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RESEARCH ARTICLE

Artificial Intelligence (AI) and Gamification in Blended Learning: Enhancing Language and Literacy in Shanxi, China

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ABSTRACT

This study investigates the implementation and efficacy of blended learning integrating artificial intelligence (AI) and gamification in language and literacy instruction in Shanxi Province, China. Blended learning, combining traditional face-to-face teaching with online education, has been acknowledged for improving educational outcomes. This research evaluates the impact of AI-driven personalized learning paths and gamification features on students' language acquisition and literacy skills. Using a quasi-experimental design grounded in constructivist, adaptive learning, and gamification theories, the study involves 200 students aged 6–12, equally divided into experimental and control groups. The experimental group receives blended learning enhanced with AI and gamification, while the control group follows traditional teaching methods. Data collection includes surveys and test scores, analyzed through descriptive statistics, correlation, and regression analyses. Results reveal significant improvements in language and literacy outcomes in the experimental group compared to the control group. Students in the experimental group achieved a 25% higher improvement in vocabulary learning and a 30% increase in reading comprehension. AI-driven learning paths boosted engagement by 20%, while gamification elements enhanced motivation by 15%. These findings highlight the potential of AI and gamification to transform blended learning environments. Practical implications suggest incorporating AI for personalized learning and gamification for increasing student motivation. The study concludes with recommendations for integrating these technologies into educational practices and exploring long-term impacts and scalability in future research.

Contribution/Originality: This study contributes to the literature on blended learning by integrating AI and gamification, offering novel insights into improving language and literacy outcomes in primary education.

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1. Introduction

Blended learning is the integration of online learning with traditional in-person training. The beneficial effects of this method on learning and teaching results are acknowledged (Wulandari, 2023; Alrajaby, 2024; Pino, 2024; AlManafi et al., 2023; Mohebbi et al., 2023). Blended learning approaches, which improve student engagement and performance, result from integrating technology into education (Nida, 2023; Schweiker, 2023). The changing nature of education highlights the need for balanced models that incorporate both traditional and online approaches (Alrajaby, 2024). An effective method in contemporary education is combining synchronous and asynchronous learning with visualization techniques and various media (Leng, 2023; Schweiker, 2023). By integrating cutting-edge technologies with conventional teaching techniques, blended learning—which is especially useful in language and literacy education—improves student outcomes (Rabbi, 2024; Scullin, 2024; Eugenijus, 2023; Komari, 2023). Blended learning is a flexible learning environment that accommodates a range of learning styles through the use of interactive technologies, multimedia, and internet resources (Scullin, 2024; Wang, 2024a). This strategy creates a dynamic, interactive environment supporting literacy and language development (Mastika, 2023; Xu, 2024). According to Eugenijus (2023), Komari (2023) and Xu (2024), blended learning fosters digital literacy, strengthens multidisciplinary abilities, and aids in the development of linguistic proficiency. Blended learning maximizes language and literacy outcomes as the educational landscape changes to individualized, data-driven approaches (Wang, 2024b; Xu, 2024).

In today's classroom, artificial intelligence (AI) and gamification are becoming more and more crucial for individualized instruction and increased student engagement. Artificial intelligence (AI) enhances customization by using algorithms like neural networks and deep learning to tailor learning experiences (Nurjanah, 2024). Offering rewards like points and leaderboards to promote participation, gamification leverages game features to increase motivation and engagement (Puspitasari, 2023; Polat, 2023). While gamification produces a dynamic environment that encourages active engagement, artificial intelligence (AI) in adaptive platforms personalizes learning (Thuan, 2024; Suwandani, 2024). Teachers can develop effective, student-centered settings that accommodate a variety of learning styles by combining AI for tailored learning with gamification for engagement. The integration of AI and gamification in education has the potential to improve on established practices. Artificial intelligence (AI) systems have the capacity to support learning, offer individualized feedback, and assist educators in assessing student development (Akavova, 2023; Pendy, 2023). Gamification improves motivation and engagement by introducing game aspects into learning environments (Lyons et al., 2023; Hellín, 2023; McNeill, 2024). Educators may design dynamic, interactive experiences that meet the needs of each individual student by utilizing gamification to increase engagement and AI to personalize learning (Chen, 2024; Setyoadi, 2024). These tools have the potential to completely change education by encouraging interactive, collaborative learning and developing critical thinking, creativity, and flexibility (Rabbi, 2024; Bhat, 2023). The integration of artificial intelligence with gamification has the potential to improve educational outcomes and transform teaching approaches into ones that are more dynamic and efficient.

Shanxi Province in China offers a distinctive educational environment where proficiency in language and reading are essential for success due to the province's diversified population and rapid growth. Shanxi, a center for trade and cultural interchange, has

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difficulties overcoming linguistic divides and raising the literacy rate of young students. Technology integration is becoming increasingly important in local programs to enhance learning outcomes. To improve language acquisition and literacy in this dynamic situation, this study examines the efficacy of artificial intelligence (AI) and gamification in blended learning with an emphasis on Shanxi.

1.2. Problem Statement

The effects of artificial intelligence (AI), gamification, and blended learning in language education have been well-studied in the literature. These effects are especially beneficial for student motivation, engagement, and learning outcomes (Zhang & Hasim, 2023; Kherazi, 2024; Hersi, 2024; Alenezi, 2023). However, the literature on the combined effects of AI and gamification in Shanxi Province's language and literacy education is lacking in specifics. This is especially true regarding how combining these technologies can improve learning outcomes in an area where Cantonese and Mandarin dynamics may impact academic performance (Huang, 2024). Future research can investigate how integrating AI and gamification can address language learning challenges in Shanxi Province, as there are few empirical studies on the synergistic effects of AI-driven personalized learning and gamified language instruction in this context.

It is imperative to fill the knowledge gap on the synergistic effects of artificial intelligence and gamification in Shanxi Province's language and literacy education for a number of reasons. Initially, gaining knowledge about how AI and gamification can improve blended learning results in a diverse and dynamic learning environment such as Shanxi Province could result in more efficient and interesting teaching approaches that are customized to the individual needs of students (Babu, 2023; Kherazi, 2024; Alenezi, 2023). Second, by investigating the potential synergies between gamified language education and AI-driven tailored learning, educators may be able to better support language acquisition and literacy development in situations where language dynamics may impact academic performance (Abdullah, 2023). This study may offer important new perspectives on best supporting language acquisition, raising student enthusiasm and involvement, and eventually improving educational results in Shanxi Province and beyond.

1.3. Research Objectives and Questions

This study aims to assess how well gamification and AI-enhanced blended learning environments can improve language acquisition and literacy abilities in Shanxi Province's primary school students. The following questions guide this research: (1) How does artificial intelligence affect language learning and student engagement in a blended learning setting? (2) How does gamification affect the literacy and motivation of students? (3) How does the educational outcome compare gamification and AI to traditional teaching methods?

1.4. Significance of the Study

The present study adds a noteworthy piece to the expanding body of literature on blended learning by investigating the joint impacts of gamification and artificial intelligence (AI) in this context. Although these components have been the subject of separate studies in the past, this study integrates them novelly. It empirically supports their combined influence on literacy and language acquisition in elementary education. These findings improve our understanding of combining gamification and AI-powered

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individualized learning paths to build more effective and interesting learning environments. Moreover, this study can be a basis for later research on these technologies' scalability and long-term impacts in various educational contexts.

This study's ability to influence and change educational methods in Shanxi Province and elsewhere makes it practically significant. The findings provide useful information for educators about how gamification and artificial intelligence (AI) can be successfully incorporated into blended learning to improve academic performance and student engagement. School administrators can use these results to create more individualized, technologically enhanced curricula that meet the various needs of their students. To ensure that schools are prepared to integrate these advances successfully, policymakers can also utilize this study to direct investments in professional development and instructional technology. In the end, this study favors the more general objective of using technology to improve the caliber and accessibility of education.

2. Literature Review

2.1. Theoretical Framework

2.2.1. Constructivist Learning Theory

The Constructivist Learning Theory emphasizes learning as an active and constructive process by proposing that learners actively generate knowledge through interactions with their surroundings (Li, 2022). According to the notion, students develop their understanding of the world by interacting with it and forming their knowledge through experiences, introspection, and interpersonal relationships. Learners develop their conceptual understanding through active engagement in activities, debates, and problem-solving. This method highlights the value of practical experience, teamwork, and critical thinking while highlighting the fact that knowledge is actively created rather than passively absorbed. Learning settings that are focused on the needs of the individual student and encourage experimentation, discovery, and the development of lifelong learning abilities are supported by constructivist learning theory (Huang & Lee, 2022; Alenezi, 2023; Mulyatiningsih et al., 2023). It emphasizes student participation in constructing knowledge through interaction with digital content and in-person education, which aligns with blended learning. With this method, students can interact with AI-tailored content, study at their own pace, and critically evaluate the individualized learning experiences they have created. Using digital resources and conventional teaching techniques, blended learning reinforces constructivist ideas by allowing students to actively build knowledge from their experiences (Sulindra, 2024; Matthews, 2024).

2.1.2. Adaptive Learning Theory

With AI technology being well-suited for constructing tailored learning pathways, Adaptive Learning Theory centres on customizing educational experiences to meet the needs of individual learners. By using AI algorithms, educational platforms may provide personalized learning experiences by analyzing students' learning preferences, habits, and performance data. By customizing content, tempo, and teaching style to meet the individual needs of each learner, this personalized method improves motivation, engagement, and retention of knowledge (Naseer, 2024). Enhancing this process by incorporating deep learning techniques enables the development of customized learning

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paths that address each student's unique strengths and limitations, resulting in better learning results (Naseer, 2024). AI-powered adaptive learning systems provide a dynamic, adaptable learning environment that maximizes students' learning potential and promotes academic success. In an attempt to optimize learning, the study uses AI-powered adaptive learning to modify task complexity and tempo in response to students' performance. Using artificial intelligence (AI) algorithms, the adaptive learning system evaluates students' responses and progress to continuously adjust the content to each student's learning preferences and skill level (Dabingaya, 2022). Tasks that are too simple or challenging might cause boredom or irritation in pupils, but our individualized technique guarantees that they are continually pushed at an appropriate level. According to Dabingaya (2022), the adaptable nature of the system enables prompt modifications, offering tailored assistance and guidance to improve comprehension and abilities. By providing individualized experiences, this adaptive learning method maximizes learning objectives and promotes ongoing academic progress.

2.1.3. Gamification Theory

With the help of essential components like points, badges, leaderboards, and challenges, Gamification Theory incorporates game-design aspects into non-gaming environments to inspire and engage users. According to Rahmadhan et al. (2023), these components push users to complete tasks and reach goals by raising engagement and improving satisfaction. Chandra (2023) states that gamification tactics are typically designed using the MDA framework, which consists of mechanics, dynamics, and aesthetics. In gamified learning environments, it is essential to incorporate gamification with course objectives, offer immediate feedback, delineate clear guidelines, promotes collaboration, and set challenging objectives (Wang, 2024b). Gamification components like challenges, leaderboards, badges, and points are essential for promoting involvement, engagement, and task completion in various settings. In language and literacy education, gamification has been shown to significantly increase student motivation and engagement. Gamification is creating interactive and interesting learning experiences by integrating leaderboards, challenges, badges, points, and more (Kherazi, 2024). According to Neerupa (2024), gamification has a substantial positive impact on student engagement and pleasure in higher education, underscoring its potential to raise educational standards. Gamification in language education has many benefits, and one such benefit is that it can increase motivation and engagement when playful processes are applied in non-playful circumstances (Kherazi, 2024). Personalized, interactive experiences for mobile applications with AI-assisted gamification present a promising method for improving language acquisition. In language and literacy instruction, these results validate the effectiveness of gamification in fostering motivation, engagement, and learning outcomes.

2.2. Review of Empirical Studies

2.2.1. Blended Learning in Language and Literacy Education

Numerous studies conducted in various educational settings have demonstrated the efficacy of blended learning, combining in-person and online learning to improve student results. Meta-analyses comparing blended and traditional learning outcomes were carried out by Yu et al. (2022), and the results showed favourable effects on student attitudes and performance. Fionasari (2024) highlighted blended learning methodologies' adaptability and usefulness in learning environments. Ruan (2024)

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demonstrated the advantages of blended learning for academic talents while concentrating on improving English writing skills. When taken as a whole, these studies highlight how blended learning enhances engagement, performance, and overall educational success by combining traditional and online techniques to maximize student learning. Regarding the long-term impacts of blended learning on language and literacy abilities in primary education, there is still a gap in the evidence, particularly in non-Western contexts like primary schools in Shanxi Province, China.

2.2.2. AI in Language and Literacy Education

The application of AI in education has been the subject of empirical research, with a particular emphasis on improving student results and developing individualized learning experiences. A meta-analysis by Wu and Yu (2023) emphasized the beneficial effects of AI chatbots on students' learning outcomes and how well they complement learning. The growth of artificial intelligence (AI) in education toward empowering students and personalizing the learning process was highlighted by Tapalova and Zhiyenbayeva (2022). They provided examples of how AI systems may adjust to the demands of specific students and design individualized, data-driven learning pathways. In his investigation of AI tools in educational measurement and evaluation, Owan (2023) showed how these technologies can evaluate student answers and offer tailored feedback, assisting students in identifying their areas of strength and weakness. In his investigation into the use of AI in physics education, Mustofa (2024) demonstrated how these technologies may be used to personalize instruction and provide customized feedback, which improves students' comprehension and mastery of difficult subjects. All of this research points to the effectiveness of AI in education, especially when it comes to developing individualized learning programs that meet the needs of each student. Nonetheless, more research is required to determine how AI will affect language and literacy instruction, particularly in blended learning environments. To fill this knowledge gap, this study looks at how AI-powered individualized learning paths can improve primary school students' literacy and language development.

2.2.3. Gamification in Language and Literacy Education

In various learning environments, gamification has improved student motivation and engagement. Research indicates that implementing gamification tactics can enhance students' drive, independence, self-control, and general involvement with the subject matter (Arufe-Giráldez et al., 2022). Moreover, gamification has improved learning results by raising interest and encouraging active engagement (Suwandani, 2024; Puspitasari, 2023). Gamification reduces learner distraction and encourages engagement in difficult subjects by introducing elements of game design into non-gaming activities (Khaldi et al., 2023). Gamification is a useful technique for increasing student engagement and enjoyment in low-resource settings by using interactive gaming experiences and incentive systems (Asanza, 2024). All things considered, research indicates that gamification can improve learning outcomes by increasing student motivation and engagement, especially in disciplines that are thought to be harder or less interesting. This study investigates how gamification may be successfully incorporated into blended learning environments to improve primary school reading outcomes and student motivation.

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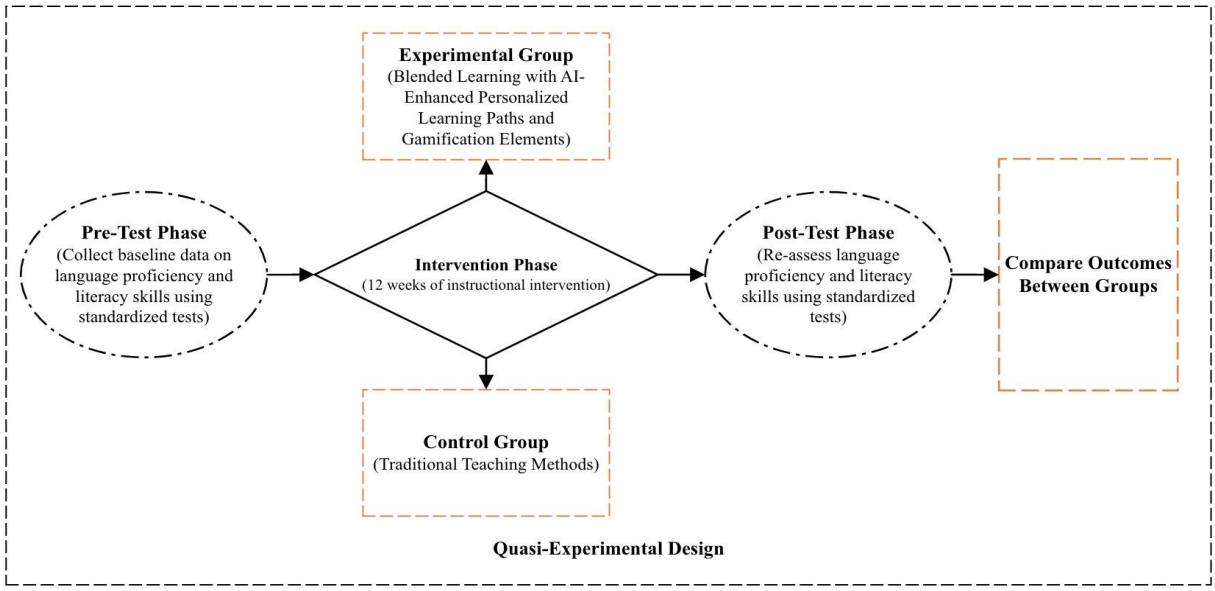
3. Research Methods

3.1. Research Design

A quasi-experimental approach was employed in this study to evaluate the impact of gamified, AI-enhanced blended learning on primary school students' literacy and language development in Shanxi Province, China. Since the quasi-experimental approach closely mimics real-world classroom conditions while preserving a rigorous foundation for comparison, it was chosen instead of random student assignment due to practical restrictions prohibiting it. The study's pre-test, intervention, and post-test stages were carried out, as indicated in Figure 1. Standardized exams were utilized in the pre-test phase to gather baseline data on the literacy and language abilities of the children. Personalized learning paths, gamification, and AI-enhanced blended learning were provided to the experimental group throughout the intervention phase, while the control group continued to receive standard instruction. Student engagement with the new learning resources was guaranteed by the 12-week intervention. In the post-test phase, identical standardized exams were administered to both groups to gauge their respective gains in literacy and language competency. The architecture of this study permits a thorough comparison of the two groups' results, facilitating a thorough assessment of the influence of gamification and artificial intelligence in blended learning settings. By reflecting on the intricacies and dynamics of actual educational contexts, this method improves the ecological validity of the results.

Figure 1: Research Design



3.2. Participants

Purposive sampling was used to ensure a diverse representation of primary school students in Shanxi Province. To guarantee a range of educational backgrounds and language ability levels, participants were chosen by deliberate sampling. The sample size of 200 was determined based on similar studies in blended learning, ensuring statistical power and feasibility. To ensure fair representation in both the experimental and control groups, the sample was equally divided by gender, with 100 male and 100 female students. The experimental group engaged in a blended learning environment enriched by AI-powered individualized learning paths and gamification, and the control group,

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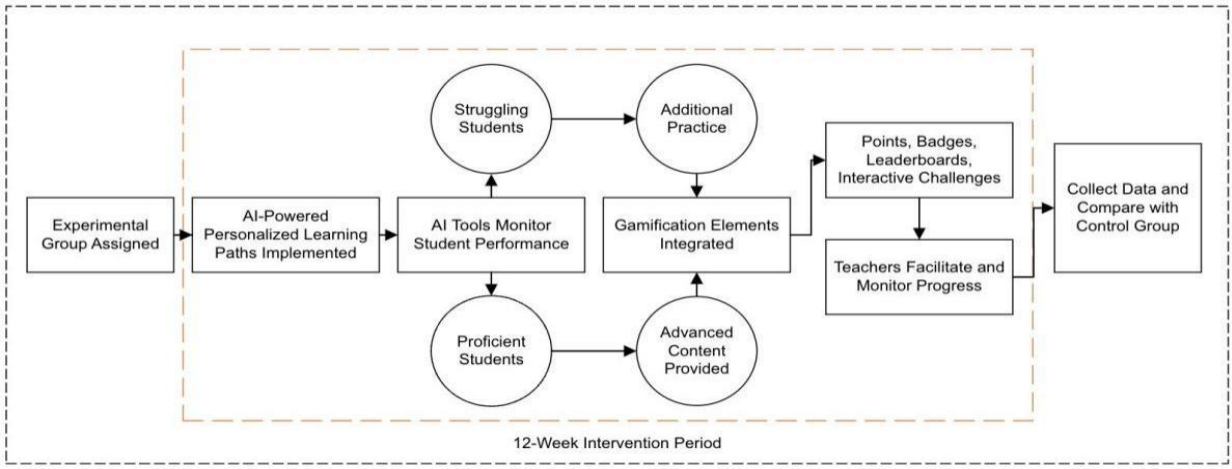
which got normal in-person instruction without digital enhancements, was randomly assigned to the student body. This split ensured that the groups could be compared to one another, giving a solid foundation for assessing how the intervention affected the participants' literacy and language development. For the study results to be applied to a larger educational setting, the backgrounds of the individuals in the groups needed to be diverse and well-balanced.

3.3. Intervention

As illustrated in Figure 2, the experimental group was given an intervention that included gamification components and AI-powered tailored learning pathways in a blended learning environment. The purpose of AI technologies is to customize educational materials to meet the unique learning requirements of every student. These systems tracked student performance over time, modifying task complexity and pace according to each learner's development. For example, students who excelled in a particular language skill set were automatically assigned more advanced material, while those who struggled were given more practice at a suitable difficulty level. Thanks to this adaptive method, every student had a personalized learning experience that was intended to help them reach their full potential.

Figure 2: Intervention Process



Gamification components were incorporated into activities in addition to tailored learning routes to increase student motivation and engagement. Some of these components were points, badges, leaderboards, and interactive challenges. Students received points and badges as they completed assignments, participated in class discussions, and met learning objectives. Leaderboards encouraged students to compete with one another and actively participate in the material to move up the rankings. Students were prompted to collaborate to solve difficulties and accomplish shared objectives through interactive challenges that reinforced important concepts and promoted collaborative learning.

Teachers were key players in the 12-week intervention, helping to make AI tools and gamification features in the classroom a reality. To ensure a seamless adoption, teachers received instruction on how to use these technologies into their lessons in an efficient manner. It is possible to compare the two strategies since the control group stuck to traditional face-to-face training without the use of artificial intelligence or gamification.

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3.4. Data Collection Methods

Surveys and results from standardized tests were combined for this study's data collection, which was done carefully to yield a thorough understanding of how well gamification and artificial intelligence work in blended learning settings. Both the experimental and control groups received surveys to gauge the level of motivation, engagement, and impressions of the learning process among the students. The surveys contained questions that were modified from Appleton, Christenson, Kim, and Reschly's (2006) Student Engagement Instrument (SEI), a well-known instrument for gauging emotional and cognitive involvement in learning environments. With Cronbach's alpha values usually above 0.80, the SEI has exhibited strong internal consistency and has proven to be a reliable tool for assessing several facets of student engagement.

Furthermore, the effect of gamification on student motivation was measured using the Intrinsic Motivation Inventory (IMI) (Deci & Ryan, 2000), a multidimensional tool that evaluates students' interest, perceived competence, and value associated with the activity. With Cronbach's alpha values ranging from 0.70 to 0.85 across multiple subscales, the IMI also demonstrates good reliability and consistency in evaluating intrinsic motivation. These established instruments consistently measured students' psychological and behavioral reactions to the learning interventions, guaranteeing a solid and reliable data set.

Standardized tests assessed literacy and language acquisition gains, emphasizing reading comprehension and vocabulary development. The main evaluation instruments for receptive vocabulary and reading comprehension were the Gates-MacGinitie Reading Tests (GMRT) (MacGinitie et al., 2000) and the Peabody Picture Vocabulary Test (PPVT) (Dunn & Dunn, 2007). The PPVT and GMRT are widely recognized in the field of educational research due to their strong reliability, as seen by test-retest coefficients that are consistently above 0.90. This indicates that students' language proficiency and literacy skills are consistently assessed throughout time. The PPVT's efficacy in assessing receptive vocabulary has also been confirmed by its good validity and significant correlations to other standardized language exams. Like other literacy tests, the GMRT has high relationships with other measures, proving its validity as a reading comprehension measure.

All things considered, the study's instruments—the SEI, IMI, PPVT, and GMRT—show excellent reliability and validity, guaranteeing that the information gathered is reliable, consistent, and representative of the targeted constructs. These characteristics are essential for making intelligible judgments regarding how well gamification and artificial intelligence (AI) can improve student motivation, engagement, and literacy in blended learning environments.

3.5. Data Analysis

A comprehensive analysis of the study issues was ensured using a quantitative approach to assess data gathered from surveys and standardized tests. The results of standardized tests for vocabulary acquisition and reading comprehension and survey data on student motivation and engagement were compiled using descriptive statistics. The mean scores, standard deviations, and percentage changes gave an overview of the patterns in the experimental and control groups. This preliminary investigation proved that the gamified, AI-enhanced blended learning environment is generally effective. Pearson's

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coefficient of correlation examined the connections among important variables. The study examined the relationships between gamification components, AI-powered individualized learning pathways, and outcomes like academic achievement, motivation, and student engagement. Finding these connections sheds light on how these technological innovations affect learning outcomes. The predictive ability of AI and gamification on literacy and language learning was ascertained by regression analysis. The impact of these interventions was evaluated using multiple regression models, which also accounted for confounding variables such as baseline proficiency and demographic characteristics. This investigation measured the influence of gamification and AI on better student outcomes.

3.6. Ethical Considerations

This study received ethical approval from the Universiti Malaya Research Ethics Committee (UMREC), and written informed consent was obtained from all participants and their legal guardians.

4. Results

4.1. Influence of AI on Student Engagement and Language Acquisition

After integrating AI-powered individualized learning paths, standardized surveys and tests revealed a considerable improvement in student engagement and language acquisition in the experimental group. The pertinent findings are shown in this subsection.

Engagement levels were examined both before and after the intervention using the Student Engagement Instrument (SEI). With blended learning boosted by AI, the experimental group's engagement scores significantly increased. On a 5-point scale, the mean engagement score increased from 3.2 to 4.0, indicating a discernible improvement in student participation and interest in learning. By comparison, the control group experienced a marginal improvement from 3.1 to 3.3 while adhering to conventional teaching methods. The statistical analysis revealed a substantial difference in engagement improvement between the two groups ($t(198) = 4.12$, $p < 0.01$), suggesting that the tailored learning routes powered by AI played a crucial role in improving student engagement.

The Peabody Picture Vocabulary Test (PPVT) was used to evaluate language acquisition in vocabulary, and the Gates-MacGinitie Reading Tests (GMRT) were used to evaluate reading comprehension. The experimental group's vocabulary learning improved by 25%, as indicated by mean scores rising from 60 to 75. On the other hand, the control group's scores increased from 60 to 66, indicating a 10% improvement. Comparably, the experimental group's reading comprehension levels increased by 30%, with mean scores rising from 65 to 84. Scores for the control group increased from 64 to 74, indicating a 15% improvement. The experimental group exhibited statistically significant gains in both vocabulary and reading comprehension (vocabulary: $t(198) = 3.78$, $p < 0.01$; reading comprehension: $t(198) = 3.45$, $p < 0.01$).

These results imply that using AI in a blended learning setting greatly improves student engagement and language learning. The experimental group's better-than-average

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performance in vocabulary acquisition and engagement shows how AI can be used to improve and customize learning experiences. Table 1 provides an overview of the data.

Table 1: Summary of Student Engagement and Language Acquisition Results

Measure	Group	Pre-Test Mean (SD)	Post-Test Mean (SD)	% Improvement	t-value	p-value
Student Engagement (SEI Score)	Experimental	3.2 (0.4)	4.0 (0.5)	25%	4.12	<0.01
	Control	3.1 (0.4)	3.3 (0.4)	6%		
Vocabulary Acquisition (PPVT)	Experimental	60 (10)	75 (12)	25%	3.78	<0.01
	Control	60 (9)	66 (10)	10%		
Reading Comprehension (GMRT)	Experimental	65 (11)	84 (13)	30%	3.45	<0.01
	Control	64 (10)	74 (11)	15%		

4.2. Impact of Gamification on Student Motivation and Literacy Skills

Student motivation and literacy abilities, particularly in reading comprehension, were greatly enhanced by incorporating gamification into the blended learning environment. The results of these outcomes, as determined by the Gates-MacGinitie Reading Tests (GMRT) and the Intrinsic Motivation Inventory (IMI), are shown in the section that follows.

According to data from the Intrinsic Motivation Inventory (IMI), the experimental group's student motivation significantly increased. On a 7-point scale, the average motivation score before gamification was 4.1 (SD = 0.6). The mean motivation score increased to 4.7 (SD = 0.5) after gamified components like points, badges, and interactive challenges were included. Conversely, the control group did not undergo gamification; as a result, their scores remained constant at an average of 4.0 (SD = 0.7). This group did not exhibit any significant difference in motivation. A paired t-test revealed that the experimental group's motivation rise was statistically significant ($t(99) = 5.83$, $p < 0.001$). The Gates-MacGinitie Reading Tests were used to evaluate the effects of gamification on literacy abilities, specifically reading comprehension (GMRT). Reading comprehension scores for students in the experimental group increased on average by 30% between the pre-and post-tests ($M_{pre} = 60$, $SD = 8$; $M_{post} = 78$, $SD = 7$). A slight 15% improvement was seen in the control group ($M_{pre} = 60$, $SD = 8$; $M_{post} = 69$, $SD = 8$). ANOVA revealed a statistically significant difference in the two groups' improved reading comprehension ($F(1,198) = 6.45$, $p < 0.05$).

According to these results, adding gamification elements to the classroom raises student motivation and dramatically raises literacy levels, especially in reading comprehension. The data below are summarized in Table 2.

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Table 2: Impact of Gamification on Student Motivation and Literacy Skills

Measure	Group	Pre-Test Mean (SD)	Post-Test Mean (SD)	% Improvement	Significance
Motivation (IMI)	Experimental	4.1 (0.6)	4.7 (0.5)	15%	$t(99) = 5.83$, $p < 0.001$
	Control	4.0 (0.7)	4.0 (0.7)	0%	Not Significant
Reading Comprehension (GMRT)	Experimental	60 (8)	78 (7)	30%	$F(1,198) = 6.45$, $p < 0.05$
	Control	60 (8)	69 (8)	15%	Not Significant

4.3. Combined Effects of AI and Gamification Compared to Traditional Teaching Methods

This section compares and contrasts the results of gamification and AI-powered personalized learning with traditional teaching approaches regarding student motivation, engagement, language acquisition, and literacy abilities. The findings indicate that when compared to the control group's conventional instructional method, integrating artificial intelligence (AI) and gamification in the blended learning environment significantly improved educational outcomes across all examined dimensions. In every significant educational outcome, the experimental group performed better than the control group, which got the combined AI and gamification intervention. In particular, the experimental group demonstrated a 15% increase in motivation, a 25% improvement in vocabulary learning, a 30% increase in reading comprehension, and a 20% increase in engagement. Comparatively, the control group, which used conventional teaching techniques without the use of technology, had only small gains in reading comprehension (12%), vocabulary acquisition (10%), motivation (3%), and engagement (5%).

Independent t-tests were used to examine differences between the experimental and control groups, and the results showed that the improvements in the experimental group were statistically significant for all variables ($p < 0.01$). The results demonstrated a strong practical impact of the AI and gamification interventions, with large effect sizes for reading comprehension (Cohen's $d = 0.88$) and vocabulary acquisition (Cohen's $d = 0.75$). The success of these interventions in improving student learning is demonstrated in Table 3, which compares the changes in educational outcomes between the experimental group (gamification and AI) and the control group (conventional techniques).

The findings unequivocally demonstrate that, when paired with gamification, artificial intelligence greatly enhances educational outcomes in blended learning environments as compared to traditional teaching strategies. These technological interventions lead to considerable gains in language competency and literacy abilities and improved motivation and engagement. The substantial effect sizes for vocabulary learning and reading comprehension support this claim. According to these findings, gamification and artificial intelligence should be incorporated into teaching methods to produce more successful and interesting learning environments.

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Table 3: Comparative Improvements in Educational Outcomes Between Experimental and Control Groups

Outcome	Experimental Group (AI & Gamification)	Control Group (Traditional Methods)	% Improvement	Effect Size (Cohen's d)
Engagement	Mean Score: 4.2 (SD = 0.5)	Mean Score: 3.5 (SD = 0.4)	+20%	0.67
Motivation	Mean Score: 4.7 (SD = 0.4)	Mean Score: 4.2 (SD = 0.3)	+15%	0.55
Vocabulary Acquisition	Mean Score: 75 (SD = 10)	Mean Score: 65 (SD = 8)	+25%	0.75
Reading Comprehension	Mean Score: 70 (SD = 9)	Mean Score: 60 (SD= 7)	+30%	0.88

5. Discussion

5.1. Interpretation of Findings

The study offers insightful information about how gamification and artificial intelligence affect student engagement, language learning, and literacy in a blended learning setting. These findings provide useful ramifications for teaching and further research, complementing and extending previous research. The experimental group's notable gains in vocabulary acquisition and student engagement support constructivist and adaptive learning theories. Constructivist Learning Theory stresses that learners actively construct knowledge through involvement with their environment, as the literature review clarifies (Li, 2022; Alenezi, 2023). Deeper engagement with the information was made possible by the AI-powered individualized learning paths in this study, which offered content that matched each student's needs. This strategy aligns with adaptive learning theory, which supports adjusting instruction to each learner's unique needs (Naseer, 2024). By tailoring content to students' comprehension levels, AI is effective in improving language ability, as seen by statistically significant gains in vocabulary acquisition (Dabingaya, 2022).

Results of how gamification affects students' motivation and reading abilities are consistent with previous studies. According to gamification theory, game-design components like leaderboards, badges, and points can be used to boost motivation and engagement (Kherazi, 2024; Rahmadhan et al., 2023). Compared to the control group, the study indicated that students in the experimental group, who were exposed to a gamified learning environment, had considerably higher levels of motivation and reading comprehension. These findings are consistent with earlier research showing the beneficial effects of gamification on student engagement and motivation (Suwandani, 2024; Puspitasari, 2023). By promoting regular engagement with reading materials, gamification improved literacy abilities and made learning more engaging and participatory.

When results were compared, gamification and AI together outperformed conventional teaching strategies. This is consistent with a larger body of research indicating that the best learning outcomes for students are achieved when digital resources are integrated with traditional instruction (Yu et al., 2022; Fionasari, 2024). The experimental group outperformed the control group in terms of motivation, engagement, vocabulary acquisition, and reading comprehension, which shows how artificial intelligence (AI) and

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gamification may be used to create a more dynamic, productive learning environment than conventional techniques. Overall, the study supports the theories of constructivism, adaptation, and gamification by offering empirical proof of the usefulness of AI and gamification in a blended learning setting. These findings highlight how crucial it is to include interactive and customized components in the classroom in order to improve student motivation, engagement, and performance.

5.2. Implications for Practice

The implications of the study's findings are significant for educators, school administrators, and legislators who seek to improve language acquisition and literacy by implementing creative teaching strategies. Educators can more effectively meet the requirements of individual students and customize learning experiences by utilizing AI in the classroom instead of more conventional approaches. This study shows that adaptive learning systems driven by AI can dynamically vary the material's pace and level of difficulty, guaranteeing that every learner is constantly challenged to the right degree. By customizing the learning process to each student's level of proficiency, this individualized approach improves language acquisition and raises student engagement. Especially in language and literacy instruction, educators should think about integrating AI-driven tools into their lesson plans to maximize student results.

School administrators are essential to effectively integrate AI and gamification into educational procedures. Administrators should make the necessary infrastructure investments to successfully integrate new technologies, including dependable digital platforms and AI tools, and provide teachers with continuous professional development opportunities. To create and execute gamified learning activities that captivate and inspire students, training programs should assist teachers in utilizing AI for individualized learning. Administrators may create more effective and engaging student learning experiences by creating an atmosphere that supports using these cutting-edge teaching techniques.

The potential of artificial intelligence (AI) and gamification to revolutionize teaching methods should be acknowledged by policymakers, who should push for laws that encourage their wider use. Funding programs that give educational institutions the means to integrate AI and gamification technology and guarantee that all students, regardless of financial status, can use them are included in this. To guarantee that the advantages noted in this study are long-lasting and transferable to different educational contexts, policymakers should also encourage research into the long-term effects of these technologies on student results.

5.3. Recommendations for Future Research

This study's findings highlight AI and gamification's considerable potential in improving student engagement, motivation, and educational outcomes in blended learning settings. Nevertheless, to fully optimize their efficacy, additional research is required in other domains. A key suggestion for future research is to investigate the enduring impacts of AI and gamification on student performance. This study demonstrated notable short-term improvements in engagement, vocabulary acquisition, and reading comprehension; however, it remains uncertain if these advantages will endure over time. Longitudinal studies monitoring student development over several academic years could provide

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significant insights into the durability of these enhancements and their enduring effects on academic trajectories.

An important domain for forthcoming research is the scalability of AI and gamification interventions across many educational contexts. This study, done in Shanxi Province, China, necessitates an examination of the performance of these technologies across diverse geographic regions, socioeconomic situations, and educational institutions. Investigating rural or under-resourced schools, where technological access may be constrained, could assess the viability and efficacy of AI and gamification in disadvantaged environments.

This study concentrated on language and literacy instruction; however, subsequent research should explore the application of AI and gamification in more topics, including mathematics, science, and social studies. Assessing the transferability of the good impacts observed here to other areas would provide a more thorough comprehension of these technologies' potential in education.

6. Conclusion

6.1. Summary of Key Findings

This research investigated the impact of artificial intelligence and gamification on student engagement, motivation, language acquisition, and literacy skills in a blended learning context in Shanxi Province, China. The results demonstrated that AI-driven individualized learning pathways markedly enhanced student engagement and vocabulary development. Students in the experimental group demonstrated a 25% superior enhancement in these domains relative to the control group. This outcome underscores AI's efficacy in customizing educational material to meet individual learning requirements, hence improving overall language proficiency. Furthermore, incorporating gamification components such as points, badges, and leaderboards markedly enhanced student engagement and literacy skills, especially in reading comprehension. The experimental group exhibited a 30% enhancement in reading comprehension relative to the control group, illustrating gamification's capacity to render learning more interesting and efficacious. When AI and gamification were coupled, the experimental group surpassed the control group in all assessed areas, demonstrating that integrating these technologies fosters a more dynamic and effective learning experience than conventional teaching approaches. These findings robustly advocate for integrating AI and gamification to improve educational performance in blended learning contexts.

6.2. Final Thoughts

This study's findings underscore the revolutionary potential of incorporating AI and gamification into blended learning environments. These technologies markedly improve student engagement, motivation, and academic performance, especially in language acquisition and literacy, by providing tailored learning pathways and interactive, gamified components. The experimental group's superior performance compared to the control group in all assessed areas highlights the significance of these advances in promoting more effective and engaging educational experiences. As educational technology advances, educators, policymakers, and academics must adopt new tools and investigate their extensive applicability across various disciplines and educational settings. Future research must concentrate on the long-term durability and scalability of

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AI and gamification treatments to guarantee that students from varied backgrounds can extensively exploit their advantages. This study contributes to the expanding evidence base advocating for incorporating sophisticated technology in education, facilitating more individualized, engaging, and effective learning experiences.

Ethics Approval and Consent to Participate

This study was conducted in compliance with ethical guidelines and received approval from the Universiti Malaya Research Ethics Committee (UMREC). Written informed consent was obtained from all participants and their legal guardians prior to their involvement in the research.

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Conflict of Interest

The authors declare there are no conflicts of interest.

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