

# Artificial Intelligence-Moderated Gamification Apps: Elevating Gen Z's English Vocabulary Mastery

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## ABSTRACT

Generation Z students are increasingly adopting gamification in language learning, often enhanced by Artificial Intelligence (AI). Gamified language learning applications are touted for their ability to improve vocabulary acquisition effectively. This study aimed to evaluate the efficacy of AI-assisted gamification in vocabulary learning among Generation Z students in Semarang, Indonesia. A descriptive cross-sectional survey design was employed, involving 400 participants. Data were collected via questionnaires and analyzed using Structural Equation Modeling (SEM) to identify the effectiveness of gamified applications and their components in vocabulary acquisition. The findings revealed that gamified vocabulary instruction using AI-assisted applications is highly effective. Specifically, AI applications demonstrated rapid impacts on learning outcomes, while gamified computer software required less sustained effort. However, the synergistic use of both technologies showed no significant additional improvement in learning outcomes. Key gamification elements such as avatars, badges, points, leaderboards, feedback, and storytelling were analyzed. Among these, game components, including avatars and badges, had the strongest influence on vocabulary acquisition. The study underscores the effectiveness of gamified applications in vocabulary learning among Generation Z, with a particular emphasis on the contribution of AI. While both AI and gamification independently enhance learning, their combined use does not yield a noticeable synergistic effect. The prominent role of game components suggests their prioritization in designing gamified educational tools. AI-assisted gamified language learning applications are effective for vocabulary acquisition, with game components playing a pivotal role. Future research should explore the long-term implications of integrating AI and gamification for sustained learning outcomes.

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## 1. INTRODUCTION

Generation Z, encompassing individuals born between 1995 and 2012 (Jayatissa, 2023; Radut, 2021), has grown up immersed in a digitally-driven era. Constant interaction with technology and social media has profoundly influenced their daily lives, including their learning habits, particularly in mastering the English language. As a generation inherently comfortable with digital tools (Palley, 2012), Gen Z frequently engages with diverse languages and informal English vocabulary through digital platforms (Juanda, 2023). While this constant exposure to English fosters communicative competence, it also presents challenges, particularly in acquiring and applying a comprehensive and appropriate vocabulary (Saptiany et al., 2024). These dynamics highlight the need to explore innovative, technology-driven methods for effective vocabulary acquisition among Gen Z learners.

Proficiency in English vocabulary is essential for the future professional endeavours of Generation Z. A high level of English proficiency can empower individuals to engage in international commerce actively (Melati et al., 2023), establish global connections and take advantage of career prospects in a progressively interconnected global job market (Saptiany & Putriningsih, 2023). English, a widely spoken language worldwide, provides access to various opportunities in several industries (Prabowo & Saptiany, 2024). Nevertheless, despite its significance, the enthusiasm and drive of Generation Z to acquire English skills frequently need to be revised. It can be ascribed to various factors, such as ineffective teaching methods and inadequate immersion in the English language in everyday activities (Loreto, 2022).

Students have quite interesting challenges with respect to expanding their vocabulary (Govindasamy et al., 2019). These challenges comprise issues in remembering, absence of context, lack of exposure to appropriate language, and lack of long-term memory retention. Proper vocabulary acquisition strategies are not interesting enough for the students, leading to low motivation and poor learning outcomes (Elmahdi & Hezam, 2020; Mohd Tahir et al., 2020). Generation Z learners are likely to have negative perceptions of traditional methods because they are savvy in technology and prefer to deal with segments that are interactive and audio visual. This is a different approach in addressing language learning problems by combining these challenges with the advantages of gamification and AI. The use of game-like aspects that are familiar to the Gen Z population presents an opportunity to better vocabulary acquisition methods and improve future education by integrating artificial intelligence (AI) in learning and customising the learning process (Betaubun et al., 2023). Nevertheless, the specific elements and considerations of these tools that influence the improvement of vocabulary acquisition among Generation Z learners have not been well explored.

Gamification applications have been developed as an innovative approach to address some of the aforementioned problems in language learning. Introduced in non-game contexts, the gamification is a new way of doing something within a limited time which has also proved to be interesting and interactive in the process of learning (Zimmerling et al., 2019; Schöbel et al., 2020). By combining elements such as points, badges, leader boards, and challenges (Koivisto & Hamari, 2019; Barata et al., 2017), gamification can augment engagement, motivation, and learning experiences (La Cruz et al., 2023; Zainuddin et al., 2020; Miftahuddin & Malihah, 2022). This approach aligns with Gen Z's natural ease with digital technology and their preference for engaging, hands-on learning methods. Concurrently with the increase in gamification, the advancement of Artificial Intelligence (AI) technology has created new opportunities in language acquisition. Gen Z often relies on AI for a range of tasks, such as searching for English translations (Liu & Chen, 2023), because AI produces language output that is more organized and systematic. Integrating AI into gamified learning environments offers a fascinating chance to improve language acquisition efficiency. Although past studies have shown that gamification helps enhance English vocabulary, the utilization of artificial intelligence (AI) in combination with gamification currently needs to be improved. A significant research gap exists in the poorly examined role of AI in mitigating the effects of gamification on language acquisition. The potential of AI to customize learning experiences in gamified settings is yet ambiguous. Artificial intelligence possesses the potential to adapt content to the specific requirements of individual learners, hence enhancing engagement and learning efficacy. However, the extent to which AI inclusion in gamified platforms can improve long-term

language retention and learning results for Generation Z remains unclear. Identifying this issue is essential for creating more efficient and customized teaching resources.

The combination of gamification and AI in educational environments has changed the interaction between educators and learners. The technologies can be leveraged by teachers in an attempt to increase the interactivity and opportunity of custom-tailored learning to different students' needs and pace of studying (Marienko et al., 2020). What is more interesting with such technologies is that Artificial Intelligence also has useful features like automatic feedback provision, tailoring learning process to an individual's needs, and intelligent tutoring systems which can, in turn, make the work of teachers easier while providing extra help to learners.

Nevertheless, it is clear that more studies need to be conducted to clarify the role played by gamification and AI in the vocabulary learning process among English Generation Z. This need arises despite the increasing popularity of gamification and various AI tools used in educational technologies. While previous studies have confirmed the effectiveness of such gamification in improving language skills (Díaz & Zajia, 2020; Thiagarajah et al., 2022; Thurairasu, 2022; Huseinović, 2023; Al-Dosakee & Ozdamli, 2021), little is known regarding the possible muzzling effect of artificial intelligence on the same. This study gap is significant because Gen Z is expected to be more interested in games and AI applications rather than traditional educational methods. As well, there is a need-to-know what elements of gamification are most likely to capture the interests of Generation Z and the role of AI in these elements. There is still a need to develop effective approaches with clearer guidelines on the integration of AI and gamification in the language learning process to seek to meet Gen Z's language learning preferences. This study will eliminate this knowledge gap by investigating the application of AI-enriched gamification techniques in the English vocabulary development of Gen Z. It can be thus stated that it would also help generate useful knowledge to develop more effective and engaging language learning tools targeting this digital generation. Besides, it is necessary to thoroughly understand the effects of these technologies on the language proficiency and memory retention for a longer time. Moreover, there is an essential need for language sensitive designs addressing the cultural differences of the language learners.

The focus of this study is investigating how gamification applications contribute to the improvement of Gen Z's vocabulary in English, emphasizing how the employment of AI modifies this relationship. By examining the relationship between Gamification, Artificial Intelligence and vocabulary acquisition among Gen Z learners. This study aims to shed light on how well these technologies work to improve English language proficiency. The results would provide significant knowledge to the fields of educational technology and language acquisition, thereby impacting the creation of more efficient learning environments catered to the requirements and tastes of Gen Z students. The objective of this study is to investigate the utilization of Gamification in enhancing English vocabulary among Generation Z, using AI as a moderator. The research problems are stated in the following manner:

1. Does the gamification application play a role in improving English vocabulary mastery among Gen Z?
2. Can Artificial Intelligence improve the efficacy of gamification applications in enhancing English vocabulary among Generation Z?
3. What Gamification features are most successful in promoting engagement and motivation among Gen Z learners when acquiring English vocabulary?

## 2. METHODS

This particular work is mainly quantitative in approach and data collection. The ability to quantitatively measure relates to the ability to explore and test objective hypotheses through variables interaction (Creswell, 2023). The quantitative method is suitable for this study as it facilitates the collection and analysis of numerical data to objectively assess the relationship between variables, particularly Gamification, Artificial Intelligence (AI), and English vocabulary acquisition among Generation Z learners. Quantitative research enables the study to test specific hypotheses about how

gamification and AI impact vocabulary acquisition, providing measurable insights into how these variables interact.

The participants of this study would be Gen Z students of English vocabulary through Gamification applications and Artificial Intelligence (AI), in this case in Semarang. This age group is important since it comprises young people who are actively engaged in employment or education. Because they use digital technology a lot, they are a good fit to study the impact of gamified language learning resources. As given on the website of Semarang city Central Bureau of Statistics, approximately 123,356 being aged twenty to twenty-four years which is some population in Semarang, were there in the year Of 2022. These individuals, otherwise known as young adults, are mostly working or studying members of Generation Z. The Sample size for this Study will be 400 persons basing on Slovincs formula on the known existing population to arrive at a scientifically demographic sample size. Such a specified sample size renders one to avoid causing harm to the proper gathering and representation of the same set of people being studied.

The data collection for this research was carried out using an online questionnaire disseminated over several social media platforms such as Instagram, WhatsApp, X, Facebook, and Tiktok Applications. To enrich the data, the researcher also distributed questionnaires to pertinent forums frequented by Generation Z individuals, such as in the coffee shops, cafes and community forums. The survey consisted of closed-ended questions utilizing a Likert scale. The researchers design the questionnaire based on the theory of Technology Acceptance Model (TAM) and Vocabulary Learning. The researcher utilizes the Technology Acceptance Model (TAM) to comprehend Gen Z's experience with Gamification and AI applications, focusing on ease of use, perceived benefits, and usage intention. Simultaneously, to evaluate their opinion of vocabulary proficiency following the utilization of the application, the researcher employs Vocabulary Learning Theories. The questionnaire for this study was also used during the pilot test conducted on students at a private university. Once the respondents finished the questionnaire, the acquired data was evaluated using statistical methods to address the study questions and test the hypotheses.

This quantitative study's data will be examined using Structural Equation Modeling (SEM) through AMOS22 software. Structural Equation Modeling (SEM) is a statistical analytic approach which utilizes factor analysis and path analysis to create a unified model (Jr et al., 2018). This study employs SEM to investigate the interactions of several factors, including gamification and AI, on English vocabulary acquisition in Generation Z learners.

SEM facilitates the measurement of latent variables that are not readily observable. This is accomplished by factor analysis, which breaks down complex ideas into quantifiable elements. Factor Analysis is a statistical technique employed to find underlying or "latent" characteristics that are not readily measurable. Latent variables are deduced from observable data, typically by clustering related survey items or indicators. Factor analysis assists in identifying hidden characteristics, such as involvement, motivation, or proficiency in vocabulary acquisition, derived from participants' responses to the questionnaire. This enables the research to quantify concepts crucial for assessing the efficacy of gamified learning and AI in enhancing vocabulary skills among Generation Z learners. Conversely, Path Analysis emphasizes the interrelationships among these variables. It analyses causal relationships by delineating how one variable affects another. Path analysis may investigate the impact of gamification tactics, such as badges or leader boards, on vocabulary acquisition and the extent to which this relationship is moderated by the utilization of AI, for instance, through individualized feedback. Path analysis enables the visualization of interactions inside a model, depicting both direct and indirect impacts. This elucidates the various aspects that influence learning results. Factor analysis identifies the essential underlying variables, while path analysis delineates the interactions among these variables, which is vital for comprehending the influence of AI in improving gamified learning settings.

This investigation examines the role of AI in moderating the relationship between gamification approaches and vocabulary enhancement. AMOS22 was selected for this investigation because of its simple user interface and sophisticated functionalities for managing large models. The software streamlines the modeling process and provides comprehensive capabilities for testing variable

interactions, making it very suitable for examining the impact of AI on gamified learning settings. The primary objective is to furnish empirical proof on the efficacy of AI-enhanced gamified learning tools in enhancing vocabulary acquisition.

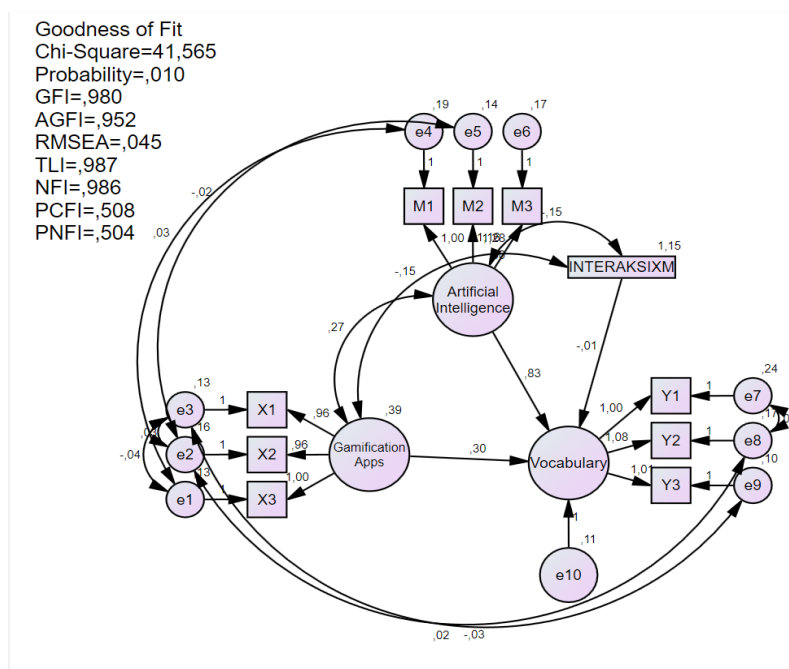
### 3. FINDINGS AND DISCUSSION

The information obtained from the questionnaires has been processed through SEM-AMOS 26.0 software and the results are presented in table 1. Table 1 summarizes the results concerning the hypothesis testing of the structural equation modeling (SEM) study.

**Table 1.** The result of hypotheses testing

			Estimate	S.E.	C.R.	P	Label
Y	<---	X	0.297	0.076	3.913	***	
Y	<---	M	0.828	0.095	8.701	***	
Y	<---	INTERAKSIXM	-0.01	0.021	-0.455	0.649	

The research also provides a graphical representation of the structural model, as shown in Figure 1.



**Figure 1.** Equal Modeling Structure

#### 3.1 Does the gamification application play a role in improving English vocabulary mastery among Gen Z?

The analytical results demonstrate that gamification applications markedly improve vocabulary proficiency among Generation Z learners. Table 1 displays the outcomes of hypothesis testing, validating the links illustrated in the structural model. The initial hypothesis, examining the direct impact of gamification applications on vocabulary acquisition (Y <--- X), demonstrates a strong positive

effect (estimate = 0.297,  $p < 0.001$ ). This suggests that gamification applications significantly enhance vocabulary acquisition in Generation Z.

Figure 1 illustrates the structural model that delineates the interactions among numerous factors, with particular emphasis on the impact of gamification applications on enhancing vocabulary mastery. The latent variable "Gamification Apps" (X) is characterized by three observable variables (X1, X2, X3), which assess various dimensions of gamification utilization in education. This variable directly influences "Vocabulary" (Y), the principal outcome of interest in this study. The model incorporates a mediating variable, "Artificial Intelligence" (M), which affects the association between gamification applications and vocabulary proficiency. Artificial Intelligence is characterized by three observed variables (M1, M2, M3). Furthermore, the interaction term "INTERAKSIXM" exists, which signifies potential external elements or moderating influences within the model. The model's path coefficients indicate a direct favorable impact of gamification applications on vocabulary (coefficient of 0.39).

### 3.2 Can Artificial Intelligence enhance the efficacy of gamification applications in enhancing English vocabulary among Generation Z?

Table 1 demonstrates that Artificial Intelligence (denoted as M) exerts a substantial positive influence on vocabulary mastery (Y). The estimate of 0.828 signifies a substantial correlation, and the associated P-value (\*\*\*) which is highly significant, corroborates the strength of this effect. The Critical Ratio (C.R.) of 8.701 further underscores the importance of this finding. This indicates that AI as an educational instrument is exceptionally proficient in enhancing vocabulary acquisition, perhaps owing to its capacity to deliver individualized, adaptable, and intelligent learning experiences. Consequently, AI serves as a crucial element in assisting Generation Z in enhancing their English vocabulary. Gamification applications (X) also significantly influence vocabulary mastery. However, their effect is less significant than that of AI. The estimate of 0.297, albeit smaller, remains statistically significant (P-value  $< 0.05$ ) with a critical ratio of 3.913. This suggests that gamification is advantageous for vocabulary development, presumably by offering exciting and engaging learning experiences. The interaction term between AI and gamification (INTERAKSIXM) has an estimate of -0.01 and a P-value of 0.649, signifying no statistically significant interaction between these variables. This indicates that the integration of AI with gamification does not yield any supplementary synergistic effect on vocabulary acquisition. Both AI and gamification independently enhance vocabulary; nevertheless, their combined application does not yield further advantages beyond their respective effects.

Figure 2 below elucidates the regression weights for the model. The path from gamification to vocabulary mastery (Estimate 0.297, labeled as par\_7) and the path from AI to vocabulary mastery (Estimate 0.828, labeled as par\_8) align with the results shown in Table 1, visually demonstrating the strength of these relationships. The absence of substantial interaction between AI and gamification (par\_9) is apparent, confirming the prior finding that the combined impact is not markedly greater than their separate influences.

**Regression Weights: (Group number 1 - Default model)**

		Estimate	S.E.	C.R.	P	Label
Vocabulary	<--- Gamification_Apps	,297	,076	3,913	***	par_7
Vocabulary	<--- Artificial_Intelligence	,828	,095	8,701	***	par_8
Vocabulary	<--- INTERAKSIXM	-,010	,021	-,455	,649	par_9
X3	<--- Gamification_Apps	1,000				
X2	<--- Gamification_Apps	,957	,055	17,538	***	par_1
X1	<--- Gamification_Apps	,962	,060	16,146	***	par_2
M1	<--- Artificial_Intelligence	1,000				
M2	<--- Artificial_Intelligence	1,160	,062	18,574	***	par_3
M3	<--- Artificial_Intelligence	1,278	,069	18,597	***	par_4
Y1	<--- Vocabulary	1,000				
Y2	<--- Vocabulary	1,082	,047	23,014	***	par_5
Y3	<--- Vocabulary	1,014	,048	21,170	***	par_6

**Figure 2.** Regression Weights

### 3.3 What Gamification features are most successful in promoting engagement and motivation among Gen Z learners when acquiring English vocabulary?

The estimate for the direct correlation between gamification applications (X) and vocabulary mastery (Y) is 0.297, signifying a moderate positive association. The importance of this path (shown by "\*\*\*") and a Critical Ratio (C.R.) of 3.913 imply that gamification elements significantly contribute to vocabulary mastery. Gamification positively influences vocabulary acquisition, indicating that Generation Z learners thrive in gamified educational settings, which often incorporate components like points, rewards, and progress monitoring.

Figure 2 displays the regression weights that elucidate the impact of gamification features on the model. X1 (Estimate = 0.962, par\_2): This feature is the most significant, suggesting that specific elements of gamification—possibly the competitive features like leader boards or point systems—are highly effective in enhancing engagement and motivation. X2 (Estimate = 0.957, parameter 1): This characteristic significantly influences motivation, possibly embodying another crucial element, such as immediate feedback or accomplishments, which might encourage Gen Z learners to remain engaged in the language acquisition process. X3 (Estimate = 1.000, par\_3): This indicates that specific gamification elements, including the comprehensive framework of the game or application, entirely capture the concept of gamification within the model. This may indicate the use of game-based learning elements such as prizes, levels, and challenges that maintain learner engagement. X3 (Estimate = 1.000, par\_3): This indicates that specific gamification elements, possibly the comprehensive framework of the game or application, entirely define the construct of gamification within the model. This may indicate the use of game-based learning elements such as prizes, levels, and challenges that maintain learner engagement.

Analysis of the data presented in Table 1 and Figure 2 indicates that gamification aspects effectively enhance engagement and motivation in Gen Z learners throughout the acquisition of English vocabulary. The most prominent attributes seem to relate to competitiveness (leader boards, points), rapid feedback (progress tracking, achievements), and the structural design of the gamified system (rewards, levels, challenges). The gamification features are exceptionally efficient in maintaining student motivation, as evidenced by the robust estimates in the model (X1 = 0.962, X2 = 0.957, X3 = 1.000). Although gamification enhances vocabulary acquisition, its primary advantage is in creating an engaging and stimulating atmosphere that facilitates the learning process, though having a less pronounced direct effect on learning outcomes compared to AI. Consequently, competitive elements, instant rewards, and a structured challenge-based environment are the most effective gamification features in enhancing motivation and engagement for vocabulary acquisition among Generation Z learners.

Table 2 displays the Overall Model Fit Test results, offering essential insights into the alignment of the proposed structural model with the observed data.

**Table 2.** Overall Model Fit Test

Testing Fit	Result
CHI	
SQUARE	41.565
Probability	0.01
CMIN/DF	1.807
RMSEA	0.045
GFI	0.98
AGFI	0.952
TLI	0.987
CFI	0.993
PCFI	0.508
PNFI	0.504

The model fit findings reveal that although the Chi-Square test indicates differences between observed and expected values, other fit indices suggest a generally satisfactory fit for the structural model. The RMSEA, GFI, AGFI, TLI, and CFI scores indicate that the model sufficiently captures the data and supports the proposed relationships among variables. The good model fit strengthens the validity of the findings by demonstrating that the structural model employed in the analysis accurately reflects the intrinsic links among gamification, AI, and language proficiency. This validation substantiates the study's conclusions, indicating that the examined correlations are dependable and may be extended to similar situations within the Generation Z learner demographic. The favorable fit indices demonstrate that the proposed model represents the data well, hence reinforcing the results on the influence of gamification and AI on vocabulary acquisition among Generation Z learners.

### **Discussion**

The interpretation of the data shown in the results section will resolve the issues described in the problem statements that were formed in the previous section.

### **The role of gamification applications in enhancing English vocabulary proficiency among Generation Z**

Consequently, the advantages of using gamification apps are clear in terms of the improvement of the English language learning among the targeted population as generation Z. This is exemplified by the regression coefficient of 0.297 between Gamification Apps and Vocabulary, of which the p-value is less than the significance threshold of  $p < 0.001$  (Table 1). Gamification Apps affected Vocabulary by a value of 0.30 per the path diagram (Figure 1). Although the effect of gamification apps on vocabulary may not be as high as that of Artificial Intelligence, there is still an improvement in vocabulary. This result is also appropriate to the study of (Waluyo & Bucol, 2021; Bueno-Alastuey & Nemeth, 2022; Cárdenas-Moncada et al., 2020; Weissheimer et al., 2019; Sirait & Kharisma, 2024; Yu, 2023; Yunus & Hua, 2021) in which the use of gamification on the vocabulary instructional procedures was found to have an improvement in as specific challenges dealing with gaining new words making it worth to include such enhancement in the words learning process. The underlying factor across this research which explains the similarities with this study's findings is the application of gamification to augment motivation, engagement, and learner autonomy. The perception and value of gamification elements could be influenced by cultural factors. Collaborative gamification features may be preferred by learners from collectivist cultures, but leaderboards may be more well-received by learners from competitive cultures. Leveraging Generation Z's enthusiasm for technology, competition, and immediate feedback, gamification converts vocabulary acquisition into an exciting experience.

Furthermore, these studies emphasize the practical uses of gamification in language learning contexts, rendering them especially pertinent to students who thrive in interactive, technology-enhanced settings. This is especially fortuitous for the people who belong to generation Z. They are anticipated to have high-level technological skills and be open to the use of effective digital education strategies (INCİK & INCİK, 2022; Szymkowiak et al., 2021). The high and positive impact of gamification applications in the dimension of vocabulary acquisition among this age cohort is significant. This implies that such apps suit their learning patterns and behaviour well.

### **The utilization of Artificial Intelligence in moderating the efficacy of gamification applications**

As per the existing results, it has not been determined that AI proves to be a factor that influences the effectiveness of gamification applications in the scope of English vocabulary enrichment of Gen Z.

Given its capacity to offer customized feedback, adjust to different learning preferences, and engage deeper cognitive processes, artificial intelligence (AI) may be a more successful method of language acquisition than gamification. By discovering specific areas where students fail, AI provides personalized, real-time feedback, guaranteeing focused and significant adjustments. AI takes into account different learning styles and provides individualized experiences for kinesthetic, visual, and auditory learners, in contrast to gamification's set rewards and visual encouragement. Additionally, AI improves long-term memory by using advanced strategies that go beyond gamification's emphasis on engagement and immediate motivation, such as spaced repetition, error pattern analysis, and semantic context-building. AI enhances learning by attending to individual demands and cognitive obstacles, making it a more powerful tool for vocabulary acquisition than gamification, which is excellent at increasing engagement through competition and prizes.

Artificial intelligence (AI) capabilities like speech recognition, adaptive algorithms, and natural language processing (NLP) can improve student achievement by tailoring and optimizing the educational process. Because adaptive algorithms modify task complexity according to learner performance, learners are continually challenged without feeling overwhelmed which encourages consistent increase in vocabulary. To improve a learner's learning trajectory, the tool might add increasingly complicated words or circumstances if the learner continuously performs well in particular vocabulary areas. Real-time feedback and pronunciation practice are made possible via voice recognition, which helps students improve their spoken language abilities. Gaining proficiency in English pronunciation, which is essential to expanding one's vocabulary, is made possible by this tool. Natural language processing (NLP) also makes it possible for AI to comprehend and process human language, which enables gadgets to provide more authentic, meaningful language use and create context-based exercises. Through the creation of interactive conversations or text-based activities that contextualize vocabulary in real-world situations, natural language processing (NLP) can help learners better comprehend and remember new words. For Generation Z learners, these AI-powered features offer more dynamic, captivating, and customized learning experiences that are especially successful at enhancing language proficiency.

Although educational technology has gained increasing attention, more studies are needed to investigate the combined impact of gamification and artificial intelligence (AI) on vocabulary mastery. Prior research, exemplified by Limonova et al. (2023), predominantly concentrated on examining the effects of these technologies on student engagement and attendance rates. Similar to earlier studies, (Duisenova & Zhorabekova, 2024) refined their strengths with a particular focus on AI and Gamification for determining the motivation and effectiveness of primary level learners of the English language. However, language learners still need to figure out the extent to which these tools enhance their learning, more concretely. Unlike the two previous who had conducted their studies by incorporating AI and Gamification in their research, a study conducted by (Crompton & Burke, 2023) focussed on finding out the role of AI in acquiring language only. The study found that language education was the main area where artificial intelligence could be practised in the sphere of education. The investigation included numerous aspects of language acquisition, such as writing, reading, and vocabulary growth. The research focuses only on the function of AI in language learning, offering a

comprehensive overview of how artificial intelligence technologies are utilized in various language skills. This approach provides vital insights into how AI influences language education, emphasizing its potential to improve many elements of language learning.

The lack of a synergistic effect between AI and gamification in vocabulary retention can be attributed to their distinct roles in the learning process, Generation Z's preference for instant gratification and potential cognitive overload from using both tools simultaneously. Learners, particularly those used to simpler interfaces, may become overwhelmed by the combination of AI's adaptive and personalized feedback systems with gamification's visually rewarding components, including leaderboards and badges. This problem is made worse by Generation Z's desire for instant satisfaction. While gamification offers instant rewards, artificial intelligence (AI) frequently offers longer-term advantages like customized learning experiences, which could not satisfy Gen Z's need for quick, visible improvement. The fundamental roles of AI and gamification are somewhat compatible, however they do not inherently enhance one another. Gamification enhances engagement and immersion (Borrás-Gené et al., 2019), whereas AI prioritizes the optimization of the learning process (Saaida, 2023). When utilized concurrently, they may not have a synergistic effect as each addresses distinct facets of the learning experience. One focuses on engagement while the other on process improvement.

Generation Z's strong preference for fast gratification renders them more receptive to the immediate incentives offered by gamification. Conversely, the advantages of AI, such as adaptive feedback, are more complex and long-term, making them less compatible with Gen Z's demand for quick, observable advancement. Consequently, AI may not provide a clear advantage above the benefits currently afforded by gamification, resulting in no substantial added value when the two are integrated. P. Yu & Wang (2024) added that AI-enhanced gamified education faces challenges. Additionally, the integration of AI with gamification may lead to cognitive overload for learners (Chen & Chang, 2024) due to the simultaneous processing of several stimuli, including gamification's visual rewards and AI's tailored interventions. Generation Z, familiar with technological simplicity, may find it challenging to handle both concurrently. This may lead to diminishing returns, wherein the combination of technologies overwhelms learners and diminishes the efficacy of each, ultimately eliminating any advantages. Several functionalities of gamification apps (Hallifax et al., 2019) might be appreciated by the users because of their engagement and competition provoked by the app and because of the engaging and customized educational content successfully designed with the use of artificial intelligence. Contrary to the assertions of the researchers (Wiethof et al., 2022), gamification can not only be implemented in human-AI collaboration but can also be promoted through AI. They further assert that this is particularly true when we humanize AI to function as a collaborator, as humans regard friendship as an experiential result of gamification

### **The most effective gamification elements**

The path visualization and regression table (figure 2) provide evidence of the efficacy of gamification features, as shown by variables X1, X2, and X3. The game components of X3, such as avatars, badges, and rewards, have the highest loading factor of 1.000. The game mechanics of X2, including feedback, narrative, and progress, have a loading factor of 0.957. The game mechanisms of X1, including points, levels, leaderboards, and challenges, have a loading factor of 0.962. All of these components significantly influence The Gamification Apps construct ( $p < 0.001$ ). The findings indicate that all the gamification features investigated in this study had a great effect on the applications in facilitating English vocabulary learning for Generation Z. It also correlates with the prior studies done by (Abu Qub'a et al., 2024; Dohny & Soekarno, 2024; Ding, 2019) whereby the researchers have proved that every single element in the gamification program encourages and raises enthusiasm and interest in the students making it easier for them to acquire the English vocabulary.

The significant efficacy of game components such as avatars, badges, and awards underscores Generation Z's pronounced inclination towards visual and reward-oriented systems, which correspond with their propensity for quick satisfaction and visual communication (Hernandez-de-Menendez et al.,

2020; Saxena & Mishra, 2021; Caserman et al., 2024; Stylos & Vassiliadis, 2023). Accumulated points or badges can thereafter be utilized to choose a nickname and customize an avatar. Customized avatars ought to motivate the Free Sprint player type, who is drawn to creative endeavors (Marczewski, 2015). Avatars and rewards offer prompt feedback and acknowledgment, aligning with Generation Z's preference for fast, specific results. The finding is significant as it highlights how these particular features fulfill their anticipations for immediate rewards and visual stimuli, enhancing engagement and learning results. By providing immediate reinforcement, these features correspond with Gen Z's frequent engagement with digital technology, where they are accustomed to swift interactions and gratification, hence enhancing their learning experience. Likewise, mechanisms such as point systems, levels, leaderboards, and challenges (X1) substantially influence engagement and motivation. The competitive disposition of Gen Z and their aspiration for quantifiable accomplishments are effectively addressed by these aspects (Tobon et al., 2020). The achievement derived from advancing through levels or ranking on leaderboards fosters a sense of purpose and excitement in the learning experience. The gamification components that resonate best can be influenced by issues of culture. Collaborative tasks may be more effective in collectivist societies, whereas badges and awards may be more appealing in individualistic settings. Cultural aesthetics and values may also need to be reflected in the visual and narrative styles used in gamification.

The cross-sectional data used to support the findings makes it difficult to prove a link between improvement in vocabulary and the use of these appliances. Furthermore, the lack of longitudinal data prevents the study from evaluating the gamification and AI technologies' long-term efficacy or how their effects change over time. Future studies should think about using experimental techniques to separate the impacts of gamification and artificial intelligence, as well as longitudinal designs to monitor variations in learners' vocabulary over lengthy periods of time. Further insights into the long-term effects of these technologies on language learning outcomes and more convincing proof of causality would be offered by such methods.

#### 4. CONCLUSION

This study explored the effects of AI-driven gamification on the development of English vocabulary among Generation Z learners. The findings indicate that while both gamification and AI contribute positively to learning on their own, their integration does not provide any additional advantages. Gamification especially with features such as avatars, badges, and leader boards, captivates Gen Z because of their inclination toward visual stimuli and immediate rewards while AI offers tailored feedback. These tools can be utilized independently, such as gamification to enhance motivation and AI for customized learning, allowing for alignment with particular objectives. The findings emphasize the importance of gamification for digital-native learners while also advising caution in its integration with AI as this may not enhance vocabulary retention any further. This study indicates that gamification may serve as a powerful method for enhancing student engagement in vocabulary acquisition among educators. The integration of AI can enhance gamification through tailored feedback, yet its implementation must be thoughtfully designed to address the unique requirements of the learners. This study offers important perspectives on the optimal use of each tool whether utilized alone or in combination based on the educational setting. A limitation of this study is its concentration on Generation Z learners within a particular educational context, potentially restricting the applicability of the results. Future investigations might look into the interactions of these tools across various educational settings or with diverse age demographics. Moreover, additional investigations could explore how the combination of AI with more sophisticated gamification elements might present new possibilities for improving vocabulary retention.

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