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Flipped classroom with gamified technology and paper-based method for teaching vocabulary

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Abstract

While gamified technology integration in vocabulary instruction within a flipped classroom has yielded beneficial teaching outcomes, specific studies have raised concerns about potential adverse effects linked to this approach. As a result, conducting a comparative analysis between gamified technology and conventional paper-based methods within the flipped classroom framework has become essential. This analysis aims to foster the development of a targeted teaching approach that adeptly addresses the unique needs of students. This study employed a sequential explanatory research design to examine the effectiveness of flipped classroom with gamified technology and paper-based method in teaching vocabulary to students with different proficiency levels. Quantitative data was gathered from a pretest and a posttest, whilst qualitative data was collected through teachers' guided reflection. Using Academic Word List (300 target words), control groups employed a paper-based, while experimental groups applied gamified technology (*Quizlet, Kahoot!, Quizizz, Socrative,* and *Google Form*), which lasted 10 weeks. The participants were 144 non-English major students who took a general English course in the 2nd semester of 2023. Quantitative data analysis ran in SPSS 25 using *Paired Sample t-Test* and *One-way ANOVA*. The qualitative data were analyzed using thematic progression. The results showed that gamified technology did not affect students' learning outcomes, while the paper-based method resulted conversely. It revealed that the paper-based method is more effective than gamified technology for students in general, with low proficiency and high-proficiency level. Further, teachers' beliefs admitted distinctive issues that gamified technology was more effective for high-proficiency learners, whereas paper-based was more effective for low-proficiency learners. The difference analysis of quantitative and qualitative data sheds light on discussing threats while implementing gamified technology and possible solutions.

Keywords: Flipped classroom, Gamified, Gamified technology, Paper-based, Vocabulary

Introduction

Recent analyses and empirical studies on the use of technological advances in a game-based method of vocabulary instruction have demonstrated benefits in terms of improving language learners' engagement. Learning with technology is claimed to increase

students' competence and success (Cripps, 2020; Pratiwi & Waluyo, 2023; Wahyuni et al., 2020; Waluyo & Bucol, 2021). It also causes a change in language teaching methodology, moving it from student-centered to teacher-centered (Kariadi & Pratiwi, 2022; Teng, 2017). It also gives students of foreign languages a chance to learn independently outside of the classroom using a variety of applications, websites, videos, online classes, e-books, etc. (Landers, 2014; Talan & Gulsecen, 2019). Furthermore, because it enables teachers to act as facilitators in the classroom, digital technology used in gamification is seen as one of the most effective techniques for promoting independent learning (Anggoro & Pratiwi, 2023; Nurhidayat et al., 2021). Students in this situation can work together to improve their conceptual and verbal skills while also employing language as a tool for acquiring knowledge, connecting new concepts to their current source of information, and strengthening their linguistic and cognitive abilities (Plass et al., 2015; Ueno, 2019).

The majority of vocabulary game research, however, is still focused on use in the classroom (Waluyo & Bucol, 2021). Students must learn numerous terms to become competent in English, yet vocabulary instruction in class rarely covers them. EFL learners may not be effectively introduced to the language and its components due to their restricted usage of English in everyday conversations, resulting in poor vocabulary mastering and a small vocabulary. Thus, vocabulary acquisition must be addressed to avoid harming EFL learners (Lavoie, 2016; Miller, 1995). Examining the practical use of gamified vocabulary instruction through the flipped classroom procedure, which occurs both inside and outside the classroom, may be necessary to determine whether improving students' vocabulary achievement is possible.

Drawing on this brief review, it can be assumed that implementing gamification in teaching and learning has proved to benefit students in improving their vocabulary skills as well as encouraging learners' enjoyment and autonomy. However, a report mentioned that the implementation of CALL and MALL in terms of a gamified learning method showed negative learners' attitudes toward language learning (Wu, 2019). In the Indonesian context, digital technologies distracted students from their studies, made them more likely to plagiarize their papers, and made them more inclined to cheat on exams (Pratiwi & Waluyo, 2023; Wijayatiningsih et al., 2022). Therefore, the ability and inclination to behave independently and cooperatively cannot be a part of the language-learning process. Independent learning, which should enable learners to control their capacity to become autonomous learners of the target language, could not be achieved (Mahalli et al., 2020; Ueno, 2019). There is also evidence of non-significant differences in test scores between the gamified and traditional paper-based vocabulary teaching classes (Rachels & Rockinson-Szapkiw, 2018). Hence, this study seeks to compare gamified technology and paper-based methods in teaching vocabulary to create a better classroom environment that students favor.

The novelty of this study lies in its dedicated pursuit of investigating and contrasting the effectiveness of a gamified technology-driven flipped classroom approach and a traditional paper-based method for teaching vocabulary to students with varying high and low proficiency levels. Addressing the crucial role of proficiency as a foundational factor in second language acquisition, Renandya et al. (2018) underscored the necessity for tailored instructional strategies catering to diverse learner proficiency levels.

Existing research has often skewed toward interventions favoring high-proficiency students, inadvertently overlooking the core challenges faced by their lower-proficiency counterparts (Alqahtani, 2015; Alshammari, 2022; Panmei & Waluyo, 2022). By comparing vocabulary instruction through the innovative lens of gamified technology and the conventional paper-based mode across both proficiency tiers, the study anticipates substantiating empirical evidence of effective vocabulary enhancement for both high and low proficiency cohorts. The envisioned outcome of this endeavour is to equip educators with invaluable insights, empowering them to selectively adopt pedagogical approaches that optimally align with the distinctive learning profiles of their students, thereby elevating the overall effectiveness and efficiency of the learning journey towards the achievement of their educational objectives in vocabulary learning.

The present study, hence, addresses the following research questions:

1. How is the effectiveness of flipped classroom with gamified technology in teaching vocabulary for high- and low- proficiency students?
2. How is the effectiveness of flipped classroom with paper-based method in teaching vocabulary for high- and low- proficiency students?
3. How is the comparison of flipped classroom with gamified technology and paper-based method in teaching vocabulary for high- and low-proficiency students?
4. How do teachers perceive flipped classroom with gamified technology and paper-based method in teaching vocabulary?

Literature review

Vocabulary teaching

Vocabulary is the most important part of any language learning; hence vocabulary instruction is essential to English teaching. Ludwig (2018) defined vocabulary teaching as the way to know a word. Nation (2001) mentioned three different types of knowing a word, including (1) knowing the form of a word; (2) knowing the meaning of a word; (3) knowing the function of a word. According to Yue (2017), English vocabulary teaching has three requirements: teaching objective, teaching object, and teaching method. Mastering pronunciation, spelling, meaning, and vocabulary usage are objectives in English vocabulary teaching. The teaching object means the students' primary, secondary, or higher level. The most important factor in determining the need for teaching objects is determining how to effectively use new teaching materials and methods to attract students' attention in the process of vocabulary acquisition. Teaching method means the way to achieve teaching objectives into teaching objects. Some aspects of the teaching method are the way of teaching (online, offline, or hybrid), materials, and media.

There were some arguments regarding vocabulary training strategies. For instance, Miller (1995) suggested some examples of various teaching methods that can be used with pupils to help them become more vocable: (a) resourcing: utilizing reference works in the target language, such as dictionaries, encyclopedias, or textbooks; (b) repetition: mimicking a linguistic model, involving direct practicing and silence recitation; (c) grouping: putting terms, jargon, or ideas into categories based on their characteristics; (d) imagery: utilizing authentic or imagined visuals to comprehend or recall new knowledge; (e) auditory representation: rehearsing in one's head the sound of a single word,

phrase, or lengthy linguistic pattern; (f) keyword method: recalling a new word by locating a well-known word in your own tongue that sounds similar to or similarly mimics the new term; and (g) transfer: employing existing language skills or expertise to support in production.

Furthermore, Lavoie (2016) proposed three vocabulary training strategies: word family (or word parts), word network, and word card strategies. A word family is a group of words comprising a root word (such as clear) and its pronunciations, created by adding different suffixes and prefixes (such as clearance, clearing, and clearly). The lexical components used in the word network strategy are processed at varying depths. Deep processing entails understanding the word's meaning, while shallow processing just considers its form. The purpose of the word card technique is to aid in learning new vocabulary by associating the shape of a word with its meaning through flashcards. This method facilitates the integration of visual and verbal data, which improves the recall of lexical items. Alqahtani (2015) claimed that effectively used word cards can help learn and review words.

Gamified technology in vocabulary instructions

The term "gamification" describes the application of game components, such as action language, evaluation, challenge, control, environment, game fiction, human interaction, immersion, and goals, to learning and associated consequences (Landers, 2014). A key consideration in the design of games for learning is striking a balance between the requirement to cover the subject matter and the desire to prioritize gameplay; this is what we mean when we talk about "gamification" of language acquisition (Plass et al., 2015; Waluyo & Tran, 2023). Rashid et al. (2019) argued that utilizing language games can help create an engaging learning environment and improve students' vocabulary mastery. It is believed that gamified vocabulary learning in the classroom or a formal setting and outside the classroom or informal setting can successfully enhance language learning as it makes language acquisition easier and quicker for students (Gokbulut, 2020; Wardoyo et al., 2021). Accordingly, gamified vocabulary instruction is one way to engage learners in learning words in a fun environment while still providing them with thorough vocabulary instruction. Therefore, an effective vocabulary game allows players to learn in interesting and pertinent circumstances, where crucial information is provided on schedule and appropriate for gamers (Anggoro & Pratiwi, 2023; Landers, 2014).

In the past, several vocabulary games were used to enhance students' vocabulary acquisition, including draw games, circle games, vocabulary exchange games, verb group games, prefixes, word formation games, vocabulary dice games, and irregular verb matches. With the development of technology, gamified vocabulary learning has moved to digital tools utilizing CALL and MALL. Digital games are the modern version of game-based learning teachers employ to engage students in meaningful and engaging activities (Rachels & Rockinson-Szapkiw, 2018). Some empirical studies have proved that interactive response system platforms are appropriate to meet students' needs in vocabulary learning as well as teachers' needs to facilitate vocabulary learning, including *Google Form, Socrative, Kahoot!, Quizizz, and Quizlet* (Anggoro & Khasanah, 2022; Pratiwi & Waluyo, 2023).

Flipped classroom

F-L-I-P—flexible environment, learning culture, intentional content, and professional educators—forms the flip model (Marshall & Kostka, 2020). It emphasizes active learning and the change from teacher-centered to student-centered instruction (Pratiwi et al., 2022). Flipped classrooms invert classroom activity and implies learners do schoolwork at home and homework at school (Anggoro & Khasanah, 2022; Pratiwi et al., 2022). Students are responsible for outside-classroom activities like watching videos, browsing course-related web pages, listening to audio, reading appropriate sources, etc. On the other hand, Teachers have to encourage pair work, group collaboration, hands-on activities, and high-level thinking by creating an engaged classroom atmosphere. Students are not restricted by the amount of time spent in class because instruction can take place in a variety of other settings (Marshall & Kostka, 2020). Flipped classrooms increase class time for practice and activities rather than language ideas. This helps students produce and learn more (Nurhidayat et al., 2021; Wannapiroon & Petsangsri, 2020).

According to Egbert et al. (2015), characteristics of the flipped classroom include the following: (1) a focus on learning rather than simply conforming to school norms; (2) the teacher's role as a tutor rather than a director; (3) greater student–teacher interaction centered on the content; (4) frequent opportunities for students to apply what they have learned; (5) frequent opportunities for students to receive feedback on their actions and progress; (6) the integration of technology into the learning process; and (7) the delivery of instruction at the precise moment it's needed. Teachers distribute the subject matter outside the classroom to let students collaborate and share understanding inside the classroom (Pratiwi & Waluyo, 2023). Therefore, flipped classrooms encourage active learning, deeper knowledge, and motivation (Anggoro & Khasanah, 2022; Mahalli et al., 2020; Pratiwi et al., 2022).

Research showed that EFL students benefited from flipped classrooms (Anggoro & Khasanah, 2022; Pratiwi et al., 2022; Talan & Gulsecen, 2019; Teng, 2017). Pratiwi and Waluyo (2022) argued that technology might be used to offer a self-paced learning environment that supports students' mastery of learning. The flipped classroom allows teachers to incorporate supporting features like tests for learning, problem-based inquiries, and differentiation strategies to provide a more flexible learning environment than typical classrooms (Pratiwi et al., 2022). Anggoro and Khasanah (2022) found out that students enjoy participating in a flipped classroom and benefit from watching their lectures in shorter lesson videos. Similarly, Talan and Gulsecen (2019) and Teng (2017) stated that learners were satisfied with the flipped classroom model in the EFL setting.

Methodology

Research design

This study employed a sequential explanatory research design—a mixed method design in which, after a quantitative phase, the researcher conducts a qualitative phase to explain the quantitative data. The primary focus was on the quantitative phase by examining the effectiveness of flipped classroom with a gamified technology compared to a paper-based method in teaching vocabulary to students with high- and low- proficiency levels. Therefore, the participants were divided into the gamified

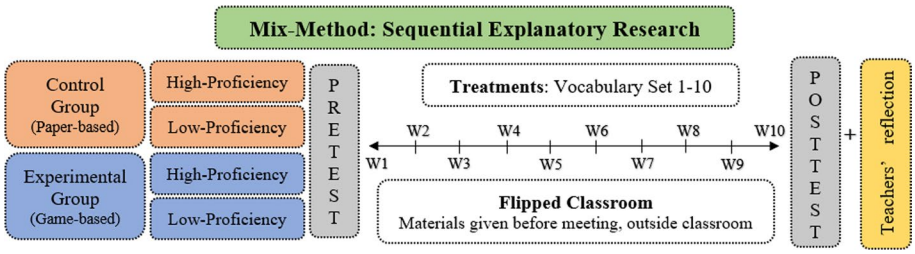

Fig. 1 Research design

technology group and the paper-based method group. The qualitative phase was implemented to further clarify the preliminary findings and how the qualitative data contributed to the explanation of the quantitative findings. This study's second phase was teachers' reflection on flipped classrooms in teaching vocabulary with gamified technology and a paper-based method. Figure 1 illustrates the research design.

The game-based method group utilized several gamified technological tools to deliver the materials in flipped classroom model. The tools belong to the Students Responsive System (SRS), which was divided into two parts: pre-class/outside the classroom (*Quizlet*) and inside the classroom (*Kahoot!*, *Quizizz, Socrative,* and *Google Form*). *Google Form* was also used to facilitate teachers' reflection. On the other hand, the paper-based method group used paper for all learning processes, inside and outside the classroom. The vocabulary sets were taken from the Academic Word List (AWL)—terms that are not often taught in elementary English classes but have a high frequency of use or a wide range of contexts in the scientific community—frequent words in the scientific literature. The sets used in this study consisted of 300 words divided into 10 vocabulary lists (1 per week, 1 vocabulary list). Each vocabulary list had 30 words.

Procedure

The course spanned 12 sessions, each lasting 100 min per week. Both the control and experimental groups followed an identical learning process, commencing with a pretest in week 1, followed by vocabulary instruction covering sets 1 to 10 from weeks 2 to 11, culminating in a post-test in week 12. In the initial session, students undertook a pretest and received materials for vocabulary set 1. Vocabulary teaching was executed within a flipped classroom framework, combining in-class and out-of-class learning. Outside classroom resources were dispensed a week prior to the class, for instance, vocabulary set 1, given at the conclusion of week 1 and employed in week 2. The control groups employed physical documents stored in folders, whereas the experimental groups accessed a *Quizlet* link. Within the classroom setting, the teacher provided additional support and facilitated discussions to encourage peer feedback. While the control groups adhered to traditional paper-based methods and classroom setups, the experimental groups leveraged gamified technological platforms. The final session encompassed a post-test for both groups. The details of this learning process are outlined in Table 1.

Table 1 Learning procedure

Week	Materials	Weekly learning tools and formative assessment application		
		Control group (paper-based method) Outside and Inside Classroom	Experimental group (game-based method)	
			Outside classroom	Inside classroom
1	Pre-test	Paper	–	Socrative
2	Vocabulary Set 1	Paper	Quizlet	Kahoot!, Socrative
3	Vocabulary Set 2	Paper	Quizlet	Quizizz, Socrative
4	Vocabulary Set 3	Paper	Quizlet	Google Form, Socrative
5	Vocabulary Set 4	Paper	Quizlet	Kahoot!, Socrative
6	Vocabulary Set 5	Paper	Quizlet	Quizizz, Socrative
7	Vocabulary Set 6	Paper	Quizlet	Google Form, Socrative
8	Vocabulary Set 7	Paper	Quizlet	Kahoot!, Socrative
9	Vocabulary Set 8	Paper	Quizlet	Quizizz, Socrative
10	Vocabulary Set 9	Paper	Quizlet	Google Form, Socrative
11	Vocabulary Set 10	Paper	Quizlet	Kahoot!, Socrative
12	Post-test	Paper	–	Socrative

Table 2 Students' background information

No.	Major	Control		Experimental	
		Freq	Percent	Freq	Percent
1	Railway Building and Track Technology	24	16.67	24	16.67
2	Railway Mechanical Technology	24	16.67	24	16.67
3	Railway Transportation Management	24	16.67	24	16.67
Total		72	50	72	50

Context and participants

This study involved the 1st-year students of an Indonesian university who took a General English course in the 2nd semester of the academic year 2022–2023. All of them were non-English major students. The total population was 216 students. In this study, groups of people with similar features were selected at random from the population using a stratified sampling method. The sample was characterized based on students' majors. After employing the sampling method, this study involved 144 students divided into 6 classes ranging from 18 to 21 years old (male = 83,33%, female = 16,67%).

There were 3 classes as control groups (C) and 3 classes as experimental groups (E), in which each class consisted of 24 students. Further, the participants of each group were divided into two proficiency levels: high (H) and low (L), based on their entrance test result. Students were categorized according to university academic standards, wherein a minimum score of 60 denoted high proficiency. The control group comprised 72 students (21 high proficiency and 51 low proficiency), mirroring the composition of the experimental group, which also included 72 students (24 high proficiency and 48 low proficiency). The students' background information can be seen in Table 2.

Considering the teachers who participated in this study, 3 teachers taught 2 classes each: one control and one experimental group. All participants, both students, and

teachers, have been informed to get their agreement to participate in this study and that their participation would be anonymous and confidential. Additional information for the students that their participation would not affect their course grades.

Data collection and instruments

The data for the study were gathered from students' test scores (pretest and posttest) and teachers' guided reflection. The pretest was used to know learners' proficiency levels and check their basic vocabulary knowledge. It consisted of 50 questions from vocabulary lists. All questions were in multiple-choice items, including words' definitions, sentence completion, part of speech, synonyms, and antonyms. Each component consisted of 10 numbers. The posttest was used to measure the effectiveness of the treatment given in vocabulary training. It differed in wording, yet, in the same format and level of difficulty as the pretest in order to avoid the threat to internal validity. All tests were done in the *Socrative* application for the experimental groups, while for control groups were given paper-based tests. The reliability of the test has been measured through internal consistency using *Cronbach's alpha* value, in which test–retest reliability was implemented. Based on the reliability statistics, *Cronbach's alpha* value of the tests is 0.731, with a range of 0.709 to 0.760 for each item. An instrument is valid if *Cronbach's alpha* value > 0.70. It means that all the test items are reliable. In the meantime, two separate raters—a native speaker from the United Kingdom and a native-like from the Philippines—check the correctness through content validity. Some grammatical errors and inappropriate words have been revised based on their feedback; subsequently, both validated that all items were valid.

Reflective learning in professional education covers what is being done, why it is being done, and how well students are learning. In this study, the teachers were asked to write their reflections on vocabulary learning using flipped classrooms with a gamified technology and a paper-based method in terms of vocabulary teaching strategies and the impact of the strategy in the classroom. 10 questions were given to guide the teachers in writing their reflections. The guided reflection was given in *Google Form* so that the teachers could easily write their teaching reflections under the questions given.

Data analysis

Since this study employed a sequential explanatory research design, the analyses were done based on quantitative and qualitative data; then, the results were combined to obtain more rigorous answers to the research questions. SPSS software was used to analyze the quantitative data, while the qualitative data were described to support the quantitative data. The quantitative data consisted of a pretest and a posttest, while the qualitative data consisted of teachers' reflection results.

Before analyzing the quantitative data, the normality of the data was examined through the value of *Skewness* and *Kurtosis.* If the *Skewness* and *Kurtosis* values ranged between -2 and $+2$, it indicated the normal distribution. After checking the results, the data indicated normal distribution or homogenous (Table 3), so the collected data were analyzed using a *Parametric* test. Specifically, the following statistical techniques were employed:

Table 3 Results of descriptive statistics

Test	N	Min	Max	M	SD	Skewness		Kurtosis	
						Value	SE	Value	SE
C Pre-	72	20.00	82.00	47.750	15.513	0.299	0.283	− 0.840	0.559
C Post-	72	24.00	86.00	53.833	14.931	0.096	0.283	− 0.657	0.559
E Pre-	72	8.00	66.00	37.527	11.105	0.279	0.283	0.342	0.559
E Post-	72	20.00	90.00	46.694	15.224	0.517	0.283	− 0.136	0.559

(1) To examine the effectiveness of flipped classroom with gamified technology and paper-based methods in teaching vocabulary for high- and low- proficiency students, *Paired-sample t-tests* were conducted on students' pretest and posttest scores.
(2) To compare the efficacy of flipped classrooms with gamified technology and paper-based methods for teaching vocabulary to students with high and low proficiency, an *ANOVA* was conducted on the students' pre- and post-test scores, and the results were supported by a mean plot.
(3) To reveal teachers' perception of flipped classroom with gamified technology and paper-based method in teaching vocabulary, thematic analysis was employed to add an insightful point of view based on teachers' perspectives.

Results

To confirm the homogeneity of the data, a descriptive statistic was run in SPSS 25 among the pretest and posttest of both control and experimental groups. The mean of the control group (N = 72) increased from 47.750 (SD = 15.513) to 53.833 (SD = 14.931), while in the experimental group (N = 72) improved from 37.527 (SD = 11.105) to 46.694 (SD = 15.224). Skewness and Kurtosis values in all data ranged between + 2 and − 2 (*Skewness* = 0.299, 0.096, 0.279, 0.517; *Kurtosis* = −0.840, −0.657, 0.342, −0.136), so the data were homogenous and could be analyzed using *parametric* tests.

Flipped classroom with gamified technology for teaching vocabulary

The results of *Paired sample t-test* in the experimental group showed a significant difference between the pretest and posttest in gamified technology classes (*Sig.* = 0.001) with a mean improvement of 6.083 (*SD* = 14.219, *t* = -3.630, *df* = 71). The *Pearson* coefficient indicated a moderate correlation between the pretest and posttest (*r* = 0.564). The effect size resulted in a medium effect between the pretest and posttest (*d* = 0.427). The results imply that gamified technology has effects in improving students' learning outcomes with medium effect size railway polytechnic students (Table 4).

Based on proficiency level, high-proficiency learners lessened their learning outcome with a mean reduction of 3.047 (*SD* = 13.320, *t* = 1.048, *df* = 20). The results of paired sample t-test showed no difference between the pretest and posttest (*Sig.* = 0.509) with weak correlation (*r* = 0.153) and small effect size (*d* = 0.153). These results reveal that gamified technology has no effect on students' learning outcomes toward high-proficiency students. On the other hand, low-proficiency learners improved their scores

Table 4 Results of paired sample t-test on experimental group

Paired sample statistics					
Test	**M**	**N**	**SD**	**SE mean**	**r**
All Pre-	47.750	72	15.513	1.828	0.564
All Post-	53.833	72	14.931	1.759	
H Pre-	68.190	21	5.6534	1.233	0.153
H Post-	65.142	21	12.9548	2.826	
L Pre-	39.333	51	7.0439	1.016	0.371
L Post-	49.176	51	14.6175	2.109	

Paired sample test									
	Paired differences					**t**	**df**	**Sig. (2-tailed)**	**d**
Pair pretest & posttest	**M**	**SD**	**SE mean**	**95% confidence interval of the difference**					
				Lower	**Upper**				
All	− 6.083	14.219	1.675	− 9.424	− 2.741	− 3.630	71	0.001	0.427
H	3.047	13.320	2.906	− 3.016	9.111	1.048	20	0.307	0.228
L	− 9.843	12.911	1.807	− 13.474	− 6.211	− 5.444	50	0.000	0.762

significantly with a mean upgrade of 9.843 ($SD = 12.911$, $t = -5.444$, $df = 50$). The paired sample t-test presented a significant difference between the pretest and postest ($Sig. = 0.000$) with weak correlation ($r = 0.371$) and medium effect size ($d = 0.762$). These results demonstrate that gamified technology significantly affects low-proficiency students' learning outcomes with a medium effect size.

Flipped classroom with paper-based method for teaching vocabulary

A *Paired sample t-test* was run in the control group to know the effect of the paper-based method for vocabulary teaching in a flipped classroom setting. The results showed that the paper-based method had a significant difference in the pretest and posttest ($Sig. = 0.000$) with a mean improvement of 9.166 ($SD = 16.913$, $t = -4.599$, $df = 71$). The *Pearson* coefficient described a very low correlation between the pretest and posttest ($r = 0.085$) with medium size effect ($d = 0.541$). The results of the analysis reveal that the paper-based method has effects to improve students' scores on vocabulary teaching in flipped classroom settings toward railway polytechnic students in general (Table 5).

Further, the analysis indicated different results when it was analyzed based on the students' level of proficiency. High-proficiency learners enhanced their scores by very low points (0.166), while low-proficiency learners enhanced higher points (13.833). The paper-based method had no difference on high-proficiency learners ($Sig = 0.957$, $SD = 14.825$, $t = 0.055$, $df = 23$) between the pretest and posttest with a very low correlation ($r = 0.040$) and very small effect ($d = 0.011$). On the other hand, the method had a significant difference in low-proficiency learners ($Sig = 0.000$, $SD = 16.057$, $t = -5.969$, $df = 47$) between the pretest and posttest with very high correlation ($r = 0.858$) and large small effect ($d = 0.861$). These results reveal that the paper-based method impacts low-proficiency learners to enhance their vocabulary scores, yet, it has no effect on high-proficiency learners.

Table 5 Results of paired sample t-test on control group

Paired sample statistics					
Test	**M**	**N**	**SD**	**SE mean**	**r**
All pre-	37.527	72	11.105	1.308	0.085
All post-	46.694	72	15.224	1.794	
H pre-	49.583	24	7.198	1.469	0.040
H post-	49.416	24	16.349	3.337	
L pre-	31.500	48	7.043	1.016	0.858
L post-	45.333	48	14.617	2.109	

Paired sample test									
	Paired differences					**t**	**df**	**Sig. (2-tailed)**	**d**
Pair pretest and posttest	**M**	**SD**	**SE mean**	**95% confidence interval of the difference**					
				Lower	**Upper**				
All	−9.166	16.913	1.993	−13.141	−5.192	−4.599	71	0.000	0.541
H	0.166	14.825	3.026	−6.093	6.426	0.055	23	0.957	0.011
L	−13.833	16.057	2.317	−18.495	−9.170	−5.969	47	0.000	0.861

Comparison of flipped classroom with gamified technology and paper-based method

Comparing the test results of experimental and control groups in one-way *ANOVA* showed a significant difference in students' vocabulary learning outcomes ($Sig = 0.000$). The students got different results in vocabulary teaching using gamified technology and paper-based method. The results were also found across high-proficiency learners of both groups ($Sig = 0.001$). It implies that there was a significant difference in their vocabulary learning outcomes among high-proficiency learners. However, across low-proficiency learners of experimental and control groups showed no difference in their average scores ($Sig = 0.172$). It reveals that low-proficiency students had no different results in learning using gamified technology or paper-based method. The results were supported by Tukey HSD analysis, which described no difference among low-proficiency students from the control and experimental groups and high-proficiency students from the control group. High-proficiency learners from experimental groups had different results among other groups of learners (Table 6).

Overall, the control group students got higher improvement ($M = 9.167$) than the experimental group ($M = 6.083$). Based on proficiency levels, the highest improvement was in low-proficiency learners in the control group ($M = 13.833$), followed by low-proficiency learners in the experimental group ($M = 9.843$). Nonetheless, there was no improvement in the high-proficiency learners' group. The analysis showed that the results slightly deteriorated for high-proficiency students in the control group ($M = -0.167$), and the peak decrease happened in high-proficiency students in the experimental group ($M = -3.048$). These results reveal that low-proficiency learners achieve higher scores in the paper-based method rather than in gamified technology during the teaching and learning process in flipped classroom settings. While high-proficiency learners could maintain their scores in the paper-based method, their average scores were decreased in gamified technology. However, high-proficiency

Table 6 Results of one-way ANOVA

	ANOVA					
		Sum of squares	**df**	**Mean square**	**F**	**Sig**
All	Between	5893.489	3	1964.496	9.743	0.000
	Within	28,228.483	140	201.632		
	Total	34,121.972	143			
H	Between	2769.906	1	2769.906	12.532	0.001
	Within	9504.405	43	221.033		
	Total	12,274.311	44			
L	Between	365.214	1	365.214	1.892	0.172
	Within	18,724.078	97	193.032		
	Total	19,089.293	98			

Tukey HSD[a,b]

Groups	**N**	**Subset for alpha = 0.05**	
		1	**2**
L C	48	45.333	
L E	51	49.176	
H C	24	49.416	
H E	21		65.142
Sig		0.672	1.000

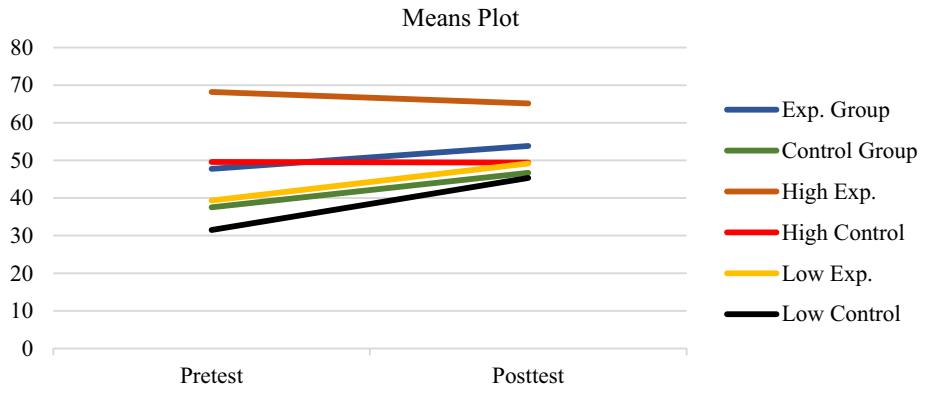

Fig. 2 Means plot

learners still got higher results than low-proficiency students in both control (paper-based) and experimental (gamified technology) groups (Fig. 2).

Teachers' perceptions

Thematic analysis was done on the results of teachers-guided reflective writing. The results were categorized into two main themes based on the treatment given to each group of students: gamified technology and paper-based method. Each theme consisted of four elements: process, effect, problem, and alternative solution. Three teachers were coded as T and a continuous number (T1, T2, and T3). At last, the

results of the thematic analysis were summarized and checked with the previous findings. The details are presented below.

Flipped classroom with gamified technology

Flipped classrooms with gamified technology allowed students to study before class so they were prepared when they arrived. Further, the students could learn independently instead of creating learning habits massively, which led to active learning. Gamified technology is considered to improve learners' enjoyment during the teaching and learning process.

> *T2: The impacts of this method are: students can learn independently, create learning habits massively, feel curious about new things, and create contextual experiences, and this is student-centered learning where the students involve actively in the process of learning.*

While this approach was expected to enhance vocabulary instruction for teachers and students, several challenges emerged. Particularly prominent were issues related to internet connectivity due to the prohibition of mobile phones in the classroom. The students relied on Wi-Fi during their in-class learning, leading to occasional disruptions. These problems resulted in hurdles that diminished students' engagement with the gamified technology-driven flipped classroom approach. Moreover, the restricted access to learning materials contradicted the flexible learning environment inherent to the flipped classroom model. Consequently, it is recommended to enhance internet connectivity services and permit students unrestricted use of their mobile phones to bolster their learning journey.

> *T3: However, the things that matter related to digital things are the connection to the internet. Sometimes, if the internet connection is low, the students cannot access the material given. In this case, the students are also prohibited from using their cell phones, and the internet connection is only allowed in classes and certain specified places. Thus, the students could not access it anytime they wanted due to limited internet connection.*
>
> *T1: As today is in the era of society 5.0, I think the students should get free access to their phones in order to support their learning experience outside the classroom, instead of improving internet connection services so that online learning materials can be easily accessible for them.*

Flipped classroom with paper-based method

Since the students had difficulties accessing the material in gamified technology due to the internet connection, the teachers thought the paper-based method could be an alternative solution. However, the paper-based was a conventional method that could create students' boredom. Thus, teachers had to monitor students' progress when implementing flipped classroom model, both in gamified technology or paper-based method.

> *T1: Flipped classrooms help Z-generation students learn English since they like using the internet. In the absence of the internet, paper-based material may work. These*

strategies are unlikely to succeed when students' motivation and self-regulation are poor. Flipped classrooms require teacher support.

Learning through the paper-based method needed extra work for both students and teachers. The students had to keep the paper which was easily broken, while the teachers were encouraged to motivate the students in order to achieve learning goals.

T2: Paper is not durable; it leads to breaking into pieces once it catches water/rain.
T3: Since the paper-based method is conventional, the teacher/lecturer needs to motivate students and analyze their progress toward learning goals.

Effective method for students with different proficiency levels

Learning in the flipped classroom setting is new and unconventional as well as challenging. Teachers have to do more preparation for the materials given to study outside the classroom before class. Having team teaching and collaboration with other English teachers might help to reduce the challenge. Yet, the students have to be motivated to have high self-regulation to learn outside the classroom to fulfill the learning goals. After teaching for 10 weeks, the teachers concluded that high-proficiency students could learn effectively with gamified technology and paper-based methods. However, gamified technology is supposed to be more effective. On the other hand, low-proficiency students were more effective in learning vocabulary in the paper-based method since internet connection problems and limited access to mobile phones became the main issues. Learning through paper would lessen their challenges as they did not need additional effort to open online materials.

T1 and T2: The game-based method seems more fun and effective for high-pro students, while low-proficiency students use paper-based methods.
T3: In my opinion, both methods could be given to high-proficiency students, but gamified technology is more challenging than paper-based. The students can use the internet and meet the new material given in different ways than usual. It will motivate them to join the method given. For low-proficiency students, the flipped classroom method is challenging and needs more effort if the students do not meet the maturity level of learning and have low self-regulation. Studying in a paper-based method will be less effort for them since it does not cause any confusion in implementing it rather than in gamified technology.

Discussion

The primary objective of the present study is to conduct a comparative analysis between flipped classrooms employing gamified technology and traditional paper-based methods in the context of teaching vocabulary. The study incorporates students' proficiency levels as a moderator variable, recognizing its pivotal role in shaping the methods of instruction within English as a Foreign Language (EFL) classrooms. The research design follows a sequential explanatory approach, with the initial quantitative findings showcasing the effectiveness of the gamified technology-driven flipped classroom model. This approach emerges as notably beneficial in enhancing overall vocabulary learning outcomes and specifically for students with low proficiency. These findings align with prior research indicating positive impacts of gamified technology on students' vocabulary scores

(Gokbulut, 2020; Rashid et al., 2019; Wardoyo et al., 2021) and its potential to yield significant improvements for low-proficiency students (Waluyo & Bakoko, 2021; Waluyo & Bucol, 2021). However, it is intriguing to note that this approach does not exhibit similar effectiveness for high-proficiency students, a contrast to the presumed notion that technology should invariably enhance learners' achievements (Cripps, 2020).

This discrepancy could potentially be attributed to various factors. For instance, limitations on mobile phone usage imposed by university regulations might hinder the high-proficiency students' engagement with the gamified technology. Moreover, challenges in maintaining a consistent internet connection during the teaching and learning process, both within and outside the classroom, could further impact the efficacy of the gamified approach. Consequently, high-proficiency students might need to invest more concerted efforts when navigating vocabulary learning through gamified technology within the flipped classroom framework. These intricate dynamics underscore the nuanced interplay between technological integration, pedagogical context, and regulatory constraints, which collectively influence the outcomes of vocabulary instruction for students across varying proficiency levels.

The second finding informed the effectiveness of flipped classroom with the paper-based method, which resulted in the same description as the first finding. It is effective for students in general and low-proficiency levels, yet, not for high-proficiency students. These results manifested a discrepancy toward some empirical studies, which claimed that most treatments were neglected for low-proficiency learners yet performed on those at high-proficiency levels (Alqahtani, 2015; Alshammari, 2022). In this study, both treatments accomplish to low-proficiency students but abort for high-proficiency students.

Comparing both treatments, the third finding explains that the paper-based method is more effective in boosting students' vocabulary scores than gamified technology, both in general conditions and at different proficiency levels. It discloses slight differences with other reports that have examined gamified technology and paper-based method. For instance, Rachels and Rockinson-Szapkiw (2018) found no difference between the learning outcomes of the class that utilized gamification and the paper-based method. In the present study, gamified technology is not effective might be caused by internet connection problems and the limitation of mobile access, making it difficult for students to study at their own pace. The integration of digital game applications, which are anticipated to be enjoyable, convenient, and user-friendly (Landers, 2014; Plass et al., 2015), presents a challenge as students are limited to accessing them exclusively through laptops in locations with reliable internet connectivity, such as the library, classroom, or canteen. Consequently, the utilization of gamified technology falls short of aligning with the inherent goal of the flipped classroom model to establish a student-centric learning environment both within and beyond the traditional confines of the classroom. This impediment becomes particularly evident in the context of outside classroom engagement, where the students' ability to interact with the materials is hindered by the stringent physical environment and the absence of adequate infrastructure.

The motivation of creating a well-rounded student-centred learning atmosphere that extends seamlessly from in-class to out-of-class experiences encounters hindrances due to the restrictive reliance on laptops and stable internet connections for accessing

gamified technology. This limitation not only disrupts the envisioned fluidity of the flipped classroom approach but also hampers the broader objective of fostering independent and flexible learning experiences for students. The resulting scenario underscores the need for a more comprehensive and accessible technological infrastructure to effectively realize the aspirations of the flipped classroom pedagogy, which places a strong emphasis on facilitating a holistic and dynamic learning environment for students within and beyond the conventional classroom boundaries.

In the last findings, the teachers confirmed that flipped classroom promotes independent and active learning as it offers a student-centered model. It is consistent with the concept of the flipped classroom that engages students' participation in the classroom since they have learned outside the classroom without restriction (Anggoro & Khasanah, 2022; Egbert et al., 2015; Pratiwi et al., 2022). Although flipped classroom reinforces technology integration, the teachers prefer to teach using the paper-based method for low-proficiency students. On the other hand, gamified technology is more relevant for high-proficiency students. This notion arises due to the challenges that have to be encountered in studying through gamified technology.

It is worth mentioning that flipped classroom successfully facilitates vocabulary teaching to improve students' vocabulary learning outcomes. Outside classroom activities give a chance for students to practice and assist their vocabulary comprehension, while inside the classroom could be used to reconstruct vocabulary knowledge to stimulate active learning. This assumption aligns with the vocabulary training strategies that Lavoie (2016) and Miller (1995) proposed. Considering the vocabulary teaching method, gamified technology or paper-based method could be implemented as those two methods result in equivalence in students' vocabulary scores enhancement. Therefore, teachers are advised to analyze students' proficiency levels and check educational infrastructure before determining teaching methods in the classroom to avoid unnecessary challenges.

Conclusion

This study has revealed the effectiveness of flipped classroom with gamified technology and paper-based method. The results showed a non-significant difference in gamified technology, yet there has been a significant difference in the paper-based method. It informs that the paper-based method is more effective than gamified technology in teaching vocabulary for non-English major students in general or in different learners' proficiency. To some extent, the result differs from previous studies due to challenges that emerged during the teaching process. It also contradicts teachers' belief that assumed gamified technology is more effective for high-proficiency learners while the paper-based method is more effective for low-proficiency learners. Technology limitation creates another issue that provokes students to not learn in their convenient learning environment. Indeed, it is difficult to assess the learning materials. Hence, gamified technology method could not effectively improve students' vocabulary scores; even this method decreases students' scores.

As much as this study intends to offer, several limitations have to be acknowledged. The present study focuses on teaching vocabulary and teachers' reflection. Students' perceptions are not examined, so the teaching method implemented from students' points of view cannot be analyzed further. Moreover, there are some challenges due to the

technological devices that create obstacles during the teaching process. It is suggested for future research to analyze based on students' points of view and equip learning environment.

Author contributions
DIP made contributions to design the study, wrote introduction, literature review, and analyzed the datasets. SWF made contributions to write abstract, introduction, and interpreted the results of the study. IY made contributions to wrote literature review and decided the research methodology used in the study. BW made contributions to wrote research methodology, conclusion and reference lists. All authors read and reviewed the manuscript, then approved the final manuscript.

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Availability of data and materials
The datasets generated and analysed during the current study are not publicly available because the participants gave consent to use of their data only for the purpose of the research, but are available from the corresponding author on reasonable request.

Declarations

Ethical approval and consent to participate
A statement on ethics approval was obtained from PPI Madiun, and informed consent were obtained from all 147 participants before they take part in the study.

Competing interests
The authors declare that they have no competing interests.

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