The Effect of AR/VR-Based Flashcards in a Flipped Classroom on Young EFL Learners' Vocabulary Mastery

Bunga Ayu Lolyta
English Education Department, Universitas Persatuan Guru Republik Indonesia Semarang, Indonesia
bungaa.lolyta@gmail.com

Lusia Maryani Silitonga
English Education Department, Universitas Persatuan Guru Republik Indonesia Semarang, Indonesia
lusiamaryanisilitonga@upgris.ac.id

ABSTRACT

The integration of immersive technology in language education offers promising opportunities for improving vocabulary mastery. This study investigated the effect of integrating AR/VR-based flashcards in a flipped classroom on young EFL learners' vocabulary mastery. A quantitative design was conducted with 30 young learners of K-4, who completed three tests using a speaking rubric adapted from school-level standard Vocabulary assessment. Results showed a significant improvement in most students, with an overall mean score of 71.00. The findings suggest that AR/VR tools combined with flipped instruction can enhance learners' vocabulary mastery, particularly in early language education contexts. Furthermore, the results have practical implications for language educators and curriculum developers to integrate immersive, student-centered tools in foundational language learning.

Keywords: AR/VR, flipped classroom, vocabulary mastery, speaking assessment, young EFL learners.

Introduction

The accelerated development of digital technologies has transformed education, offering new paths to create more interactive and meaningful learning environments (Al-Ansi et al., 2023; Getenet et al., 2024; Kurnia et al., 2025; Silitonga et al., 2024; Suciati et al., 2024). Despite this, many classrooms still rely on a traditional approach, like teacher-centered approaches (Alsowat, 2016; Huang et al., 2023; Huang et al., 2022; Lin et al., 2024; Song et al., 2024). As young learners today are surrounded by digital media,

including video games and virtual content, there is a crucial requirement to reimagine how a language is taught in schools (Huang et al., 2022; Song et al., 2024; Vretos et al., 2019).

The flipped classroom model has developed as a promising alternative, shifting passive content delivery to students' study time and using classroom sessions for active yet collaborative learning (Pusparini et al., 2025; Qu & Miao, 2021; van Alten et al., 2019). Studies have shown that the flipped instruction supports deeper understanding, improves classroom interaction, and nurtures learner autonomy (Del Arco Bravo et al., 2019; Huang et al., 2022; Ma et al., 2019; Schallert & Lavicza, 2020; Silitonga, et al., 2024; Vitta & Al-Hoorie, 2023). While vocabulary is foundational to communication, flipped classrooms have been combined with tools like flashcards to strengthen learners' exposure to new words (Linda & Shah, 2020; Parmaxi & Demetriou, 2020; Pratiwi et al., 2022; Pusparini et al., 2025; Rahman et al., 2023; Teng, 2022; Wahyuningsih & Fitriani, 2022; Yuan et al., 2024; Zarrati et al., 2024).

Digital and immersive flashcards continue to be widely used for promoting speaking skills retention through repetition and visual cues (Rahman et al., 2023; Wahyuningsih & Izzah, 2023). Recent studies suggest that Augmented Reality (AR) and Virtual Reality (VR) can accelerate this process even more effectively by providing context-rich, interactive experiences that stimulate memory and learner motivation (Angelelli et al., 2023; Huang et al., 2023; Peng et al., 2023; Wu et al., 2024). However, the majority of these studies focus on surface-level outcomes like vocabulary recall or recognition, often assessed through multiple-choice or matching assignments (Haoming & Wei, 2024; Zarrati et al., 2024).

As reported by Parsazadeh et al., (2021), creativity and engagement improved through computational thinking and digital storytelling, yet the study focused more on general ICT than language learning. Weerasinghe et al., (2022) found that keyword-based AR improved vocabulary and speaking retention, but without addressing classroom implementation. Huang et al., (2022) demonstrated that a flipped classroom using business simulation games increased participation, but did not explore AR/VR or language outcomes. Silitonga et al., (2024) showed improved motivation via AI chatbot learning, yet lacked focus on speaking skills or immersive experiences. Al-Ansi et al., (2023) noted interest in AR/VR tools but identified a few empirical studies involving young learners. Lin et al., (2024) confirmed that VR's effect on engagement, but not in flipped models or primary education. Studies by Suciati et al., (2024), Wiyaka et al., (2024), and Figueroa & Jung, (2025), Pratiwi et al., (2022), Teng (2022); Wahyuningsih & Afandi, (2020), Yuan et al., (2024) shared similar limitations.

A considerable amount of research focuses on speaking skills, but few examine how immersive technologies impact vocabulary mastery in young learners. This study addresses that gap through a quantitative design investigating AR/VR-based flashcards in a flipped classroom setting. The main contribution of this study is its integrated focus on immersive technology, early learners, and cognitive engagement in language learning. Therefore, this study aims to investigate how AR/VR-based flashcards enhance young EFL learners' vocabulary mastery.

Methods

This study applied a quantitative design to investigate the impact of AR/VR-based flashcards with a flipped classroom approach on improving EFL students' vocabulary mastery (Saraswati & Devi, 2023). The participants were 30 young EFL learners from a private primary school in Semarang, in K-4, using a flipped classroom model. Individual oral performance tasks were assessed using a rubric adapted from a school-level standard vocabulary assessment that evaluated five criteria, namely, vocabulary use, pronunciation, fluency, grammar, and comprehensibility. Each dimension was rated from 0-100, with higher scores indicating better performance.

Table 1. Vocabulary Assessment Rubric

Score	Vocabulary Use	Description
0-44	Poor	Very limited vocabulary range. Word usage is often unclear or incorrect.
45-59	Fair	Limited vocabulary range. Frequent errors reduce clarity.
60-74	Satisfactory	Basic vocabulary. Some repetition or unclear word choices.
75-89	Good	Good range. Minor word choice issues.
90-100	Excellent	Wide, accurate, and effective vocabulary use.

A quantitative approach was conducted, involving three stages of speaking assessment administered to 30 students throughout the study. The data were analyzed using descriptive statistics (Creswell, 2020). Mean scores for each student were calculated to observe the pattern of improvements.

To analyze the results, the mean score (average) was calculated for speaking test performance using the following formula:

$$\text{Mean} = \frac{\sum X}{N}$$

Where:

$\sum X$ = The sum of all students' total scores.

N = The number of students in the group.

·Discussion

As shown in Table 2, the findings of this study show that integrating AR/VR-based flashcards in a flipped classroom significantly improved vocabulary mastery. The descriptive analysis of young EFL learners' vocabulary mastery showed significant improvements across the three assessments. The mean score for each student was calculated based on their performance in Test 1 (59.00), Test 2 (69.83), and Test 3 (84.17). The overall mean score was 71.00, indicating an enhanced level of achievement.

Table 2. Mean Scores in Speaking-Based Vocabulary Assessment

No	Students	Test 1	Test 2	Test 3
1	An	65	70	85
2	Ah	60	70	75
3	Ey	55	75	80
4	Vi	70	75	90
5	El	40	70	80
6	Me	50	70	85
7	Za	60	65	75
8	De	50	70	85
9	Ea	50	65	80
10	Da	50	65	80
11	Aq	50	70	88
12	To	65	70	80
13	Dy	60	70	80
14	Aa	50	65	80
15	Se	50	65	75
16	Ka	50	60	80
17	Mi	60	70	80
18	Di	60	70	85
19	Ke	60	70	75
20	Fa	50	60	80
21	Ci	55	75	90
22	Au	60	70	85
23	At	60	70	85
24	Bu	60	70	85
25	Ak	60	70	80

26	Na	50	75	90
27	Sy	60	70	75
28	Ji	70	75	80
29	Zo	65	70	85
30	Em	65	70	70
Mean Score per Test		**59.00**	**69.83**	**84.17**
Overall Mean Score				**71.00**

These results are aligned with previous research on the benefits of integrating digital learning tools, especially in vocabulary mastery (Huang et al., 2023; Silitonga et al., 2023; Silitonga et al., 2024; Suciati et al., 2024). This research also addresses a crucial gap in the literature by combining immersive technologies with a flipped classroom setting for young EFL learners. It demonstrates that even beginner-level young learners can benefit from AR/VR when they are guided properly, particularly in speaking tasks that require active vocabulary use. Overall, the results provide evidence that technology-enhanced flipped instruction is effective and impactful for young learners.

Conclusion

This research examined the use of AR/VR-based flashcards in a flipped classroom to find out the improvement of 30 young EFL learners' vocabulary mastery through speaking using a quantitative descriptive design across three tests. The analysis shows improved performance in most students, with an overall mean score of 71.00.

These results suggest that repeated speaking tasks may support vocabulary development over time, too. Despite these promising findings that significantly enhance vocabulary mastery, this study has some limitations due to its small sample size, short duration, focus on spoken vocabulary assessment, and did not compare between instructional methods. Broader studies with longer interventions and diverse assessment formats are recommended to validate and extend these discussions.

The results offer practical insights for teachers and curriculum developers. AR/VR-supported flipped learning can boost vocabulary learning, particularly in early language education.

References

Al-Ansi, A. M., Jaboob, M., Garad, A., & Al-Ansi, A. (2023). Analyzing augmented reality (AR) and virtual reality (VR) recent development in education. *Social Sciences and Humanities Open*, *8*(1), 100532. https://doi.org/10.1016/j.ssaho.2023.100532

Alsowat, H. (2016). An EFL flipped classroom teaching model: Effects on English language higher-order thinking skills, student engagement and satisfaction. *Journal of Education and Practice*, *7*(9), 108–121.

Angelelli, C. V., Ribeiro, G. M. de C., Severino, M. R., Johnstone, E., Borzenkova, G., & da Silva, D. C. O. (2023). Developing critical thinking skills through gamification. *Thinking Skills and Creativity*, *49*(August 2022), 101354. https://doi.org/10.1016/j.tsc.2023.101354

Brown, H. D. (2004). *longman.com* (1st ed.). Pearson Education ESL. https://doi.org/10.1177/0265532207086784

Creswell, J. W. (2020). Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research, Global Edition- Sixth Edition. In *Pearson Education ESL* (6th ed., Vol. 62, Issue 1). Pearson Education ESL.

Del Arco Bravo, I., Alarcia, Ó. F., & García, P. S. (2019). The development of the model flipped classroom at university: Impact of its implementation from student voice. In *Revista de Investigacion Educativa* (Vol. 37, Issue 2, pp. 451–469). Asociacion Interuniversitaria de Investigacion en Pedagogia. https://doi.org/10.6018/rie.37.2.327831

Figueroa, R. B., & Jung, I. (2025). Integrating VR tours in online language learning: A design-based research study. In *Australasian Journal of Educational Technology* (Vol. 2025, Issue 1).

Getenet, S., Cantle, R., Redmond, P., & Albion, P. (2024). Students' digital technology attitude, literacy and self-efficacy and their effect on online learning engagement. *International Journal of Educational Technology in Higher Education*, *21*(1). https://doi.org/10.1186/s41239-023-00437-y

Haoming, L., & Wei, W. (2024). A systematic review on vocabulary learning in AR and VR gamification context. *Computers & Education: X Reality*, *4*(December 2023), 100057. https://doi.org/10.1016/j.cexr.2024.100057

Huang, Y. M., Silitonga, L. M., & Wu, T. T. (2022). Applying a business simulation game in a flipped classroom to enhance engagement, learning achievement, and higher-order thinking skills. *Computers and Education*, *183*(June 2021), 104494. https://doi.org/10.1016/j.compedu.2022.104494

Huang, Y., Silitonga, L. M., Murti, A. T., & Wu, T. (2023). *Learner Engagement in a Business Simulation Game : Impact on Higher-Order Thinking Skills*. *61*(1), 96–126. https://doi.org/10.1177/07356331221106918

Kurnia, C., Guru, U. P., & Semarang, R. I. (2025). *Impact of Reading Eggs on Reading Skills : A TaRL-Based Study of Age and Gender Dynamics*. *6*(1), 79–90. https://doi.org/10.51454/jet.v6i1.478

Lin, X. P., Li, B. Bin, Yao, Z. N., Yang, Z., & Zhang, M. (2024). The impact of virtual reality on student engagement in the classroom–a critical review of the literature. In *Frontiers in Psychology* (Vol. 15). Frontiers Media SA. https://doi.org/10.3389/fpsyg.2024.1360574

Linda, A., & Shah, P. M. (2020). Vocabulary Acquisition Style in the ESL Classroom: A Survey on the Use of Vocabulary Learning Strategies by the Primary 3 Learners. *Creative Education*, *11*(10), 1973–1987. https://doi.org/10.4236/ce.2020.1110144

Ma, X., Su, Y., Liu, J., & Li, S. (2019). *Design and Test of Flipped Classroom Learning Support Model in Mobile Learning Environment*. 246–261. https://doi.org/10.4236/ce.2019.102020

Missildine, K., Fountain, R., Summers, L., & Gosselin, K. (2013). Flipping the classroom to improve student performance and satisfaction. *The Journal of Nursing Education*, *52*(10), 597–599. https://doi.org/10.3928/01484834-20130919-03

Parmaxi, A., & Demetriou, A. A. (2020). Augmented reality in language learning: A state-of-the-art review of 2014–2019. *Journal of Computer Assisted Learning*, *36*(6), 861–875. https://doi.org/https://doi.org/10.1111/jcal.12486

Parsazadeh, N., Cheng, P. Y., Wu, T. T., & Huang, Y. M. (2021). Integrating Computational Thinking Concept Into Digital Storytelling to Improve Learners' Motivation and Performance. *Journal of Educational Computing Research*, *59*(3), 470–495. https://doi.org/10.1177/0735633120967315

Peng, H. H., Murti, A. T., Silitonga, L. M., & Wu, T. T. (2023). Effects of the Fundamental Concepts of Computational Thinking on Students' Anxiety and Motivation toward K-12 English Writing. *Sustainability (Switzerland)*, *15*(7). https://doi.org/10.3390/su15075855

Pratiwi, D. I., Ubaedillah, U., Puspitasari, A., & Arifianto, T. (2022). Flipped Classroom in Online Speaking Class at Indonesian University Context. *International Journal of Instruction*, *15*(2), 697–714. https://doi.org/10.29333/iji.2022.15238a

Pusparini, L. A., & Silitonga, L. M. (2025). *Artificial Intelligent Supported Duolingo : Enhancing Students ' Speaking Skills and Reducing Speaking Anxiety in Vocational Education*. *37*(1), 91–111. https://doi.org/10.23917/varidika.v37i1.10431

Qu, X., & Miao, R. (2021). Research of Learning Strategies in Flipped Classroom. *OALib*, *08*(05), 1–8. https://doi.org/10.4236/oalib.1107398

Rahman, M. A., Faisal, R. R., & Tho, C. (2023). The Effectiveness of Augmented Reality Using Flash Card in Education to Learn Simple English Words as a Secondary Language. *Procedia Computer Science*, *227*, 753–761. https://doi.org/10.1016/j.procs.2023.10.580

Saraswati, P., & Devi, A. (2023). Mixed Methods-Research Methodology an Overview. *Nursing and Health Care*, *5*(4), 1–3. https://doi.org/10.30654/mjnh.100024

Schallert, S., & Lavicza, Z. (2020). Implementing Augmented Reality In Flipped Mathematic Classrooms To Enable Inquiry-Based Learning. *Proceedings of 14 Th International Conference on Technology in Mathematics Teaching*, *May*, 1–8. https://www.researchgate.net/profile/Daniel-Thurm/publication/341622852_Proceedings_of_the_14th_International_Conference_on_Technology_in_Mathematics_Teaching_-_ICTMT_14/links/5ecbdf27a6fdcc90d698322c/Proceedings-of-the-14th-International-Conference-on-Te

Silitonga, L. M., Hawanti, S., Aziez, F., Furqon, M., Zain, D. S. M., Anjarani, S., & Wu, T. T. (2023). The Impact of AI Chatbot-Based Learning on Students' Motivation in English Writing Classroom. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *14099 LNCS*, 542–549. https://doi.org/10.1007/978-3-031-40113-8_53

Silitonga, L. M., Wiyaka, Suciati, S., & Prastikawati, E. F. (2024). The Impact of Integrating AI Chatbots and Microlearning into Flipped Classrooms: Enhancing Students' Motivation and Higher-Order Thinking Skills. *Lecture Notes in Computer*

▪ *Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *14786 LNCS*, 184–193. https://doi.org/10.1007/978-3-031-65884-6_19

Silitonga, L. M., Wiyaka, W., & Prastikawati, E. F. (2024). Boosting Students' ESP Vocabulary by Utilizing AI Chatbot. *ETERNAL (English Teaching Journal)*, *15*(2), 275–283. https://doi.org/10.26877/eternal.v15i2.605

Song, Y., Wu, K., & Ding, J. (2024). Developing an immersive game-based learning platform with generative artificial intelligence and virtual reality technologies – "LearningverseVR." *Computers & Education: X Reality*, *4*(May), 100069. https://doi.org/10.1016/j.cexr.2024.100069

Suciati, S., Silitonga, L. M., Wiyaka, Huang, C. Y., & Anggara, A. A. (2024). Enhancing Engagement and Motivation in English Writing Through AI: The Impact of ChatGPT-Supported Collaborative Learning. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *14786 LNCS*, 205–214. https://doi.org/10.1007/978-3-031-65884-6_21

Teng, M. F. (2022). Incidental L2 vocabulary learning from viewing captioned videos: Effects of learner-related factors. *System*, *105*. https://doi.org/10.1016/j.system.2022.102736

van Alten, D. C. D., Phielix, C., Janssen, J., & Kester, L. (2019). Effects of flipping the classroom on learning outcomes and satisfaction: A meta-analysis. *Educational Research Review*, *28*(March), 1–18. https://doi.org/10.1016/j.edurev.2019.05.003

Vitta, J. P., & Al-Hoorie, A. H. (2023). The flipped classroom in second language learning: A meta-analysis. *Language Teaching Research*, *27*(5), 1268–1292. https://doi.org/10.1177/1362168820981403

Vretos, N., Daras, P., Asteriadis, S., Hortal, E., Ghaleb, E., Spyrou, E., Leligou, H. C., Karkazis, P., Trakadas, P., & Assimakopoulos, K. (2019). Exploiting sensing devices availability in AR/VR deployments to foster engagement. *Virtual Reality*, *23*(4), 399–410. https://doi.org/10.1007/s10055-018-0357-0

Wahyuningsih, S., & Afandi, M. (2020). Investigating English speaking problems: Implications for speaking curriculum development in Indonesia. *European Journal of Educational Research*, *9*(3), 967–977. https://doi.org/10.12973/EU-JER.9.3.967

Wahyuningsih, S., & Fitriani, F. N. (2022). Incorporating English Vocabulary Through the Use of Poster Media for Elementary School Students. *Edulingua: Jurnal Linguistiks Terapan Dan Pendidikan Bahasa Inggris*, *8*(2), 13–22. https://doi.org/10.34001/edulingua.v8i2.2027

Wahyuningsih, S., & Izzah, N. S. (2023). Introducing english vocabulary to young learners through flashcards: evidence from Indonesian elementary school teachers. *Jurnal Ilmiah Pendidikan Dasar*, *10*(2), 88. https://doi.org/10.30659/pendas.10.2.88-99

Weerasinghe, M., Biener, V., Grubert, J., Quigley, A., Toniolo, A., Pucihar, K. C., & Kljun, M. (2022). VocabulARy: Learning Vocabulary in AR Supported by Keyword Visualisations. *IEEE Transactions on Visualization and Computer Graphics*, *28*(11), 3748–3758. https://doi.org/10.1109/TVCG.2022.3203116

Wiyaka, W., Silitonga, L. M., Sunardi, S., & Pramudi, Y. T. C. (2024). From Nervous to Fluent: The Impact of AI Chatbot-Assisted Assessment on English Reading Anxiety and Performance in Indonesia. *Theory and Practice in Language Studies*, *14*(12), 3851–3860. https://doi.org/10.17507/tpls.1412.20

Wu, T. T., Silitonga, L. M., & Murti, A. T. (2024). Enhancing English writing and higher-order thinking skills through computational thinking. *Computers and Education*, *213*(January 2023), 105012. https://doi.org/10.1016/j.compedu.2024.105012

Yuan, H., Kleemans, T., & Segers, E. (2024). The role of the traditional and digital home literacy environment in Chinese Kindergartners' language and early literacy. *Early Childhood Research Quarterly*, *67*, 67–77. https://doi.org/10.1016/J.ECRESQ.2023.11.009

Zarrati, Z., Zohrabi, M., Abedini, H., & Xodabande, I. (2024). Learning academic vocabulary with digital flashcards: Comparing the outcomes from computers and smartphones. *Social Sciences and Humanities Open*, *9*(November 2023), 100900. https://doi.org/10.1016/j.ssaho.2024.100900