

The Effect of Using Miro-Based Interactive Whiteboards on Learning of Phrasal Verbs and Improving EFL Learners' Engagement in a Technology-Enhanced Classroom

Mitra Shayanfar¹, Ali Roohani²

¹ Corresponding Author, Department of English, Faculty of Letters & Humanities, Shahrekord University, Shahrekord, Iran. mitrashayanfar22@gmail.com

² Department of English, Faculty of Letters & Humanities, Shahrekord University, Shahrekord, Iran. roohani.ali@gmail.com

Article Info	Abstract
Article type: Research Article Article history: Received September 24, 2025 Received in revised form May 17, 2026 Accepted June 16, 2026 Published online June 28, 2026 Keywords: technology-enhanced classroom, interactive whiteboard, Miro, phrasal verbs, student engagement.	A technology-enhanced classroom provides access to a combination of learning and technology. Despite the growing adoption of interactive whiteboards (IWBs) as potential instructional technologies in language classrooms, there is a lack of experimental research on their effectiveness in teaching phrasal verbs, a difficult structure for EFL learners due to their idiomatic and syntactic complexity. Moreover, no previous study has examined the impact of IWB-based instruction on all three dimensions of learner engagement (affective, behavioral, and cognitive). Therefore, this study investigated the effect of IWBs, along with traditional (non-IWB) instruction, on the learning of English phrasal verbs and learners' engagement. Using a quasi-experimental pretest-posttest design with convenience sampling, 60 female English learners (at intermediate level) from a high school in Isfahan were assigned to two groups: the IWB and non-IWB groups, each with 30 English learners. The first group received instruction on phrasal verbs via the Miro IWB for 6 weeks. The non-IWB group received traditional teacher-fronted instruction using a conventional classroom whiteboard. A 40-item phrasal verb test and Lam and Jimerson's (2014) Student Engagement Scale served as the pretest and posttest measures, respectively. The results of a one-way analysis of covariance (ANCOVA) showed that the IWB-based instruction was significantly more effective than the traditional method for phrasal verb learning and overall student engagement. The findings provide practical evidence for integrating Miro-based interactive whiteboards into EFL classes to enhance both lexical learning and learner engagement.

Cite this article: Shayanfar, M., & Roohani, A. (2026). The Effect of Using Miro-Based Interactive Whiteboards on Learning of Phrasal Verbs and Improving EFL Learners' Engagement in a Technology-Enhanced Classroom. *Technology Assisted Language Education*, (), 49-67. doi: 10.22126/tale.2026.12866.1144



© The Author(s).

Publisher: Razi University.

DOI: <http://doi.org/10.22126/tale.2026.12866.1144>

Introduction

In today's classrooms, the integration of technology has become increasingly important. One central tool in a technology-enhanced classroom is the interactive whiteboard (IWB). When used effectively, IWBs can foster student learning, motivation, and engagement (Shi et al., 2021), particularly in challenging linguistic areas like vocabulary acquisition (Kuhl & Wohnisland, 2022). However, due to a lack of experimental studies, little is known about how students' learning develops through different forms of IWB use in the classroom, which may explain potential differences in student engagement.

The incorporation of IWBs, such as Miro, has transformed traditional teaching by enabling collaborative learning through various visual aids (Wang et al., 2019). Prior studies indicate that IWBs have the potential to foster pedagogical skills and improve active learning by providing access to digital content and interactive features (Bidaki & Mobasher, 2013). For instance, through IWBs like Miro, students are provided with an infinite canvas and real-time communication features, enabling the whole class to interact simultaneously while overcoming the spatial limitations of traditional whiteboards. The use of technology-enhanced classrooms that employ IWBs such as Miro is supported by Vygotsky's sociocultural theories of collaborative learning, which hold that interaction with others and scaffolding foster language acquisition (Thompson & Yuen, 2022).

Miro has more advantages over other IWBs, such as Jamboard, Smart Notebook, and Explain Everything: (1) it is completely free with no institutional subscription required; (2) it supports Persian (Farsi) language interfaces, reducing cognitive load for Iranian students; (3) it allows asynchronous collaboration, meaning students could contribute outside class hours; (4) it requires no sign-up or login for basic use, eliminating technical barriers. These features can make Miro particularly suitable for a public high school setting, such as the one in Iran with limited IT support. Despite these advantages, the effectiveness of IWBs is greatly linked to their pedagogical implementation (Bidaki & Mobasher, 2013). Although some studies in applied linguistics yield mixed results, meta-analyses indicate that interactive features (e.g., visual aids, gamification, drag-and-drop exercises) are necessary for higher achievement in language learning (Mariz et al., 2017).

The current study aimed to investigate whether Miro's interactive features can significantly affect foreign language learners' phrasal verb learning and engagement, addressing gaps in the existing literature regarding the role of interactive whiteboards in EFL classes in Iran. While previous studies have examined IWBs for general vocabulary learning (Kuhl & Wohnisland, 2022) or motivation (Ali Bakhshi et al., 2019), very few have focused on phrasal verbs, a difficult structure for EFL learners due to their idiomatic and syntactic complexity. Moreover, no prior study has simultaneously investigated the effect of IWBs on all three dimensions of engagement (affective, behavioral, and cognitive) in relation to phrasal verb learning. Furthermore, existing research has typically used very short interventions (e.g., one 45-minute lesson) or small samples.

Theoretically, IWBs like Miro afford multimodal, interactive, and collaborative learning environments. These affordances directly address the two main difficulties of phrasal verbs (opaque meaning and particle selection) by allowing students to manipulate verb-particle combinations and receive immediate feedback visually. Simultaneously, the interactive nature of IWBs increases behavioral engagement (physical interaction), affective engagement (enjoyment and reduced anxiety), and cognitive engagement (deeper processing through problem-solving). Thus, IWB use is hypothesized to improve both phrasal verb learning and engagement.

In summary, vocabulary learning is a complex and important process, particularly for phrasal verbs, which are often linked to grammatical functions (Mahdavi & Bagheri, 2014). A phrasal verb has two components: a verb and a particle. In some cases, the meaning cannot be predicted simply from the verb and particle in isolation (e.g., “turn on”). Therefore, learning phrasal verbs is challenging for learners due to their number, forms, and multiple meanings (Side, 1990). Learner engagement is another important factor in academic success. Engagement can be defined as learners’ cognitive, emotional, behavioral, and social involvement in the learning process. Some studies (e.g., Appleton et al., 2008; Shernoff & Schmidt, 2008) indicate that engagement fosters performance and is a powerful predictor of achievement and classroom behavior. Despite the importance of learning phrasal verbs and student engagement in EFL learning, there is a dearth of research on the effect of IWB use on developing different types of engagement and phrasal verb learning. Keeping the above points, this study adopted a pretest-posttest quasi-experimental control group design to address the following questions:

- Is there a significant difference in posttest phrasal verb performance between the EFL learners taught through IWB-based instruction (Miro) and those taught through traditional teacher-fronted instruction (without IWB)?
- What is the effect of using Miro on learners’ affective, behavioral, and cognitive engagement, after controlling for pretest engagement scores?

Literature review

IWBs, Phrasal Verbs, and Engagement

The present study is situated at the intersection of three constructs: interactive whiteboard (IWB) technology, phrasal verb learning, and learner engagement. Phrasal verbs present unique learning difficulties (idiomaticity, particle selection, syntactic flexibility) that require explicit, multimodal, and contextualized instruction (Bakhshi, 2019; Spring & Takeda, 2024). IWBs offer affordances, drag-and-drop manipulation, immediate visual feedback, collaborative annotation, and gamification that directly address these difficulties. For example, drag-and-response mechanisms have been shown to facilitate awareness and collaborative performance in technology-mediated learning environments (Hwang et al., 2013). These same affordances are hypothesized to enhance learner engagement across behavioral, affective, and cognitive dimensions. Empirical studies indicate that IWB use can significantly increase learner

motivation (Bakhshi, 2019; Hall & Higgins, 2005) and that interactive, collaborative features of IWBs lead to higher levels of attention and satisfaction (Mercer et al, 2010). Thus, the central premise of this review is that the IWB-based method is not merely a delivery mechanism but a pedagogical approach that can simultaneously improve both learning outcomes and engagement with complex lexical items such as phrasal verbs.

Interactive Whiteboards in Language Education

The interactive whiteboard is a touch-sensitive digital display connected to a computer and projector, offering features such as drag-and-drop, hide-and-reveal, highlighting, and real-time annotation (Smith et al., 2005). In language classrooms, IWBs have been promoted as tools that can transform teacher-fronted instruction into multimodal, collaborative learning environments (Wang et al., 2019). The outline of the IWB-based approach is illustrated in Figure 1.

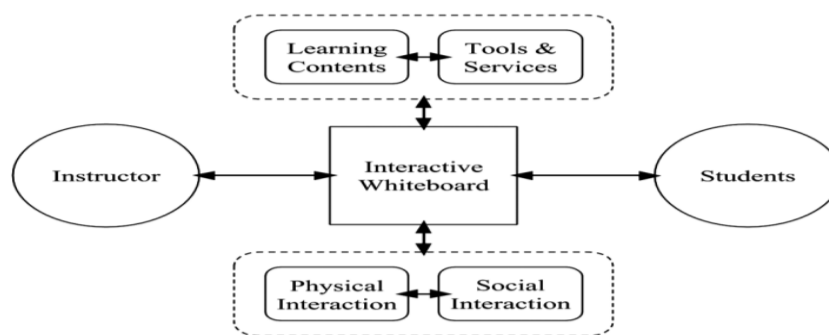


Figure 1 *IWB-Based Instructional Approach (Adapted from Shi et al., 2018)*

However, the empirical evidence for IWB effectiveness is mixed and context-dependent. On one hand, several studies report positive outcomes. Kuhl and Wohninsland (2022) found that a 45-minute IWB-based lesson led to higher vocabulary test scores and increased motivation among 102 German secondary students compared to a non-IWB lesson. Similarly, Shi et al. (2015) reported that three months of IWB-based instruction enhanced Chinese college students' academic self-efficacy. Adrini and Wahyuna (2023) and Türel and Johnson (2012) also found improvements in EFL learners' engagement and motivation due to the use of IWB-based instruction.

On the other hand, null or mixed findings persist. Norouzi et al. (2014) found no significant difference in vocabulary retention between IWB-based and traditional instruction among Iranian EFL learners. Bidaki and Mobasheri (2013) have emphasized that IWB effectiveness depends more on pedagogical implementation than on the technology itself. Mariz et al. (2017), in a meta-analytic review, concluded that interactive features such as visual aids, gamification, and drag-and-drop were necessary but not sufficient for achievement gains; teacher training and instructional design were critical moderators.

The mixed findings suggest that IWB research has often treated the technology as a monolithic intervention. Few studies have isolated which specific IWB features increase learning gains. Moreover, most existing studies have focused on general vocabulary or grammar, leaving phrasal verbs, a particularly challenging structure, largely unexamined.

Phrasal Verbs

Phrasal verbs consist of a verb and a particle (e.g., turn on, give up, look after). Their difficulty for EFL learners arises from three sources: (1) idiomaticity, the meaning often cannot be predicted from the verb and particle in isolation (Side, 1990); (2) syntactic complexity, some phrasal verbs are separable (turn the light on), others are not (look after the child); and (3) high frequency, phrasal verbs are common in natural speech but often avoided by EFL learners (Subramaniam, 2017).

Traditional instructional approaches, such as rote memorization of verb-particle combinations or teacher-fronted whiteboard explanations, have shown limited effectiveness. Mahdavi and Bagheri (2014) have noted that phrasal verbs are often linked to grammatical functions in ways that decontextualized instruction fails to capture. Technological interventions for phrasal verbs have shown encouraging signs of effectiveness. Ali Bakhshi et al. (2019) examined the use of smart boards for phrasal verb instruction and found significant improvements in both learning and motivation, though they acknowledged limitations, including a small sample size and an 8-week duration. Pirasteh and Mirzaeian (2015) used SMS as a mobile-assisted language learning (MALL) tool to teach phrasal verbs and found that the experimental group outperformed a control group using booklets.

While these studies demonstrate that technology can support phrasal verb learning, none have specifically examined IWB-based instruction for phrasal verbs. Furthermore, the study by Ali Bakhshi et al. (2019) used smart boards (a precursor to IWBs) but did not investigate engagement dimensions. In other words, little research has examined the effect of IWB-based instruction on phrasal verb learning and learner engagement simultaneously.

Learner Engagement

Learner engagement as a powerful predictor of academic achievement is widely conceptualized as having three dimensions: affective (emotional reactions to learning), behavioral (participation and effort), and cognitive (use of learning strategies and deep processing) (Appleton et al., 2008; Fredricks et al., 2004; Jimerson et al., 2003; Walker et al., 2006).

IWBs may enhance behavioral engagement by allowing physical manipulation of digital objects such as drag-and-drop, clicking, and writing. They may increase affective engagement through gamification, immediate visual feedback, and reduced foreign language anxiety (Kuhl & Wohninsland, 2022). They may foster cognitive engagement by requiring learners to process multimodal information, make decisions, and respond to real-time feedback.

However, empirical evidence directly linking IWBs to multidimensional engagement is scarce. Tsayang et al. (2022) examined smart boards in Botswana and found that their use improved learners' engagement and interaction, but they did not examine different dimensions of engagement. Thompson and Yuen (2022) reported that Miro enhanced online engagement in a science communication module, but their study was not conducted in an EFL context and did not measure language-learning outcomes. Prior empirical research has paid less attention to the multidimensionality of the learner engagement variable in the EFL context and to the use of IWB-supported technology for learning phrasal verbs. Thus, any empirical research on these topics contributes to the literature, especially given the scarcity of research on Miro-based instruction.

Miro as the IWB Platform

Miro's specific interactive features directly align with the pedagogical needs of phrasal verb instruction. Drag-and-drop allows learners to explicitly match verbs with particles. Hide-and-reveal enables self-testing and retention checks. Sticky notes support collaborative definition building. The infinite canvas allows for visual organization of phrasal verbs by verb family or thematic group. Real-time multi-user editing promotes peer collaboration and immediate feedback. These affordances are not available in traditional whiteboards or in simpler digital tools like PowerPoint. While Miro has been used in business and science education, its application to EFL phrasal verb instruction has not been empirically validated. The present study provided this validation.

Method

Participants

A convenience sampling method was used, as participants were selected from an intact high school to which the researchers had access. This non-probability sampling method is common in EFL classroom research when randomization of individual students is not feasible due to school scheduling constraints. A pool of 60 Persian-speaking native speakers (all female) from a high school in Isfahan, Iran, participated in the study. Their ages ranged from 16 to 17 years. All participants took the Oxford Placement Test (OPT, 2018 version), a standardized 60-item test that measures grammar and vocabulary. Based on the OPT test's mapping to the CEFR, scores between 40 and 60 (out of 100) indicate B1 (intermediate) level. The mean OPT score was 48.6, confirming intermediate proficiency. This step ensured that any differences in phrasal verb learning could be attributed to the intervention rather than to initial proficiency differences.

All participants used *Vision 2*, the national English textbook for Iranian high school students. With the school principal's approval, EFL teachers were allowed to provide supplementary instruction to facilitate L2 learning. The supplementary instruction involved teaching English phrasal verbs using a list of 101 essential phrasal verbs. Learners were

assigned to two instructional groups: the IWB-based class ($n = 30$) and the non-IWB classroom ($n = 30$).

One of the researchers taught both classes to control for differences in teacher quality. However, three measures were taken to minimize bias: (1) The teacher followed a detailed, scripted lesson plan for both groups, with identical phrasal verb lists, examples, and time allocation (30 minutes per session, 8 sessions). (2) A blinded research assistant (who did not know the group assignments) administered the pretests and posttests. (3) The engagement questionnaire was administered using anonymous codes, not names. Based on pretest scores, there were no statistically significant differences in phrasal verb knowledge between groups. However, one-way analysis of covariance (ANCOVA) was still used to control for any remaining differences statistically.

Instruments

A 40-item test developed and validated by Roohani and Heidari Vinchek (2021) was used as a pretest and posttest. It includes 15 items on recognition of the correct particle, 10 items on recognition of the main verb, and 15 items on recognition of the whole phrasal verb. Test items were based on a list of 101 essential phrasal verbs taught during instruction. Roohani and Heidari Vinchek (2021) reported a Kuder-Richardson (KR-20) reliability coefficient of .87 for this test. In the current study, the KR-20 was .85, indicating good internal consistency. Several items of the phrasal verb test are provided in Appendix A.

The scale developed by Lam and Jimerson (2014) was used to measure affective (9 items), behavioral (12 items), and cognitive (12 items) engagement. Students responded to affective and behavioral items on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). For cognitive engagement, they indicated frequency (1 = never, 5 = always). The overall engagement score was the average of the three subscales. Lam and Jimerson (2014) reported Cronbach's alphas of .87, .85, and .86 for the three subscales. In the current study, alphas were .88 (affective), .84 (behavioral), and .87 (cognitive), indicating high internal consistency. The Student Engagement Scale is provided in Appendix B.

Procedure

A pretest–posttest quasi-experimental control group design was used, consisting of three phases: (1) pretests, (2) instructional period, and (3) posttests and data analysis.

Phase 1 (Pretests: Week 1): One week before instruction began, all the participants completed the phrasal verb test (40 minutes) and the Student Engagement Scale (15 minutes). A blinded research assistant administered both instruments. This established baseline measures.

Phase 2 (Instructional period: Weeks 2 to 5, eight sessions): The IWB-based group had two 90-minute sessions weekly, receiving 30 minutes of phrasal verb instruction per session using Miro on classroom laptops (one laptop per pair of students). They learned 5-12 new phrasal verbs per session via Miro's digital features (drag-and-drop matching of verbs to

particles, sticky notes for definitions, hide-and-reveal for self-testing, collaborative text annotation). Miro is a free online/offline whiteboard that can be used without signing up. For example, the EFL learners came to the board (or used their laptops) to extract phrasal verbs from a text and added definitions and examples in sticky notes (see Figure 2).

The non-Miro group attended two 90-minute classes weekly and received 30 minutes of instruction per session using traditional teacher-fronted methods: the teacher wrote phrasal verbs on a physical whiteboard, grouped them by the verb (e.g., “turn” group: turn on, turn off, turn down), and provided definitions and example sentences orally and in writing. Students copied the examples into notebooks. No digital tools, laptops, or interactive features were used (see Figure 3).

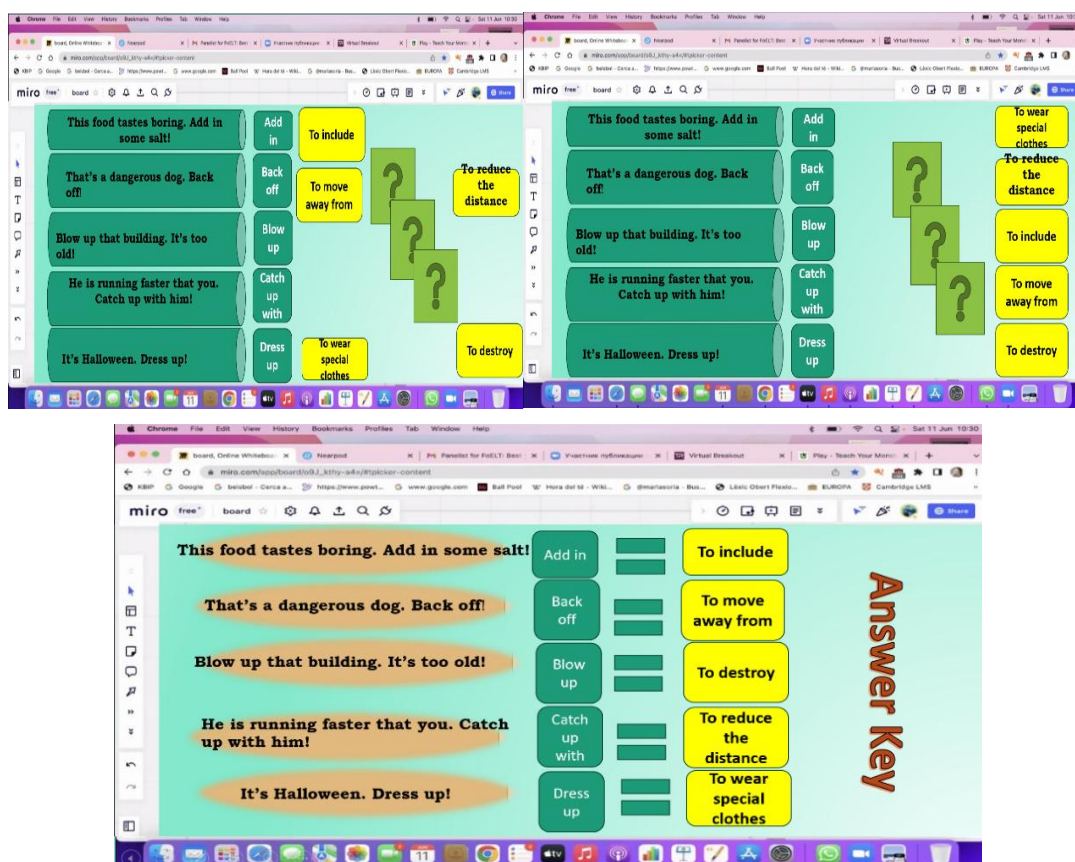


Figure 2 Screenshots of Phrasal Verb Instruction on the Miro Board

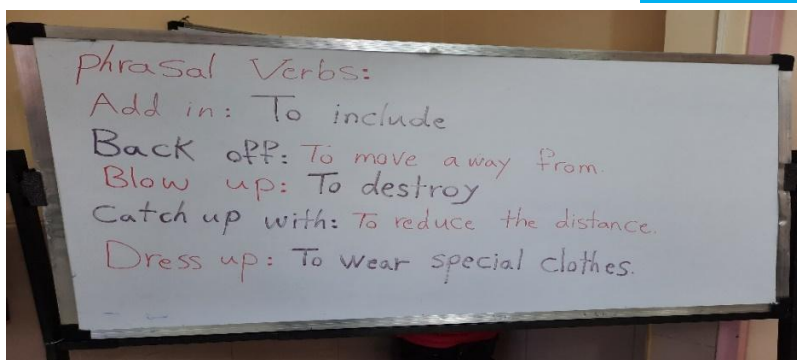


Figure 3 Screenshot of Phrasal Verb Instruction in the Non-Miro Group

Phase 3 (Posttests: Week 6): One week after the final instructional session, both groups completed the same phrasal verb test (40 minutes, but items rearranged to reduce test-wiseness) and the same engagement scale (15 minutes), again administered by the blinded research assistant.

Data Analysis

Data were entered into SPSS version 26. A one-way ANCOVA was conducted on phrasal verb posttest scores, with pretest scores as the covariate and instructional group (IWB vs. non-IWB) as the fixed factor. Separate ANCOVAs were conducted to examine the effect of using a Miro-based IWB on learner engagement and each engagement subdimension (affective, behavioral, and cognitive). Assumptions of ANCOVA (normality, homogeneity of regression slopes, linearity, and Levene's test for equality of error variances) were checked and met. Partial eta squared (η^2) was used as the measure of effect size (small = .01, medium = .06, large = .14).

Findings

Before conducting ANCOVA, the assumptions were tested. The Shapiro-Wilk test indicated that posttest scores were normally distributed for both groups ($p > .05$). Levene's test was non-significant for phrasal verb posttest scores ($F(1, 58) = 1.24, p = .27$) and for engagement posttest scores ($F(1, 58) = 0.98, p = .33$), indicating homogeneity of variances. The homogeneity of regression slopes assumption was met, as the interaction between pretest scores and group was non-significant for phrasal verbs ($F(1, 56) = 0.52, p = .47$) and for engagement ($F(1, 56) = 0.38, p = .54$). Descriptive statistics are presented in Tables 1, 2 and 3.

Table 1

Descriptive Statistics for Phrasal Verb Scores: IWB-Based Group

Time	N	Mean	Standard Deviation	Standard Error Mean
Pretest	30	32.36	5.91	1.08
Posttest	30	38.80	3.85	0.77

Table 2*Descriptive Statistics for Phrasal Verb Scores: Classroom-Based (Non-IWB) Group*

Time	N	Mean	Standard Deviation	Standard Error Mean
Pretest	30	32.26	4.56	0.65
Posttest	30	34.20	3.98	0.73

Table 3*Descriptive Statistics for Overall Engagement Scores*

Group	Time	N	Mean	Standard Deviation
IWB-Based	Pretest	30	3.12	0.68
IWB-Based	Posttest	30	4.21	0.59
Non-IWB	Pretest	30	3.08	0.71
Non-IWB	Posttest	30	3.15	0.65

A one-way ANCOVA was conducted to compare the effect of the instructional method (IWB vs. non-IWB) on phrasal verb posttest scores, controlling for pretest scores. The results showed a significant main effect of instructional group after controlling for pretest scores: $F(1, 57) = 24.36, p < .001$, partial $\eta^2 = .30$. This represents a large effect size, indicating that approximately 30% of the variance in posttest scores was explained by the instructional method. Detailed ANCOVA results are presented in Table 4.

Table 4*ANCOVA Summary for Phrasal Verb Posttest Scores with Pretest as Covariate*

Source	Sum of squares	df	Mean square	F	Sig.	Partial Eta Squared
Pretest (covariate)	245.67	1	245.67	18.34	.001	.24
Instructional group	326.45	1	326.45	24.36	.001	.30
Error	763.12	57	13.39			
Total	1335.24	59				

A separate one-way ANCOVA was conducted for overall engagement posttest scores, controlling for pretest engagement scores. The results showed a significant main effect of

instructional group: $F(1, 57) = 18.42, p < .001$, partial $\eta^2 = .24$ (large effect size). For the three engagement subscales, separate ANCOVAs were conducted (Affective engagement: $F(1, 57) = 12.87, p = .001$, partial $\eta^2 = .18$ (large effect), Behavioral engagement: $F(1, 57) = 22.45, p < .001$, partial $\eta^2 = .28$ (large effect), Cognitive engagement: $F(1, 57) = 15.93, p < .001$, partial $\eta^2 = .22$ (large effect)). The results are summarized in Tables 5 and 6.

Table 5

ANCOVA Summary for Overall Engagement Posttest Scores with Pretest as Covariate

Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Pretest (covariate)	8.45	1	8.45	12.34	.001	.18
Instructional group	12.62	1	12.62	18.42	.001	.24
Error	39.04	57	0.68			
Total	60.11	59				

Table 6

ANCOVA Summary for Engagement Subscales with Pretest Scores as Covariates

Subscale	Source	F	Sig.	Partial Eta Squared
Affective Eng	Instructional Group	12.87	.001	.18
Behavioral Eng	Instructional Group	22.45	.001	.28
Cognitive Eng	Instructional Group	15.93	.001	.22

Discussion

The present study investigated the effect of IWB-based instruction using Miro on EFL learners' phrasal verb learning and multidimensional engagement (affective, behavioral, and cognitive). Two research questions were addressed: the first examined whether there was a significant difference in phrasal verb posttest scores between IWB-based and traditional instruction, controlling for pretest scores; the second examined whether IWB-based instruction affected learners' affective, behavioral, and cognitive engagement.

The results demonstrated that the IWB-based instruction group significantly outperformed the traditional instruction group on phrasal verb posttest scores, even after controlling for pretest differences using ANCOVA ($F(1, 57) = 24.36, p < .001$, partial $\eta^2 = .30$). Additionally, the IWB-based group showed significantly higher levels of affective ($F(1, 57) = 12.87, p = .001$, partial $\eta^2 = .18$), behavioral ($F(1, 57) = 22.45, p < .001$, partial $\eta^2 = .28$), and cognitive ($F(1, 57) = 15.93, p < .001$, partial $\eta^2 = .22$) engagement compared to the traditional instruction group. These findings confirm that IWB-based instruction using Miro was more effective than traditional teacher-fronted instruction for teaching phrasal verbs to EFL learners and for enhancing learner engagement across all three dimensions.

The finding that IWB-based instruction produced significantly greater gains in phrasal verb learning than traditional instruction aligns with previous research on technology-enhanced phrasal verb instruction. Ali Bakhshi et al. (2019) found that the use of a smart board improved phrasal verb learning and motivation. Although they used t-tests for data analysis and did not employ ANCOVA to control for pretest differences, their results were consistent with those of the present study. Moreover, Pirasteh and Mirzaeian (2015) demonstrated that SMS-based instruction outperformed booklet-based instruction for learning phrasal verbs. The present study extends the above findings by isolating the effect of IWB-specific features (drag-and-drop, hide-and-reveal, sticky notes, and real-time collaboration) on phrasal verb learning within an EFL context.

However, the effect sizes observed in this study for phrasal verbs and engagement dimensions are larger than those typically reported in IWB research. Mariz et al. (2017) concluded that most IWB studies produced small to moderate effects ($\eta^2 = .01-.10$). Shi et al. (2021) reported a meta-analytic average effect size of $d = 0.56$ (moderate) for IWB-based instruction on cognitive learning outcomes. Several contextual and methodological factors may explain why the present study produced larger effects. First, phrasal verbs present unique learning challenges, including idiomaticity, particle selection, and syntactic complexity (Side, 1990; Subramaniam, 2017), which are particularly well addressed by Miro's interactive affordances. The drag-and-drop feature allowed explicit manipulation of verb-particle pairings, creating a kinesthetic and visual learning trace. The hide-and-reveal feature enabled self-paced testing. According to research, this feature can enhance long-term retention (Roohani & Heidari Vincheh, 2021). Moreover, participants had no prior experience with collaborative IWBs such as Miro in the Iranian EFL context. Technology acceptance research suggests that initial exposure to interactive tools can produce heightened engagement and learning gains (Türel & Johnson, 2012).

Second, the traditional instruction group showed minimal gain (+0.94 points), which is consistent with the documented ineffectiveness of rote memorization and teacher-fronted explanations for phrasal verbs (Mahdavi & Bagheri, 2014). Thus, the large effect size reflects both the effectiveness of Miro and the relative weakness of traditional instruction for this specific linguistic structure.

Third, the cumulative, pattern-based nature of phrasal verbs may have contributed to the large effect. Because many phrasal verbs share particles (e.g., *up*, *off*, *out*, *down*) that convey systematic meanings (e.g., *up* often indicates completion or increase), learning one verb-particle combination can facilitate the acquisition of others (Side, 1990). This compounding benefit may not be captured in studies of general vocabulary.

Fourth, the measurement instrument utilized in the current study was aligned with the target items (101 essential phrasal verbs), which is appropriate for intervention fidelity. This issue can produce larger effect sizes than generalized vocabulary tests (Norouzi et al., 2014). The finding that IWB-based instruction significantly enhanced all three dimensions of engagement (affective, behavioral, and cognitive) is consistent with theoretical predictions and previous research. The largest effect was observed for behavioral engagement (partial $\eta^2 = .28$), followed by cognitive engagement ($\eta^2 = .22$) and affective engagement ($\eta^2 = .18$). This pattern suggests that Miro's interactive features most strongly influence participation and physical actions of the EFL learners, which may then facilitate deeper cognitive processing and positive emotional responses.

The behavioral engagement finding aligns with Asher's (1996) Total Physical Response theory, which posits that learners internalize language better when they respond with physical movement to input. In the IWB-based class, students physically dragged, clicked, wrote, and manipulated digital objects on the board or their laptops. This physical interactivity likely increased their behavioral engagement compared to the traditional class, where students remained seated and copied notes.

The cognitive engagement finding is supported by Thompson and Yuen's (2022) observation that Miro promotes deeper cognitive processing through multimodal content and real-time feedback. Students retain information better when it is presented in visual forms. Visual learning aids include images, diagrams, simulations, and interactive digital content (Rodger et al., 2009). Those EFL learners taught via IWB may be more engaged because they understand information better when they see and manipulate it. Moreover, those EFL learners taught through IWB should make decisions (matching verbs with particles), self-test using hide-and-reveal, and collaboratively construct definitions using sticky notes. These activities demand higher-order cognitive processing than simply listening to teacher explanations and copying examples, which characterized the traditional instruction group.

The affective engagement finding reflects the gamified and visually appealing nature of Miro. It was observed that learners in the IWB group expressed greater enjoyment and lower anxiety, consistent with Kuhl and Wohninsland's (2022) finding that IWB use reduces foreign language classroom anxiety. The immediate visual feedback and collaborative atmosphere likely contributed to positive emotional responses.

Conclusion

This study demonstrated the effectiveness of Miro as an IWB in teaching English phrasal verbs, "one of the most challenging linguistic items" (Subramaniam, 2017, p. 82), and in promoting

learner engagement in EFL classrooms. It adopted a quasi- experimental design. The ANCOVA results revealed that the IWB-based instruction was significantly more effective than traditional instruction, with large effect sizes for both phrasal verb learning and overall engagement. The findings suggest that learning through IWBs is workable in an EFL context. Therefore, it is reasonable to include IWBs like Miro in phrasal verb instruction in an EFL context.

The interactive, collaborative environment of Miro worked significantly better than traditional methods, especially in boosting retention of idiomatic phrasal verbs and in maintaining engagement across affective, behavioral, and cognitive dimensions. These findings are supported by contemporary sociocultural theories of language learning, which emphasize scaffolding, peer interaction, and multimodal content (Vygotsky, 1978). However, using Miro required careful planning to prevent cognitive overload (too many sticky notes or simultaneous edits) and to balance individual versus collaborative work. This reflects Adrini and Wahyuna's (2023) emphasis on pedagogical considerations over technological adoption alone. Miro's benefits are most evident when teachers strategically use its features rather than relying on novelty effects.

While this study provides robust evidence for the effectiveness of IWB-based instruction for learning phrasal verbs and developing engagement, the following limitations must be acknowledged. These limitations suggest directions for future research.

Sampling method: Convenience sampling (intact classes) limits generalizability. Future studies should use random or stratified sampling.

Sample homogeneity: Only female, intermediate-level high school students participated in the present study. Future researchers should pay attention to different genders, proficiency levels, and educational contexts.

Short duration: The intervention lasted only 6 weeks. Longitudinal studies (e.g., 6-month follow-up) are recommended to examine retention of English phrasal verbs.

Teacher-researcher bias: The same researcher taught both groups in the current study. Future studies should use different teachers or fully automated instruction.

Technological requirements: Miro requires internet access and individual devices, which may not be available in all classrooms.

Single linguistic focus: The study focused only on phrasal verbs; results may not generalize to other aspects of language learning (e.g., grammar, pronunciation, writing).

The large effect sizes observed in the present study require cautious interpretation. As discussed previously, these large effects may be partially attributable to the novelty of Miro in this context, the specific alignment between Miro's affordances and the demands of phrasal verb learning, the minimal gain in the control condition, the cumulative, pattern-based nature of phrasal verbs, and measurement sensitivity. Replication studies across contexts are needed to determine the

boundary conditions of these large effects and whether they would be reproduced with different IWBs, learner populations, and linguistic targets.

Although not statistically significant, the IWB-based group had a slightly higher pretest mean than the non-IWB group. While ANCOVA statistically controlled for this difference, the ideal design would have perfectly equivalent groups at the pretest phase. Future studies should employ stratified random assignment or matched-pair designs to ensure pretest equivalence.

The findings are specific to Miro. Different IWBs (Jamboard, Smart Notebook, Explain Everything, Padlet) offer different affordances and may produce different effects. Future comparative studies can use multiple IWBs to identify which specific design features maximize language-learning outcomes and engagement for different linguistic targets.

Despite these limitations, the present study makes several important contributions to the fields of computer-assisted language learning, phrasal verb instruction, and learner engagement research. According to the current study's findings, Miro and similar IWBs should be strategically integrated into phrasal verb instruction, particularly for verbs with idiomatic meanings that are challenging for EFL learners. Teacher training courses should emphasize effective IWB implementation, not just technical skills but also pedagogical strategies such as scaffolding, timing feedback, and balancing individual versus collaborative tasks. The study also contributes to understanding engagement in digital learning contexts. Future research should explore how the above findings apply to other complex linguistic structures beyond the 6-week intervention period. Comparative studies of different IWBs (e.g., Miro, Jamboard, and Smart Notebook) could identify specific design features that maximize language-learning outcomes. Additionally, future studies should employ randomized controlled trials (RCTs) and multilevel modeling to strengthen causal claims further.

Bio-data

First Author: collected data, designed, conducted the procedure, and wrote the first draft.

Second Author: read, made necessary revisions, and approved the final manuscript.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of Competing Interests: The authors declare no competing interests.

References

- Adrini, R. R. A. M., & Wahyuna, Y. T. (2023). The effect of using interactive whiteboard in EFL context. *JIWP Journal*, 9 (14), 618-624.
- Ali Bakhshi, G., Zeinali, M., & Bakhtiarvand, M. (2019). On the impact of using smart boards on improving EFL learners' motivation and learning of phrasal verbs. *Technology of Education Journal*, 13 (2), 401-408.

- Appleton, J. J., Christenson, S. L., Kim, D., & Reschly, A. L. (2006). Measuring cognitive and psychological engagement: Validation of the Student Engagement Instrument. *Journal of School Psychology, 44* (5), 427-445. <https://doi.org/10.1016/j.jsp.2006.04.002>
- Appleton, J. J., Christenson, S. L., & Furlong, M. J. (2008). Student engagement with school: Critical conceptual and methodological issues of the construct. *Psychology in the Schools, 45* (5), 369-386. <https://doi.org/10.1002/pits.20303>
- Asher, J. (1996). *Learning another language through actions* (5th ed.). Sky Oaks Productions.
- Bakhshi, G. A. (2019). On the impact of using smart boards on improving EFL learners' motivation and learning of phrasal verbs. *International Journal of English Language & Translation Studies, 7*(3), 72-78.
- Bidaki, M. Z., & Mobasheri, N. (2013). Teachers' views of the effects of the interactive whiteboard (IWB) on teaching. *Procedia - Social and Behavioral Sciences, 83*, 140-144. <https://doi.org/10.1016/j.sbspro.2013.06.028>
- Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research, 74* (1), 59-109. <https://doi.org/10.3102/00346543074001059>
- Hall, I., & Higgins, S. (2005). Primary school students' perceptions of interactive whiteboards. *Journal of Computer Assisted Learning, 21*(2), 102-117.
- Hart, S. R., Stewart, K., & Jimerson, S. R. (2011). The Student Engagement in Schools Questionnaire (SESQ) and the Teacher Engagement Report Form-New (TERF-N): Examining the preliminary evidence. *Contemporary School Psychology, 15* (1), 67-79.
- Hwang, W. Y., Shadiev, R., Huang, Y. M., Cai, Y. T., Yang, Y. S., & Su, J. H. (2013). Effects of drag-and-response interaction mechanism of multi-touch operated tabletop technology on users' awareness and collaborative performance. *Computers & Education, 67*, 130-141.
- Jimerson, S. R., Campos, E., & Greif, J. L. (2003). Toward an understanding of definitions and measures of school engagement and related terms. *The California School Psychologist, 8* (1), 7-27. <https://doi.org/10.1007/BF03340893>
- Kuhl, T., & Wahninsland, P. (2022). Learning with the interactive whiteboard in the classroom: Its impact on vocabulary acquisition, motivation, and the role of foreign language anxiety. *Education and Information Technologies, 27* (7), 10387-10404. <https://doi.org/10.1007/s10639-022-11004-9>
- Lam, S. F., Jimerson, S., Wong, B. P. H., & Kikas, E. (2014). Understanding and measuring student engagement in school: The results of an international study from 12 countries. *School Psychology Quarterly, 29* (2), 213-232. <https://doi.org/10.1037/spq0000057>
- Mahdavi, B. R., & Bagheri, M. S. (2014). EFL learners' incidental acquisition of English phrasal verbs through enhanced extensive reading vs. unenhanced extensive reading. *International Journal of Foreign Language Teaching and Research, 2* (8), 33-42.

- Mariz, C., Stephenson, J., & Carter, M. (2017). Interactive whiteboards in education: A literature scoping survey. *Australasian Journal of Educational Computing*, 32 (1), 1-18.
- Mercer, N., Hennessy, S., & Warwick, P. (2010). In the mind and in the technology: The vicarious presence of the teacher in pupil's learning of science in collaborative group activity at the interactive whiteboard. *Computers & Education*, 55(1), 350-362.
- Norouzi, H., Aziz Mohammadi, F., & Madani, D. (2014). The effect of interactive whiteboard on teaching vocabulary to Iranian EFL learners' retention. *Enjoy Teaching Journal*, 2 (1), 99-105.
- Pirasteh, P., & Mirzaeian, V. R. (2015). The effect of Short Message Service (SMS) on learning phrasal verbs by Iranian EFL learners. *Language in India*, 15 (1), 144-161.
- Rodger, S. H., Bashford, M., Dyck, V., Hayes, J., Liang, L., Nelson, D., & Qin, H. (2009, March 3-7). Engaging middle school teachers and students with Alice in a diverse set of subjects [Conference session]. *SIGCSE '09: Proceedings of the 40th ACM Technical Symposium on Computer Science Education*, Chattanooga, TN, United States. <https://doi.org/10.1145/1508865.1508927>
- Roohani, A., & Heidari Vincheh, M. (2021). Effect of game-based, social media, and classroom-based instruction on the learning of phrasal verbs. *Computer Assisted Language Learning*, 36 (3), 375-399. <https://doi.org/10.1080/09588221.2021.1929325>
- Shernoff, D. J., & Schmidt, J. A. (2008). Further evidence of an engagement-achievement paradox among U.S. high school students. *Journal of Youth and Adolescence*, 37 (5), 564-580. <https://doi.org/10.1007/s10964-007-9241-z>
- Shi, Y. H., Peng, C. L., Yang, H. H., & Macleod, J. (2015). Examining IWB-based instruction on the academic self-efficacy, academic press and achievement of college students. *Open Learning*, 30 (2), 115-130. <https://doi.org/10.1080/02680513.2015.1067591>
- Shi, Y., Zhang, J., Yang, H., & Yang, H. H. (2021). Effects of interactive whiteboard-based instruction on students' cognitive learning outcomes: A meta-analysis. *Interactive Learning Environments*, 29 (2), 283-300. <https://doi.org/10.1080/10494820.2019.1608847>
- Side, R. (1990). Phrasal verbs: Sorting them out. *ELT Journal*, 44 (2), 144-152. <https://doi.org/10.1093/elt/44.2.144>
- Smith, H. J., Higgins, S., Wall, K., & Miller, J. (2005). Interactive whiteboards: Boon or bandwagon? A critical review of the literature. *Journal of Computer Assisted Learning*, 21 (2), 91-101. <https://doi.org/10.1111/j.1365-2729.2005.00117.x>
- Spring, R., & Takeda, J. (2024). Teaching phrasal verbs and idiomatic expressions through multimodal flashcards. *STEM Journal*, 25(2), 40-53.
- Subramaniam, R. (2017). The learning of phrasal verbs among Malaysian ESL learners: A sign-oriented approach. *Politeknik & Kolej Komuniti Journal of Social Sciences and Humanities*, 1, 82-100.
- Thompson, A. A., & Yuen, B. P. L. (2022). Using Miro to enhance students' online engagement and learning in a science communication module. *Teaching Connections*. Centre for

- English Language Communication, National University of Singapore.
<https://blog.nus.edu.sg/teachingconnections/2022/08/26/using-miro-to-enhance-students-online-engagement-and-learning-in-a-science-communication-module/>
- Tsayang, G., Batane, T., & Majese, S. (2022). The impact of smart boards on student engagement and academic achievement in Botswana junior secondary schools. *International Journal of Educational Research*, 12 (3), 45-59.
- Türel, Y. K., & Johnson, T. E. (2012). Teachers' belief and use of interactive whiteboards for teaching and learning. *Educational Technology & Society*, 15 (1), 381-394.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
- Walker, C. O., Greene, B. A., & Mansell, R. A. (2006). Identification with academics, intrinsic/extrinsic motivation, and self-efficacy as predictors of cognitive engagement. *Learning and Individual Differences*, 16 (1), 1-12.
<https://doi.org/10.1016/j.lindif.2005.06.004>
- Wang, X., Dostál, J., & Bucková, H. (2019). The use of interactive whiteboards for English foreign language education. In *Proceedings of the 11th International Conference on Computer Supported Education* (Vol. 1, pp. 169-174). SCITEPRESS.
<https://doi.org/10.5220/0007692801690174>

Appendix

Appendix A: Sample Items of the Phrasal Verb Test

Part A: Directions: Please read the following sentences and check the best particle on your answer sheet.

1. Please turn the radio? I can't hear anything.
a) out b) back c) up d) off
2. Please point the road signs while I drive.
a) up b) out c) away d) off
3. Take a deep breath and try to calm It's not worth getting upset about.
a) down b) on c) over d) under
4. Hold to your bag tightly. There are a lot of pick pockets around here.
a) up b) on c) in d) off

Part B: Directions: Please read the following sentences and check the best main verb on your answer sheet.

5. The tennis match was stopped because of the rain, but it on as soon as the rain stopped.
a) switched b) carried c) dragged d) snacked
6. Why are you the door in? Here's the key.
a) bargaining b) giving c) logging d) breaking
7. The sign says we have to off the grass, so they want us to walk along this path and not go off it.

a) rip b) keep c) kick d) doze

8. The average household away three kilos of waste every week.

a) passes b) fires c) blows d) throws

Part C: Directions: Please read the following sentences and check the best phrasal verb on your answer sheet.

9. That's a dangerous animal. Please

a) kick off b) back off c) rub out d) fall out

10. If I see someone taking my car, I will them.

a) duck out b) make after c) take after d) pat down

11. Please what we need for the party. I'm going to the supermarket in the evening.

a) tug at b) cast aside c) jot down d) beat up

12. I'll you this time, but don't do that again.

a) let off b) rip off c) grass on d) look over

Appendix B: Student Engagement in School Items

Affective Engagement

How much do you agree that the following statements accurately describe your learning experience in this semester?

- I am very interested in learning.
- I think what we are learning in school is interesting.
- I like what I am learning in school.
- I enjoy learning new things in class.
- I think learning is boring.
- I like my school.
- I am proud to be at this school.
- Most mornings, I look forward to going to school.
- I am happy to be at this school.

Behavioral Engagement

How much do you agree that the following statements accurately describe your learning experience in this semester?

- I try hard to do well in school.
- In class, I work as hard as I can.
- When I'm in class, I participate in class activities.
- I pay attention in class.
- When I'm in class, I just act like I'm working.
- In school, I do just enough to get by.
- When I'm in class, my mind wanders.
- If I have trouble understanding a problem, I go over it again until I understand it.
- When I run into a difficult homework problem, I keep working at it until I think I've solved it.
- I am an active participant of school activities such as sport day and school picnic.

- I volunteer to help with school activities such as sport day and parent day.
- I take an active role in extra-curricular activities in my school.

Cognitive Engagement

When learning things for school in this semester, how often do you do the following?

- When I study, I try to understand the material better by relating it to things I already know.
- When I study, I figure out how the information might be useful in the real world.
- When learning new information, I try to put the ideas in my own words.
- When I study, I try to connect what I am learning with my own experiences.
- I make up my own examples to help me understand the important concepts I learn from school.
- When learning things for school, I try to see how they fit together with other things I already know.
- When learning things for school, I often try to associate them with what I learnt in other classes about the same or similar things.
- I try to see the similarities and differences between things I am learning for school and things I know already.
- I try to understand how the things I learn in school fit together with each other.
- I try to match what I already know with things I am trying to learn for school.
- I try to think through topics and decide what I'm supposed to learn from them, rather than studying topics by just reading them over.
- When studying, I try to combine different pieces of information from course material in new ways.