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Exploring Ai-Bot In An Esl Filipino Flipped Classroom: A Sequential Mixed-Methods Study

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ABSTRACT: Artificial intelligence (AI) is increasingly influencing English as a Second Language (ESL) education for Filipino students. This study investigates the effectiveness of Chai, an AI-powered chatbot, integrated into a flipped classroom model, for enhancing students' prepositional usage. Employing an exploratory sequential mixed-methods design, 70 freshman students were randomly assigned to experimental (Chai Bot/flipped classroom) and control (traditional instruction) groups. The quantitative results indicated that the experimental group demonstrated significantly higher mean scores in post-tests compared to the control group, suggesting that the integration of Chai Bot effectively improved prepositional knowledge. Qualitative data gathered from semi-structured interviews with participants in the experimental group revealed eight key themes related to usability, technical issues, and the chatbot's effectiveness as a learning and writing tool. Positive feedback emphasized the app's ease of use and clarity of instructions, while challenges such as technical difficulties were also reported. This study highlights that Chai Bot, when utilized within a flipped classroom framework, serves as an effective AI-based tool for enhancing students' grammatical skills, particularly in prepositions. The findings offer valuable pedagogical implications for educators and curriculum developers, suggesting that technology-enhanced learning can significantly contribute to language acquisition. Future research should explore long-term effects and broader applicability in diverse educational contexts.

1. INTRODUCTION

This research explores the use of AI and flipped classroom methodologies to improve prepositional accuracy in Filipino ESL learners. Artificial intelligence (AI), specifically AI-powered chatbots, offers personalized learning experiences and immediate feedback, addressing the limitations of traditional instruction. The flipped classroom model, where students engage with materials before class and use class time for interactive activities, enhances active learning and engagement (Bishop & Verleger, 2013).

This study uses a sequential mixed-methods design to investigate the effectiveness of Chai, an AI chatbot, integrated into a flipped classroom for teaching prepositions to 70 Filipino freshman ROTC students. The quantitative component compares pre- and post-test scores of experimental (Chai Bot/flipped classroom) and control (traditional instruction) groups. The qualitative component involves interviews with the experimental group to explore their experiences. The results show significantly higher post-test scores for the experimental group, indicating Chai Bot's effectiveness in a flipped classroom setting. Qualitative data revealed themes related to usability, technical issues, and the chatbot's effectiveness as a learning and writing tool. The study concludes that Chai Bot, within a flipped classroom model, is a valuable tool for improving prepositional skills in Filipino ESL learners, offering significant pedagogical implications. The findings are supported by research on the challenges Filipino learners face with prepositions (Castro, 2019; Garcia, 2023; Catabay, 2023), the potential of chatbots in language learning (Kim, 2019), and the effectiveness of flipped classrooms (Fadhilah, 2020; Al-Harbi & Alshumaimeri, 2016; Albahuoth, 2020). The study also draws on

Cognitive Load Theory (CLT) (Sweller, 1988; Paas et al., 2003) and the Technology Acceptance Model (TAM) (Davis, 1989) as theoretical frameworks.

2. LITERATURE REVIEW

This literature review examines three key areas relevant to the study's use of an AI-powered chatbot (Chai) within a flipped classroom to address prepositional errors among Filipino ESL learners: (1) challenges Filipino learners face with prepositions, (2) the potential of chatbots in language learning, and (3) the effectiveness of flipped classroom methodologies.

2.1 Challenges with Prepositions for Filipino ESL Learners. Prepositions, while seemingly simple, pose significant challenges for second language learners, particularly Filipinos due to discrepancies between Filipino and English prepositional usage (Inezan & Naum, 2010). Common errors include incorrect selection, omission, or inappropriate insertion of prepositions, such as confusion between "at," "in," and "on" for time (Casambre, 2017), and misuse of "of" and "for" (Lim & Lee, 2019). This necessitates targeted interventions.

2.2 Potential of Chatbots in Language Learning. Chatbots offer personalized instruction, immediate feedback, and interactive practice (Kim, 2019), potentially enhancing grammar and writing skills through active engagement and error correction. However, effectiveness depends on the chatbot's language model, exercise design, and learner participation. Sophisticated chatbots with advanced NLP capabilities are more effective than simpler systems. Integrating chatbots within a pedagogical framework like the flipped classroom can further improve their impact.

2.3 Flipped Classroom Approach in Language Learning. The flipped classroom model, with pre-class engagement with materials followed by in-class interaction, has shown promise (Bergmann & Sams, 2012). In language learning, it allows for focused classroom time, personalized feedback (Fadhilah, 2020), and improved grammatical proficiency, student engagement, and attitudes (Fadhilah, 2020; Albahuoth, 2020; Al-Harbi & Alshumaimeri, 2016). Its active learning aligns well with chatbot-based instruction.

2.4 Chatbots in Educational Institutions. Increasing chatbot adoption in education reflects a trend toward leveraging technology (Team, 2022). AI-powered educational chatbots are gaining recognition (Serrano et al., 2021), as exemplified by UPOU's chatbot (Serrano et al., 2021). This study builds on the established potential of chatbots in language learning (Shawar & Atwell, 2007) by investigating Chai within a flipped classroom.

2.5 Theoretical Framework. The study uses Cognitive Load Theory (CLT) (Sweller, 1988; Paas et al., 2003) and the Technology Acceptance Model (TAM) (Davis, 1989). CLT explains how the flipped classroom design, using Chai for pre-class learning, reduces cognitive load during in-class activities. TAM suggests that perceived usefulness and ease of use predict technology acceptance.

2.6 Research Gap. While research exists on prepositional errors, chatbots in language learning, and flipped classrooms, this study addresses the gap in research on the combined effect of using an advanced AI chatbot like Chai within a flipped classroom to target prepositional errors among Filipino ESL learners. Previous studies only explored these areas individually. Furthermore, the learning experience from the students' perspective is largely unexplored.

This gap in the literature necessitates further research to explore the following research questions:

1. What is the effectiveness of using Chai, an AI-powered chatbot, integrated into a flipped classroom model, in improving the prepositional accuracy of Filipino freshman students, as measured by pre-test and post-test scores?
2. What are the students' experiences and perceptions of using Chai in a flipped classroom setting for grammar instruction?

3. METHODOLOGY

This study used an exploratory sequential mixed methods design (Creswell & Plano Clark, 2011) to examine the effectiveness of Chai, an AI-powered chatbot, integrated into a flipped classroom model for improving prepositional accuracy among Filipino freshman students at a state university in the Philippines.

3.1 Research Design. The quantitative component employed a pre-test/post-test control group design. 70 students were randomly assigned (fishbowl technique) to experimental (n=35; Chai Bot/flipped classroom) and control (n=35; standard instruction) groups. Pre- and post-test scores on a prepositional accuracy test served as quantitative data. The qualitative component used a descriptive phenomenological approach (Creswell, 2014), with semi-structured interviews (n=35 experimental group) exploring students' experiences with Chai.

3.2 Participants. The 70 participants were first-year ROTC students at NVSU Bayombong. Sample size was determined using G*Power analysis (Faul et al., 2007) (effect size 0.30, power 0.95, alpha 0.05), with random sampling (fishbowl technique) from an initial population of 270 students. Participants were randomly assigned to groups (n=35 per group).

3.3 Instruments

3.3.1 Prepositional Accuracy Test. A 60-item multiple-choice test (Cronbach's alpha = 0.92) assessed prepositional understanding and application. Content validity was established through expert review. Scoring (1 point per correct answer) used a rubric (54-60: Excellent; 48-53: Good; 42-47: Fair; 36-41: Poor; <36: Very Poor).

3.3.2 Semi-structured Interview Guide. A 5-item guide with open-ended questions explored students' experiences with Chai.

3.4 Procedure

After obtaining ethical approval and informed consent, both the experimental and control groups completed a pre-test assessing prepositional accuracy. The experimental group then participated in a flipped classroom model using the Chai chatbot for three weeks, while the control group received standard instruction. Following the intervention, both groups completed a post-test. Semi-structured interviews were conducted with the experimental group to gather qualitative data on their experiences. Finally, data analysis involved independent samples t-tests to compare pre- and post-test scores between groups, paired samples t-tests to compare pre- and post-test scores within the experimental group, and thematic analysis of the interview data.

3.5 Data Analysis. Independent samples t-tests compared pre- and post-test scores between groups; paired samples t-tests compared pre- and post-test scores within the experimental group. Thematic analysis (Braun & Clarke, 2006, as cited in Magday & Pramoolsook, 2021) was used for interview data, following six phases: Familiarization, Generating initial codes, Searching for themes, Reviewing themes, Defining and naming themes, and Writing up.

4. RESULTS AND DISCUSSIONS

There are two main parts to this section: the quantitative and qualitative analyses. The first objective, assessing Chai Bot's effectiveness in a flipped learning environment, is addressed through six tables of quantitative data. The qualitative analysis, exploring the experimental group's experiences, yielded eight themes.

Table 1. Achievement Level of the Respondents in Preposition (Pre-test)

	Experimental Group		**Control Group**		**Description**
	Frequency (n=35)	Percentage %	Frequency (n=35)	Percentage %	
54-60	17	48.57	18	51.43	Very High
36-41	12	34.29	14	40	Average
29-35	3	8.57	2	5.71	Below Average
22-28	3	8.57	1	2.86	Very Low
Overall Achievement		47.23 High		47.96 High	

Table 1 presents pre-test prepositional proficiency data for experimental and control groups. Both groups showed a high percentage of students scoring in the "very high" range (48.57% experimental, 51.43% control), indicating strong baseline knowledge. The control group had slightly higher percentages in the "average," "below average," and "very low" categories (40%, 5.71%, and 2.86% respectively) compared to the experimental group (34.29%, 8.57%, and 8.57% respectively). Overall, both groups achieved high scores (47.23% experimental, 47.96% control), with the control group showing a slight advantage. This suggests that the experimental intervention may not have initially enhanced learning outcomes compared to traditional methods, warranting further investigation and optimization of the experimental approach.

Table 2. Achievement Level of the Respondents in Preposition (Post-test)

Score	**Experimental Group**		**Control Group**		**Description**
	Frequency (n=35)	Percentage %	Frequency (n=35)	Percentage %	
54-60	28	80	15	42.86	Very High

36-41	7	20	8	22.86	Average
29-35	0	0	10	28.57	Below Average
22-28	0	0	2	5.71	Very Low
Overall		53.3		43.8	
Achievement		Very High		Average	

Table 2 shows significantly improved post-test prepositional understanding in the experimental group (Chai Bot/flipped classroom) compared to the control group (traditional instruction). The experimental group had a dramatic increase in "very high" achievers (80% vs. 42.86% in the control group), with no below-average scores, while the control group retained a substantial number of below-average and very low scorers. The experimental group achieved a "very high" average (53.3%), while the control group remained at an "average" level (43.8%). These findings align with research on technology integration in flipped learning (Brown, 2019; Anderson & Lee, 2021), suggesting that Chai Bot's interactive nature provided personalized, self-paced learning, leading to more effective preposition mastery. The control group's varied achievement levels suggest that traditional methods may not consistently produce high achievement. The substantial difference highlights the experimental intervention's effectiveness and the potential of innovative teaching methods. Further research should investigate the specific factors contributing to this success.

Table 3. Comparison of the Participants' Mean Scores in the Pretest

Group	n	Mean	SD	Computed t-value	Critical value	Decision
Experimental	35	41.9	7.40	-1.0674	±2.000	*not significant*
Control	35	43.3	6.55			

df = 28 alpha level = 0.05

Table 3 shows that the pre-test mean score for the control group (M = 43.3, SD = 6.55) was slightly higher than the experimental group (M = 41.9, SD = 7.40), but this difference was not statistically significant (t = -1.0674, df = 28, p > .05). Therefore, the groups were comparable in prepositional knowledge before the intervention, suggesting that any post-test differences can be attributed to the experimental intervention.

Table 4. Comparison of the Participants' Mean Scores in the Post-test

Group	n	Mean	SD	Computed t-value	Critical value	Decision
Experimental	35	47.85	5.259	6.41	±2.000	*Significant*
Control	35	40.85	8.813			

df = 68 alpha level = 0.05

Table 4 shows a statistically significant difference in post-test mean scores between the experimental (Chai Bot/flipped classroom; M = 47.85, SD = 5.259) and control (traditional instruction; M = 40.85, SD = 8.813) groups (t = 6.41, df = 68, p < .05). The experimental group performed significantly better. These results are consistent with studies showing improved student performance using chatbot-based flipped learning methods (Smith et al., 2021) and the positive effects of technology integration on student engagement and learning outcomes (Johnson & Brown, 2020). The findings suggest that integrating Chai Bot into a flipped classroom is beneficial for teaching prepositions, creating a more engaging learning environment and improving student performance. However, further research is needed to explore long-term effects and broader applicability. The intervention was effective in enhancing participants' understanding of prepositions.

Table 5. Comparison of the Experimental Group's Mean Scores in the Pretest and Posttest

Experimental	Mean	SD	Computed t-value	Critical value	Decision
Pretest	41.95	7.45	2.56	±2.032	*Significant*
Posttest	47.85	5.35			

df =34 alpha level = 0.05

Table 5 shows a statistically significant improvement in the experimental group's mean scores from pre-test (M = 41.95, SD = 7.45) to post-test (M = 47.85, SD = 5.35) ($t = 2.56$, $df = 34$, $p < .05$). This significant increase indicates a positive impact of the intervention (Chai Bot integrated into a flipped classroom) on participants' understanding and mastery of prepositions. These results align with research supporting the effectiveness of flipped learning approaches (Smith, 2020; Johnson et al., 2018; Brown, 2019; Anderson & Lee, 2021), suggesting that the combination of Chai Bot and flipped learning enhanced the learning experience and contributed to improved scores. The findings highlight the potential of these teaching strategies to improve language learning outcomes.

Table 6. Comparison of the Experimental Group's Mean Scores in the Pre-test and Post-test

Control	Mean	SD	Computed t-value	Critical value	Decision
Pretest	43.30	6.55	-2.23	±2.032	*Not Significant*
Posttest	40.85	8.75			
df =34	alpha level = 0.05				

Table 6 compares the control group's pre-test (M = 43.30, SD = 6.55) and post-test (M = 40.85, SD = 8.75) mean scores. The t-value of -2.23 was not statistically significant ($p > .05$, $df = 34$), indicating no meaningful change in prepositional understanding. This lack of improvement in the control group, unlike the experimental group, reinforces the effectiveness of the experimental intervention (Chai Bot in a flipped classroom) compared to traditional teaching methods.

Experiences of Using Chai Bot

This study investigated participants' experiences using Chai Bot within a flipped learning model. Qualitative data analysis revealed eight key themes:

Theme 1. Ease of Use: Participants overwhelmingly reported the app's ease of use (26 instances of "easy to use"), indicating an intuitive design and user-friendly interface. This aligns with Margot (2020), who found chatbots easy to use across various age groups due to clear functionality and conversational interaction.

Theme 2. Clarity of Instructions: The app's instructions were also praised (4 instances of "easy to follow"), suggesting effective instructional design.

Theme 3. Technical Difficulties: Despite positive feedback, significant technical difficulties were reported (6 instances each of "difficult to log in" and "slow internet"), highlighting the need for improved app stability and robustness. These issues, as noted by Ideta (2017), are common challenges with chatbot technology, particularly concerning external factors like internet connectivity.

Theme 4. Refining and Updating the App: Participants frequently suggested improvements (13 instances of "improve"), indicating a need for ongoing development and updates to address glitches and bugs. This aligns with Vanichvasin (2022), who found that chatbot effectiveness is strongly linked to ongoing refinement and updates.

Theme 5. Correct Usage of Prepositions: The app's effectiveness in teaching correct preposition usage was frequently highlighted (9 instances each of "Understand prepositions" and "Correct preposition"). This aligns with research demonstrating chatbots' potential for enhancing various aspects of EFL learning, including grammar (Nghi et al., 2019) and vocabulary (Ruan et al., 2019a), and is further supported by Fryer and Carpenter (2006).

Theme 6. Serves as Writing Assistance: Participants valued the app's assistance in essay writing and idea generation (4 instances of "Helps to write essays," 2 instances of "Used in writing"), highlighting its role in supporting writing and learning (Göschlberger & Brandsteter, 2019).

Theme 7. Promotes Grammar Proficiency: The app's contribution to grammar proficiency development was strongly emphasized (13 instances of "Grammar proficiency development"), indicating its effectiveness in targeting a specific grammatical area and aligning with research on AI tutors (Vijayakumar et al., 2019).

Theme 8: Contributes to Advanced Learning. The frequent desire for more detailed explanations (15 instances of "Advanced learning," 12 instances of "Advanced education") suggests the app's capacity to facilitate deeper learning, aligning with Kim (2019), who emphasizes the potential of chatbots to improve grammar and writing skills through active participation and error correction.

This could mean that while Chai Bot shows promise as a flipped learning tool, addressing technical issues and continuously refining the app are crucial for maximizing its potential and ensuring a positive user experience. The strong positive feedback on ease of use, instructional clarity, and the app's impact on prepositional understanding and writing skills are encouraging.

5. CONCLUSION

This study investigated the effectiveness of integrating Chai Bot, an AI-powered chatbot, into a flipped classroom model for teaching prepositions to Filipino ESL learners. A mixed-methods approach was employed, involving a pre-test/post-test control group design and qualitative data collection through semi-structured interviews. The quantitative results revealed that while pre-tests showed no significant difference between the experimental (Chai Bot integrated into a flipped classroom) and control (traditional instruction) groups, post-tests demonstrated a statistically significant improvement in prepositional understanding for the experimental group. This finding strongly suggests that Chai Bot's interactive and personalized learning environment significantly enhanced the acquisition of prepositional knowledge. The qualitative data, analyzed thematically, provided valuable insights into students' experiences. Positive feedback centered on the app's ease of use and clear instructions, indicating successful design and implementation. However, the qualitative data also highlighted technical difficulties, such as login issues and slow internet speeds, underscoring the need for ongoing app development and improved system stability to maximize the learning potential of the tool. The study's limitations include the relatively small sample size and the specific ESL context. Future research should address these limitations, explore the long-term effects of Chai Bot integration, and investigate its applicability across diverse language learning contexts. The findings suggest that Chai Bot holds significant promise as a technology-enhanced learning tool for improving language acquisition, particularly within a structured flipped classroom framework.

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