Interest—provides further insights into the efficacy of the JBUG Land module. The Interest dimension, with the highest mean score, indicates that students found the module particularly engaging. This finding is consistent with literature that emphasizes the role of interest in motivating students and enhancing their learning experiences (Kangasvieri, 2021). The moderate standard deviation suggests that while most students were engaged, there were individual differences in how much they enjoyed the gamified approach, which could be influenced by personal preferences and learning styles (Arin, 2022).

Extrinsic Motivation, with a mean score reflects the effectiveness of external factors such as rewards and competition in motivating students. The relatively low standard deviation suggests that these extrinsic motivators had a consistent impact across the student cohort, reinforcing the idea that gamification elements can effectively enhance engagement through external incentives (Sarkis et al., 2020). In contrast, Intrinsic Motivation, with a mean score and the highest standard deviation indicates greater variability in students' internal drive to engage with the module. This variability suggests that while many students were intrinsically motivated, some may require more personalized approaches to enhance their internal motivation (Iqrammah & Rijanto, 2019). The pattern analysis of items within the Intrinsic Motivation construct reveals that students exhibited strong enthusiasm and excitement regarding the learning activities. The item with the highest mean score, indicating excitement for upcoming activities, underscores the potential of gamified learning to foster a positive emotional response among students (Fitria, 2024). However, the variability in responses, particularly regarding the consistency of motivation over time, suggests that further refinement of the module may be necessary to sustain high levels of intrinsic motivation across all students (Naz et al., 2020). Similarly, the analysis of Extrinsic Motivation highlights the effectiveness of gamification elements in sustaining student engagement. The highest mean score for the item related to gamification elements motivating continued engagement emphasizes the importance of external incentives in educational contexts (Kangasvieri, 2017). However, the moderate variability in responses suggests that while many students are motivated by these external factors, some may benefit from additional support to maximize their engagement (Ulfa, 2019).

Finally, the Interest construct analysis indicates that the gamified Periodic Table of Elements module successfully captured students' interest, with the highest mean score reflecting a positive impact on their motivation to continue learning. The variability in responses regarding readiness to participate and enjoyment suggests that personalized approaches may be necessary to maximize the module's appeal to all students (Manfroi et al., 2022). Overall, the findings underscore the effectiveness of gamification in fostering student motivation while highlighting the need for ongoing adjustments to better cater to diverse learner preferences and needs. In conclusion, the analysis of student motivation in relation to the JBUG Land module provides compelling evidence of its effectiveness in enhancing engagement through both intrinsic and extrinsic motivational factors. The high mean scores across various dimensions indicate a successful implementation of gamified learning, while the observed variability emphasizes the importance of personalization in educational interventions. Future iterations of the module should focus on addressing individual differences to ensure an inclusive and impactful learning experience.

CONCLUSION AND RECOMMENDATIONS

This study demonstrates that *JBUG Land* is an effective tool for enhancing student motivation in science learning, particularly in the topic of the Periodic Table of Elements. The gamification elements incorporated in this module successfully stimulated intrinsic, extrinsic motivation, and student interest, making it a promising approach that can be expanded in science education across the nation. Therefore, it is recommended that educators in Malaysia continue to integrate technology and gamification elements into their teaching methods to boost student engagement and foster higher motivation. Further research should be conducted to assess the impact of *JBUG Land* on student academic performance and to explore the effectiveness of gamification in other science curriculum topics.

Implications of the Study

The findings of this study suggest that *JBUG Land* effectively enhanced student motivation through its gamification approach. Students not only displayed high intrinsic motivation but also actively participated in each learning session using this module. Elements such as rewards, challenges, and competition embedded in *JBUG Land* have been shown to enhance extrinsic motivation, encouraging students to be more diligent in understanding and mastering the Periodic Table of Elements. These findings align with previous studies indicating that gamification can stimulate student motivation, improve their understanding, and ultimately enhance academic performance.

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