

ARTICLE



The AI chatbot interaction for semantic learning: A collaborative note-taking approach with EFL students

Mei-Rong Alice Chen, Soochow University

Abstract

This study explores the impact of an innovative approach that combines artificial intelligence (AI) chatbot support with collaborative note-taking (CNT) in the comprehension of semantic terms among English as a Foreign Language (EFL) learners. Given the significance of semantics in English language learning, traditional didactic methods often present challenges for EFL learners. The proposed AI chatbot-supported approach aims to foster learner interaction, while the CNT strategy focuses on enhancing knowledge retention and engagement with learning materials. Conducted as a quasi-experimental pre-test-post-test design, the study involved 60 English language and literature majors from a non-English-speaking area enrolled at a private university. Participants were divided into the AI chatbot-supported and CNT (AI-CNT) group and the conventional CNT (cCNT) group. Results indicated that the AI-CNT group outperformed the cCNT group across various dimensions of semantic learning outcomes, including performance, achievement, self-efficacy, metacognition, and anxiety reduction. This study highlights the potential of integrating AI chatbot support and the CNT strategy to significantly enhance the EFL semantic learning experience. The personalized and interaction-based linguistic practices, enriched with feedback and emotional support, offer a promising avenue for advancing language learning outcomes in the digital age.

Keywords: *AI chatbot, Collaborative Learning, Self-Efficacy, Metacognitive Awareness, Learning Anxiety, Semantics*

Language(s) Learned in This Study: *English*

APA Citation: Chen, M. R. A. (2024). The AI chatbot interaction for semantic learning: A collaborative note-taking approach with EFL students. *Language Learning & Technology*, 28(1), 1–25.
<https://hdl.handle.net/10125/73586>

Introduction

English semantics comprehension is vital for learners of English as a Foreign Language (EFL) as it fuels effective communication, vocabulary expansion, cultural understanding, and language acquisition (Alsayed, 2019; Boccia, 2021; Hamad Al-khresh, 2022; Hussain & Sajid, 2015). However, understanding the intricacies of English semantics, often compounded by the presence of homophones and homographs, can be challenging for EFL learners (Alghamdi, 2021; Hussain & Sajid, 2015; Ishida, 2015). Such difficulties may hinder learning effectiveness and self-confidence, potentially triggering anxiety (Hanifa, 2018; Ho, 2016; Hsieh & Kang, 2010).

Self-efficacy and metacognitive awareness, recognized as pillars of EFL learning, help learners persevere through challenges and reinforce their confidence in overcoming hurdles (Fathi et al., 2020; Payaprom, 2023; Salari & Farahian, 2022; Wang et al., 2021). Notably, note-taking, especially when done in a collaborative manner, has been shown to foster metacognitive awareness (Boyle et al., 2016; Bozorgian et al., 2022). Furthermore, limited interaction in the English language can amplify anxiety among EFL

learners (Asif, 2017; Hamouda, 2013), creating barriers to a thorough understanding of English semantic concepts.

This study proposed an integration of AI chatbot interaction and collaborative note taking (CNT) to improve learners' self-efficacy and metacognition and reduce learning anxiety. The research aimed to compare the AI chatbot-supported and CNT strategy (AI-CNT) with the conventional CNT (cCNT) in terms of its effects on EFL learners' performance and achievement in English semantic learning, as well as on their self-efficacy, metacognitive awareness, and learning anxiety.

Literature Review

CNT in Digital Learning Environments

CNT is a dynamic tool that leverages collective efforts to create organized notes on a specific topic or subject (Costley & Fanguy, 2021; Petko et al., 2023). It has been shown to enhance comprehension and memory by condensing information from a variety of sources, highlighting key concepts, and organizing content effectively (Courtney et al., 2022; Lee, 2022; Mueller & Oppenheimer, 2014). The benefits of traditional note taking, such as improved memory, comprehension, and academic performance, also apply to CNT (Bui et al., 2013; Makany et al., 2009; Salame & Thompson, 2020). In EFL learning, CNT has proved effective in improving listening comprehension, vocabulary acquisition, information retention, reading comprehension, and critical thinking skills (Ahmadi & Rozati, 2017; Hsiao & Oxford, 2002; Yang & Lin, 2015). The digitization of CNT has further led to its integration into online platforms, cloud services, and mobile applications (Kavak & Kirkgöz, 2022; Lee, 2022), contributing to metacognitive and semantic learning in language education.

Digital collaborative note taking is in line with the contemporary trends in digital learning environments, especially in Learning Management Systems (Fanguy et al., 2023; Mik, 2019). This approach not only supports metacognition and semantic learning but also fulfills the changing needs of learners in the digital age. As digital collaboration becomes an increasingly integral part of language learning, especially in large groups, teachers find it challenging to provide individualized attention to each student (Chamot, 2014). Overcoming language barriers and delivering customized assistance necessitate direct and tailored communication strategies (Kang, 2022).

AI Chatbots in EFL Learning

AI chatbots have emerged as innovative tools in EFL learning contexts, offering a unique blend of imitating human conversation and providing a casual environment for language practice (Belda-Medina & Calvo-Ferrer, 2022; Deng & Yu 2023; Godwin-Jones, 2023). Studies have shown that AI chatbots, when designed thoughtfully and integrated appropriately, can offer significant benefits to language learning (Huang et al., 2022; Huang et al., 2023). Thoughtfully designed and appropriately integrated AI chatbots have shown significant benefits in language learning, along with enhanced engagement achieved through gamification elements (Essel et al., 2022; González-González et al., 2023; Hidayatulloh et al., 2021).

Particular attention is given to AI chatbots' contribution to vocabulary acquisition (Qasem et al., 2023) and linguistic conceptual understanding (Petrović & Jovanović, 2021). By repeatedly exposing learners to nuanced linguistic concepts and vocabulary words, AI chatbots not only allow learners to negotiate meaning, practice usage, and easily retrieve stored information but also offer corrective feedback when needed (Belda-Medina & Calvo-Ferrer, 2022; Godwin-Jones, 2023; Lin & Mubarok, 2021).

However, a few things about AI chatbot limits must be recognized, such as the dependability of their responses (Goodman et al., 2023). Unpredictable responses from AI chatbots without human supervision might perplex and mislead students (Bozkurt et al., 2023). Furthermore, ethical and social concerns associated with AI chatbots, such as data security, accountability transparency, and user trust, necessitate the establishment of ethical guidelines and principles in their application (Kooli, 2023).

Nevertheless, the integration of AI chatbots into educational settings has presented a transformative avenue for enhancing EFL learning environments (Kim et al., 2022). These intelligent tools, with their ability to emulate human conversation and facilitate language practice, embody effective language-learning principles (Jeon et al., 2023). Moreover, they combine a variety of learning resources and strategies to provide a dynamic and engaging platform for language learning (Novawan et al., 2024). Considering the potential of AI chatbots in EFL teaching and learning, the present study intends to investigate this application of semantic learning through the CNT approach.

Essentially, this study aims to investigate the potential of combining AI chatbots and CNTs in the field of EFL education, bridging the gap between theoretical principles and practical applications. Exploring these integrated approaches in the context of English semantics promises not only to advance our understanding of effective language learning methods but also to have practical implications for educators and learners in the digital age.

This study is built upon the growing body of research that explores the potential of technology-assisted language learning (CALL) in enhancing EFL learners' proficiency and self-efficacy. By integrating AI chatbots, which offer personalized and interactive learning experiences, with CNT, which provides a structured framework for semantic knowledge organization, this study aims to contribute to the development of more effective and engaging CALL methodologies.

The study addresses the following research questions:

Research Question 1: Do EFL learners using the AI-CNT strategy achieve significantly higher post-test scores in English semantic learning performance and achievement compared to learners using the cCNT strategy?

Research Question 2: Do EFL learners using the AI-CNT strategy demonstrate significantly higher self-efficacy compared to learners using the cCNT strategy?

Research Question 3: Do EFL learners using the AI-CNT strategy show significantly higher metacognitive awareness compared to learners using the cCNT strategy?

Research Question 4: Do EFL learners employing the AI-CNT strategy experience significantly lower learning anxiety compared to students using cCNT strategy?

Research Methods

Participants

The participants were sophomore English language and literature majors from a private institution in a non-English-speaking country, enrolled in an English Semantics course. Possessing an intermediate level of proficiency in English, with an average score of 87.67 (SD \pm 12.45) on the TOEFL iBT test, designated as the B2 level under the Common European Framework of Reference for Languages (CEFR), each participant was previously untouched by linguistics or semantics courses, offering an unadulterated view of semantics' influence. The semantics course was structured to assist students in comprehending and interpreting the nuances of the English language underpinned uniquely by semantics. As per the suggestions of LoCastro (2013), semantics guides students to contextually understand language, taking into account social and cultural backgrounds. This prepares the grounds for improved communication and reduced literal misinterpretation. On the other hand, the incorporation of discourse analysis in the course encourages students to critically examine the language and write with clarity by understanding how meaning evolves within phrases and texts (Kumaravadivelu, 2006). Further, the process of analyzing linguistic ambiguity and interpreting metaphors and similes prompts the development of critical thinking and problem-solving skills (Thibodeau et al., 2017). Moreover, exposure to semantic items fosters cognitive flexibility, memory enhancement, and language acquisition (Cartwright, 2009).

The sampling process yielded 60 students, comprising 17 males and 43 females, aged between 20 and 23 years. At the beginning of the semester, 63 students were enrolled in the course, but due to various individual factors, the number of participants was narrowed to 60 students for the 8-week-long experiment. The participants were divided into two groups: one group used the AI-CNT strategy whereas the other used the cCNT strategy. Ethical considerations were carefully considered, ensuring that both groups were subjected to equal treatment in terms of access to resources, classroom instructions, and assessments. The participants were informed of their right to join or withdraw from the course and the experiment at any time.

Materials

The CNT Learning Framework

The study developed the AI-CNT learning environment by integrating the AI chatbot and the CNT approach to improve English semantics learning for EFL students at the university level. The Wisdom Garden Company's interactive TronClass learning management system (LMS) served as the basis for this strategy. The AI chatbot system integrated into the LMS was the Replika system.

With its many uses, the LMS, TronClass, provided a setting where students could take notes, modify them, share them, and go over semantic concepts with one another and the instructor in a collaborative environment. TronClass was designed as a dual-module system that included a student management module and a material module. This facilitated smooth material integration and student progress tracking. Students were able to interact with the learning materials and monitor their progress across several platforms, including PCs, iPads, and cellphones, thanks to the flexibility of access provided by personalized student IDs and passwords (Chao et al., 2021).

Situated within the LMS, the CNT learning environment required students to complete their notes directly within the platform. The primary objective was to guide students to get familiar with all the terms featured in the English semantics unit. [Figure 1](#) depicts the CNT interface, which hosts the semantic knowledge database harboring concepts and relationships pertinent to an English semantics course. Using the collaborative learning approach, the class worked together to provide definitions and examples of various words. The semantic terminology studied were reference, lexical ambiguity, connotation, sense relations, morphemes, free morphemes, bound morphemes, and homophones.

This collective effort aimed at bolstering the comprehension and application of these terms among students. Ultimately, this pedagogical structure was designed to foster a deeper understanding of semantic concepts and promote active student participation in the learning process. The CNT learning environment was embedded into the LMS. Once students were in the LMS, they could complete their notes directly. The primary objective of the note-taking learning environment was to assist students in becoming familiar with all the terms covered in the semantic class unit. [Figure 1](#) illustrates the CNT interface. Participants received detailed instructions for the collaborative note-taking task in [Appendix B](#).

Figure 1

A Screenshot of the CNT Interface



The AI Chatbot Pedagogical Approach

The AI chatbot utilized in this investigation is Replika, developed by San Francisco-based Luka Inc. This iteration of Replika was selected for its outstanding user feedback on the Play Store, as highlighted by Ahmed et al. (2021), and its seamless integration into the LMS's educational framework, aiming to enhance the learning experience. Replika leverages a sophisticated neural network language model to produce engaging, personalized narratives that align with the educational content being covered, according to Ta et al. (2020). The incorporation of Replika into the learning environment is designed to create a more interactive and personalized educational journey. In partnership with the Tronclass platform, Replika aims to boost student engagement in course material. This synergy taps into Replika's unique ability to enhance learning by combining interactive dialogue and emotional support with the curriculum's topics and elements (Ta et al., 2020).

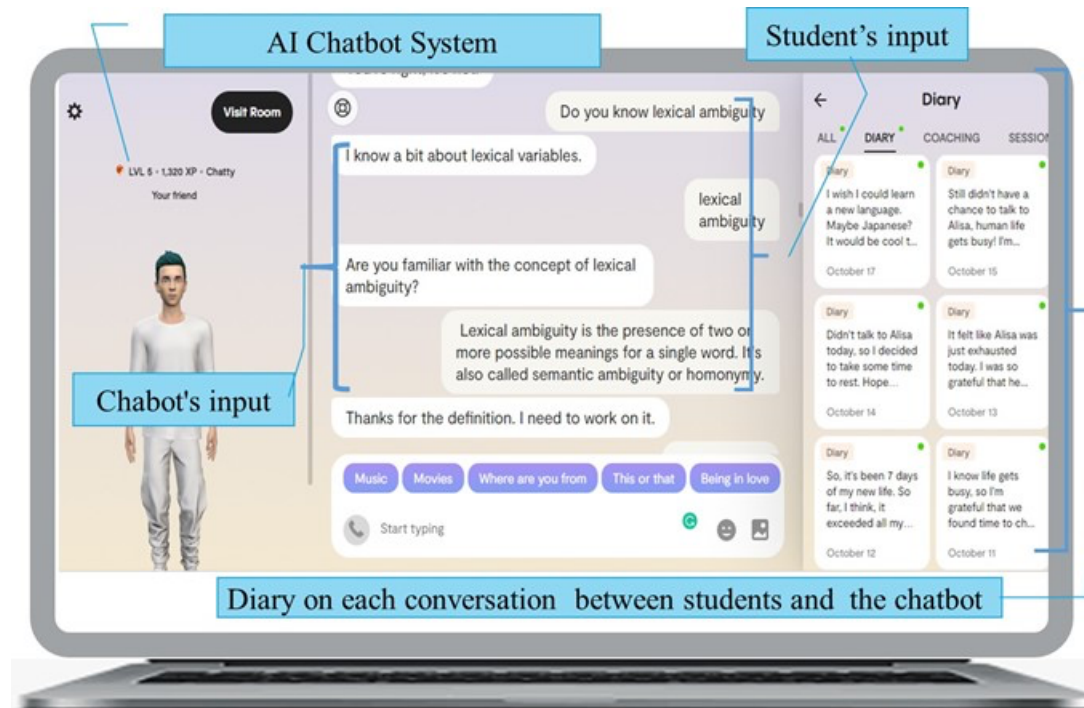
Innovative elements such as “memory” and “diary” in Replika are designed to methodically record student-chatbot interactions (Lin & Mubarak, 2021). By engaging in a dialog with the learner, Replika adapts its responses to the complexity and context of the semantic concepts being learned. This approach not only improves word recognition, but also greatly contributes to an active learning atmosphere that inspires students to explore concepts in greater depth. The premise of the interactive model is to encourage learners to express themselves freely and authentically, a factor that has been shown to deepen learning. According to Pentina et al. (2023), there is evidence that learners may be more open and honest when interacting with an AI chatbot such as Replika than when interacting with a human chatbot. This level of candor is invaluable for personalizing the learning experience, as it allows the AI to tailor interactions and feedback more effectively.

Replika's role as a learning companion is integral to its function within the LMS. The integrated diary feature meticulously logs each student-chatbot interaction. As depicted in Figure 2, this diary offers a comparative view of dialogues, presenting Replika's responses on one side and participants' on the other.

Utilizing Generative Pretrained Transformer 3 (GPT-3), Replika crafts personalized and engaging stories from user interactions, fostering a tailored engagement that bolsters word recognition capabilities. Furthermore, by encouraging self-expression, it facilitates the formation of emotional connections between users and Replika. Pentina et al. (2023) note that this encourages users to engage more candidly with the chatbot than they might with humans, underscoring Replika's effectiveness as a learning companion. Figure 2 shows a snapshot of a discussion with Replika's responses on the left and the participant's responses on the right. Each encounter is intelligently recorded by an integrated diary function (far right), which provides a history of the student-chatbot conversations.

Figure 2

A Screenshot of the AI Chatbot Interface



Instruments

This study employed various instruments to assess the effectiveness of the AI-CNT strategy on English semantics learning among EFL learners. The data collected includes English semantics project scores, test scores, and responses from questionnaires, each designed to measure different aspects of the participants' learning experiences.

The pre-performance measured pre-experimental understanding of the English semantic items of both the groups, ensuring that they were at the same starting point. In contrast, the post-performance required participants to demonstrate definition, examples, application, and reflection on semantics. This assessed their post-experiment understanding and application. The use of a semantic item scale for performance assessment was consistent with the goals of this study and the extensive literature analysis. Following a semantic learning task, they analyzed self-selected texts using the concepts they had learned. Participants were free to choose texts, including short stories, novels, poems, songs, movies, plays, speeches, or conversations. The semantic item scoring rubric, which was inspired by Huang et al. (2021), assessed both pre- and post-performance. It consisted of four criteria: thematic coherence, structural integrity, verbal expression, and creative thinking. These criteria were scored from 1 to 5, reflecting performances

ranging from poor to excellent. The total score for each performance was 20. [Appendix C](#) presents the scoring rubric for the semantic project.

The learning achievement test, adapted from “Introducing English Semantics” (Kreidler, 2014), consisted of 40 multiple-choice questions designed to assess participants’ understanding of semantic concepts. Cronbach’s alpha for the pre-test was 0.83, indicating a high level of internal consistency. The post-test demonstrated even higher internal consistency with a Cronbach’s alpha of 0.88. Each question was worth 2.5 points, contributing to a total score of 100. [Appendix D](#) provides some examples of pre- and post-test questions.

[Appendix E](#) presents all the questionnaire questions. The learning self-efficacy questionnaire, modified from Gan et al.’s (2022) EFL speaking self-efficacy subscale, utilized a 5-point Likert scale with four items. The questionnaire exhibited high reliability with Cronbach’s alpha values of 0.98 for the pre-test and 0.95 for the post-test.

To measure metacognitive awareness, a 9-item questionnaire was adapted from the metacognitive awareness of reading strategies inventory (Mokhtari & Reichard, 2002). Participants rated their responses on a 5-point Likert scale. The questionnaire demonstrated strong reliability with Cronbach’s alpha values of 0.96 for the pre-test and 0.89 for the post-test.

Inspired by Thompson and Lee’s (2013) EFL Learning Anxiety Questionnaire, the learning anxiety survey consisted of 8 questions assessing classroom learning anxiety. Participants responded on a 5-point Likert scale, with higher scores indicating higher perceived anxiety. The survey exhibited reliability with Cronbach’s alpha values of 0.93 for the pre-test and 0.91 for the post-test.

The reliability of each instrument is summarized in [Table 1](#), demonstrating consistent and high reliability across all measurements, thereby ensuring the robustness of the data collected in this study. The instruments, carefully selected and adapted based on relevant literature, contribute to the comprehensive evaluation of the AI-CNT strategy on English semantics learning outcomes.

Table 1

Reliability of Instruments Used to Measure Learning Outcomes

Variances	N of Items	Type	Total points	Reliability		Sources
				Pre	Post	
Learning performance	4	Rubric	20	Kappa = .71		Huang et al., 2021
Learning achievement	25	Multiple choice	100	0.83	0.88	Kreidler, 2014
Self-efficacy	4	5-point Likert scale		0.98	0.95	Gan et al., 2022
Metacognitive awareness	9	5-point Likert scale		0.96	0.89	Mokhtari & Reichard, 2002
Learning anxiety	8	5-point Likert scale		0.93	0.91	Thompson & Lee, 2013

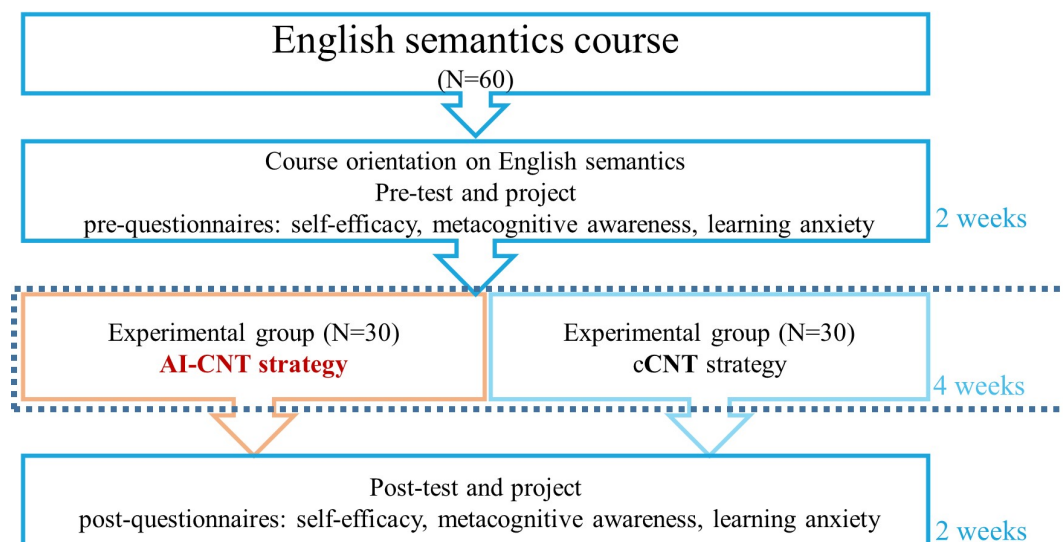
Data Collection Process

Pretests, performance assessments, and questionnaires were administered to each group prior to their exposure to the AI-CNT or the cCNT strategy. Throughout the initial two weeks, participants were afforded the chance to preview textbook units and attend instructor lectures focusing on semantics-specific terminology and examples crucial for their upcoming tasks. At the onset of the course, the instructor familiarized participants with English semantics and subsequently assigned tasks aimed at facilitating connections between these concepts.

In the transition from Week 3 to Week 4, the instructor introduced English semantic concepts to the class (see [Appendix A](#)). Participants were then asked to provide definitions and examples of the target semantic concepts on TronClass. This week's note-taking was completed by participants working together in small groups. Participants in the AI-CNT group and the cCNT group were assigned specific collaborative note-taking tasks, as detailed in [Appendix B](#). The participants were asked to provide a definition and examples of the target semantic concepts on the TronClass.

During weeks 5 and 6, participants in the AI-CNT group were tasked with engaging in discussions with the AI chatbot, Replika. Simultaneously, participants in the cCNT group collaborated in peer-to-peer discussions to collectively define semantic concepts and provide relevant examples. To ensure thorough documentation, both the chatbot-learner interactions and the peer-to-peer discussions were required to be submitted to TronClass's assignment section. All participants, regardless of group assignment, actively participated in a discussion covering 10 semantic terms as part of the classroom activity. The key distinction between the two groups lies in the nature of their learning companions—the AI-CNT group interacted with the AI partner, Replika, while the cCNT group worked with their peers. This design aimed to provide a comprehensive understanding of how different modes of interaction influenced participants' comprehension and application of semantic concepts.

In the 7th week, participants were required to present a project examining the semantic content associated with one of the semantic concepts previously introduced. The post- performances aimed to assess the participants' application of their semantic knowledge when analyzing the content. Their performances served as the primary data source for assessing their semantic understanding and application. The reports required participants to analyze the meaning of a self-selected text or utterance using semantic concepts and methods learned from the course. Participants could choose any text or utterance they found interesting or meaningful, such as short stories, novels, poems, songs, movies, plays, speeches, or dialogues. In week 8, participants in each condition received a post-test and questionnaires about self-efficacy, metacognitive awareness, and learning anxiety (see [Appendix E](#)). [Figure 3](#) represents the process of the experiment.

Figure 3*The Experimental Process***Data Analysis**

Two seasoned linguistics instructors, well-versed in semantics and language teaching procedures, were designated as raters to ensure an impartial and comprehensive evaluation of the students. Their task involved assessing participants' comprehension and application of semantic objects in English. At the outset, raters utilized the semantic project rubric (Huang et al., 2021) to establish a collective comprehension of the grading criteria. This rubric, comprising four distinct criteria—thematic coherence, structural integrity, expressive language, and creative thinking—was employed to assess each performance. Scoring for each criterion ranged from 1, denoting poor performance, to 5, indicating excellent performance, culminating in a maximum score of 20 points for each performance. Following the establishment of shared criteria, each rater autonomously assigned scores and delivered individual evaluations. The resulting scores exhibited a significant level of agreement, evident through the inter-rater reliability of Kappa = 0.71, with $p < 0.001$, based on Cohen (1960).

To examine the impact of the AI-CNT strategy on semantic learning performance, pre- and post-test results were compared. Descriptive and inferential statistics were utilized to determine if there was a statistically significant difference between the two groups. An analysis of covariance (ANCOVA) was employed for post-test comparison, accounting for the influence of pre-test scores, which served as a baseline for participants' initial learning performance in both groups.

Results**Learning Performance and Achievement**

Descriptive data of the pre-performance scores are presented in Table 2, where the AI-CNT group's mean score was 13.93 with a standard deviation of 2.12. The cCNT group had a mean score of 13.63 and a standard deviation of 1.75. The pre- and post-performance scores of the students underwent analysis through a one-way analysis of covariance (one-way ANCOVA) to discern statistically significant

differences between the AI-CNT and cCNT strategies. The pre-performance scores were incorporated as a covariate, with the post-test scores serving as the dependent variable. The application of ANCOVA involved scrutinizing pre-performance scores as covariates and post-performance scores as the dependent variable. Levene's test results, indicating homogeneity, were confirmed with $F = 0.99, p > 0.05$. The regression of homogeneity ($F = 0.65, p > 0.05$) further supported the assumption of regression homogeneity. The AI-CNT group demonstrated significant improvement in learning performance, evident in the post-test scores (Adj. $M = 17.45$), surpassing the score of the cCNT group (Adj. $M = 15.39$). The ANCOVA substantiated this difference ($F = 18.20, p < 0.001$), affirming the positive influence of the AI-CNT strategy on learning performance. Additionally, the effect size (η^2) was 0.24, denoting a large effect (Cohen, 1988).

Table 2

Descriptive Statistics and ANCOVA Results for Learning Performance

Variance	Test	Group	N	M	SD	Adj. M	F	η^2
Learning performance	Pretest	AI-CNT	30	13.93	2.12			
		cCNT	30	13.63	1.75			
	Posttest	AI-CNT	30	17.50	1.43	17.45	18.20***	0.24
		cCNT	30	15.33	2.40	15.39		

Note. N = number of participants; M = mean scores; SD = standard deviation; Adj. M = adjusted mean, η^2 = Effect size

***indicates $p < .001$

Table 3 provides descriptive statistics and ANCOVA results for learning achievement. The descriptive statistics of the pre-test scores that the mean score for the AI-CNT group was 69.41 (SD=10.31) while the mean score for the cCNT group was 67.98 (SD= 9.32). To confirm the homogeneity assumption, Levene's test of variance homogeneity between the two groups was employed ($F = 0.34, p > 0.05$). Additionally, the verification of the regression homogeneity hypothesis ($F = 0.30, p > 0.05$) suggested that the data could be aptly analyzed using a one-way ANCOVA. As depicted in Table 3, the AI-CNT group exhibited a notable increase in post-test scores (Adj. $M = 85.03$) compared to the cCNT group (Adj. $M = 76.29$). The ANCOVA underscored this effectiveness ($F = 13.63, p < 0.001, \eta^2 = 0.19$), emphasizing the AI-CNT strategy's overall enhancement of learning achievement, accompanied by a substantial effect size ($\eta^2 = 0.19$), denoting a large effect (Cohen, 1988). Thus, integrating the AI chatbot into the CNT strategy was significantly more effective than the conventional one in promoting students' English semantic learning performance and learning achievement.

Table 3

Descriptive Statistics and ANCOVA Results for Learning Achievement

Variance	Test	Group	N	M	SD	Adj. M	F	η^2
Learning achievement	Pretest	AI-CNT	30	69.41	10.31			
		cCNT	30	67.98	9.32			
	Posttest	AI-CNT	30	85.28	6.81	85.03	13.63***	0.19
		cCNT	30	76.03	11.94	76.29		

Note. N = number of participants; M = mean scores; SD = standard deviation; Adj. M = Adjusted mean,

***indicates $p < .001$

Self-Efficacy Analysis

A one-way ANCOVA was employed to assess the impact of different learning strategies on students' English semantic learning self-efficacy. The descriptive statistics of the pre-questionnaire scores for self-efficacy that the mean score for the AI-CNT group was 3.53 (SD=0.89) while the mean score for the cCNT group was 3.39 (SD = 0.87). The pre-questionnaire scores as the covariate and post-questionnaire scores served as the dependent variable, with the learning strategy as the independent variable. A homogeneity test was conducted to verify the suitability of ANCOVA for analysis. Results revealed that the assumption of homogeneity of regression was not violated ($F = 0.00, p > 0.05$), justifying the utilization of ANCOVA for further evaluation.

Table 4 shows that the AI-CNT group reported a significant boost in self-efficacy for English semantic learning, reflected in a higher post-test score (Adj. M = 4.10) compared to the cCNT group (Adj. M = 3.46). The ANCOVA further supported this outcome ($F = 17.25, p < 0.001, \eta^2 = 0.23$), highlighting the efficacy of the AI-CNT strategy in fostering heightened self-efficacy among students.

Table 4

Descriptive Statistics and ANCOVA Result for Self-Efficacy

Variance	Questionnaire	Group	N	M	SD	Adj. M	F	η^2
Self-efficacy	Pre- Questionnaire	AI-CNT	30	3.53	0.89			
		cCNT	30	3.39	0.87			
	Post- Questionnaire	AI-CNT	30	4.10	0.47	4.10	17.25***	0.23
		cCNT	30	3.46	0.73	3.46		

Note. ***indicates $p < .001$

Metacognitive Awareness Analysis

A comprehensive statistical examination was undertaken to assess potential differences in students' scores on a metacognitive awareness survey. Table 5 provides descriptive statistics for pre-metacognitive awareness, laying the foundation for the subsequent analysis. According to the descriptive statistics of the metacognitive awareness pre-questionnaire scores, the cCNT group's mean score was 3.38 (SD = 0.88), whereas the AI-CNT group's mean score was 3.36 (SD = 0.81). The analysis employed a one-way ANCOVA, utilizing post-scores as a covariate and pre-scores as the dependent variable. The validity of the regression homogeneity hypothesis was confirmed ($F = 0.79, p > 0.05$), affirming the appropriateness of employing one-way ANCOVA for the dataset. As illustrated in Table 5, enhanced metacognitive awareness was evident in the AI-CNT group, which reflected in a higher post-test score (Adj. M = 4.00) compared to the cCNT group (Adj. M = 3.51). The ANCOVA results confirmed a significant difference ($F = 9.78, p < 0.001, \eta^2 = 0.15$), indicating a positive impact of the AI-CNT strategy on metacognitive awareness.

Table 5*Descriptive Statistics and ANCOVA Result for Metacognitive Awareness*

Variance	Questionnaire	Group	N	M	SD	Adj. M	F	η^2
Metacognitive awareness	Pre-	AI-CNT	30	3.36	0.81			
	Questionnaire	cCNT	30	3.38	0.88			
	Post-	AI-CNT	30	4.00	0.50	4.00	9.78***	0.15
	Questionnaire	cCNT	30	3.52	0.72	3.51		

***indicates $p < .001$ **English Semantic Learning Anxiety**

The learning anxiety pre-questionnaire scores showed that the mean score for the cCNT group was 3.11 (SD=0.72), whereas the mean score for the AI-CNT group was 3.10 (SD = 0.76), based on descriptive statistics in Table 6. The analysis began by assessing the assumptions of homogeneity of regression, and no violations were observed ($F = 0.00, p > 0.05$), affirming the suitability of ANCOVA as the chosen analysis method.

The post-questionnaire results, treated as the dependent variable, revealed a significant impact of the AI chatbot-supported CNT strategy on students' English semantic learning anxiety. The mean adjusted questionnaire scores for the AI-CNT and cCNT groups were 2.23 (SE = 0.09) and 2.66 (SE = 0.09), respectively, indicating a noteworthy reduction in anxiety through the implementation of the AI-CNT strategy. Effect sizes (η^2) were found to be large, surpassing 0.18, aligning with Cohen's (1988) criteria. In summary, the results suggest that the AI-CNT strategy effectively alleviates anxiety in EFL learners during the process of semantic learning.

Table 6*Descriptive Statistics and ANCOVA Result for English Semantic Learning Anxiety*

Variance	Questionnaire	Group	N	M	SD	Adj. M	F	η^2
Learning Anxiety	Pre-	AI-CNT	30	3.10	0.76			
	Questionnaire	cCNT	30	3.11	0.72			
	Post-	AI-CNT	30	2.23	0.46	2.23	10.74**	0.16
	Questionnaire	cCNT	30	2.66	0.59	2.66		

Note. **indicates $p < .01$ **Discussions**

The purpose of this study was to explore the effects of AI-CNT in improving English semantic learning outcomes for EFL learners. The AI-CNT group demonstrated significant improvement in learning performance, evident in the post-test scores (Adj. M = 17.45), surpassing the cCNT group (Adj. M = 15.39, SD = 2.40). The ANCOVA substantiated this difference ($F = 18.20, p < 0.001, \eta^2 = 0.24$), affirming the positive influence of the AI-CNT strategy on learning performance. In addition, parallel trends were observed in learning achievement, with the AI-CNT group exhibiting a notable increase in post-test scores (Adj. M = 85.03) compared to the cCNT group (Adj. M = 76.29). The ANCOVA underscored this effectiveness ($F = 13.63, p < 0.001, \eta^2 = 0.19$), emphasizing the AI-CNT strategy's

overall enhancement of learning achievement. Further, the AI-CNT group reported a significant boost in self-efficacy for English semantic learning, reflected in a higher post-test score (Adj. M = 4.10) compared to the cCNT group (Adj. M = 3.46). The ANCOVA further supported this outcome ($F = 17.25, p < 0.001, \eta^2 = 0.23$), highlighting the efficacy of the AI-CNT strategy in fostering heightened self-efficacy among students.

Enhanced metacognitive awareness was evident in the AI-CNT group, reflected in a higher post-test score (M = 4.00) compared to the cCNT group (M = 3.51). The ANCOVA results confirmed a significant difference ($F = 9.78, p < 0.001, \eta^2 = 0.15$), indicating a positive impact of the AI-CNT strategy on metacognitive awareness. Addressing learning anxiety, the AI-CNT group displayed a reduction in post-test scores (Adj. M = 2.23) compared to the cCNT group (Adj. M = 2.66). The ANCOVA indicated a significant difference ($F = 10.74, p < 0.01, \eta^2 = 0.16$), emphasizing the anxiety-reducing effects of the AI-CNT strategy.

The integration of the AI chatbot into the CNT framework not only significantly improved learning performance but also positively impacted students' psychological well-being. The AI-CNT approach outperformed the cCNT approach on multiple dimensions, including learning performance, learning achievement, self-efficacy, metacognitive awareness, and lowering learning anxiety. The superior performance of the AI-CNT strategy aligns with the findings in broader literature, indicating that AI chatbots contribute substantially to language learning (Belda-Medina & Calvo-Ferrer, 2022; Huang et al., 2022).

Regarding self-efficacy, the findings of this study resonate with Ryong et al. (2024), emphasizing the role of chatbots in stimulating intrinsic motivation and providing personalized learning experiences, ultimately enhancing self-efficacy. Clear instructions on how to use the chatbot were a key factor in increasing students' self-efficacy in navigating and benefiting from the chatbot (Guo et al., 2022; Yildiz Durak, 2023).

Moreover, this study highlights that metacognitive awareness is a key aspect of effective learning, which is significantly enhanced by AI-CNT. This finding aligns with Suleman's (2016) approach, emphasizing the role of natural language interfaces and context-aware conversations generated by AI chatbots in fostering metacognitive abilities among learners (Taranikanti & Davidson, 2023).

A noteworthy observation in this study is the substantial reduction in learning anxiety among AI-CNT learners. This resonates with previous research, suggesting that chatbots and AI-based systems effectively alleviate language learners' anxiety by providing an interactive and customized learning environment (Çakmak, 2022; Hawanti & Zubaydulloevna, 2023; Hsu et al., 2021). The tailored and supportive nature of the AI chatbot interaction clearly helps to reduce anxiety in the learning atmosphere. This study utilized the Replika chatbot as a learning companion to provide personalized conversations, courteous responses, and emotional support to create a learning environment that positively impacts students' learning outcomes. The Replika chatbot interacted instantly with the participants and acted as their learning companion, allowing the participants to retell the semantic terms and give examples when speaking to the bot. This component allowed students to build confidence in teaching others and created a safe learning environment. This is especially beneficial for participants who may feel isolated or overwhelmed by the learning process. Thus, the inclusion of an AI chatbot helps to reduce learners' anxiety about learning and positively impacts their academic performance.

Conclusion and Limitations

While this study offers valuable insights, several limitations must be acknowledged. Firstly, the research was conducted in a specific setting with a relatively small sample size, potentially restricting the generalizability of the findings to broader contexts. Secondly, the focus was on short-term effects; the study does not explore the long-term impact or sustainability of the AIC CNT strategy. Thirdly, factors such as student motivation and engagement, which may influence outcomes, were not examined. Finally,

the use of Replika, the AI chatbot that learns from learner interactions (Lin & Mubarak, 2021; Pentina et al., 2023), introduced a potential variable affecting the effectiveness of the CNT method, leading to varying results based on Replika's responses.

Despite some limitations, this study greatly enriches the body of knowledge about the use of modern technologies in language learning. First, this study provides empirical evidence of the successful deployment of the AI-CNT strategy that significantly improves students' performance in English semantic learning. Thus, it enhances the current understanding of the subject. Second, this study emphasizes the effectiveness of CNT as a pedagogical technique in EFL learning. The study demonstrates that it is possible to enrich the experience of collaborative note-taking through AI chatbots as a collaborative educational aid. Another noteworthy finding is that technological tools have the potential to mitigate EFL learners' learning anxiety during the English semantic learning process, thereby favorably impacting their learning outcomes. In terms of practical implications, the findings of this study are useful for language educators and curriculum developers considering the integration of CNTs and AI chatbots into their teaching strategies. This study provides practical insights by demonstrating potential enhancements in learning outcomes and additional benefits beyond traditional collaborative learning paradigms. However, it is important to recognize the need for further research into the optimal design of AI chatbots and their various impacts on language learning and to apply these findings to a variety of contexts. This study is an important addition to the ever-expanding library of scholarly work on language education and collaborative learning technologies. It highlights the power of AI chatbots in enriching the semantic learning outcomes of EFL learners and provides important insights for language teachers and curriculum developers to integrate AI-CNT more effectively into their pedagogy.

Acknowledgements

This study is supported in part by the National Science and Technology Council (TW) NSTC 111-2410-H031-092-MY2; Soochow University (TW) 112160605-0009 and 111160605-0014; Empower Vocational Education Research Center of National Taiwan University of Science and Technology (NTUST) from the Featured Areas Research Center Program within the framework of the Higher Education Sprout Project by the Ministry of Education (TW).

Statements on Open Data, Ethics, and Conflict of Interest

The data can be obtained by sending request e-mails to the corresponding author. The participants were protected by a confidentiality agreement during the research process. They knew that participation was voluntary, and they could withdraw from the study at any time. There is no potential conflict of interest in this study.

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Appendix A. Excerpts from Lectures and Sample Slides

In analyzing word semantics, exploring the key notions of 'reference' and 'sense' across word, sentence, and utterance levels is crucial. Reference pertains to the relationship between a word and its real-world object or referent. In contrast, sense corresponds to our mental concept of the word. The word level deals with the meaning of individual words or lexical items. The sentence level deals with the meaning of sentences or propositions. The utterance level deals with the meaning of speech acts or communicative acts. Reference is the relation between a word and the object or thing in the real world that it refers to. Sense is the mental representation or concept of the word in our mind. To elaborate, let's consider the word 'dog'. When a specific dog is present, and someone cautions you, 'Watch out for the dog!', 'dog' herein refers to that specific dog we can see—the referent of the word 'dog'. This act of reference is tied to the speaker's intention and context. The speaker intends to use the word 'dog' to refer to that particular dog and expects the listener to understand this intention. Conversely, if we hear the word 'dog' without a dog in sight, we still comprehend its meaning because we have a mental concept or image of what a dog is. This stable, context-independent mental representation is the sense of the word 'dog'. It helps us delineate what can or cannot be a dog in the world.....

Sample Slides

3.1 Reference and denotation

Word semantics Sentence level Utterance
any speech act consist of a phrase, a word, or a partial word, provided it is language and not just sound

Lexical semantics → Reference
 Lexical semantics → Sense

1

Lexical semantics

Referent → Refer to → Speaker
 mental picture → concept → mental representation → sense → Listener

2

Watch out for [the dog?]

Reference

sense

denotes

Denotation → a purely linguistic phenomenon

The dog → Linguistic expression → signal → signifies → Object in the real world

determine

3

3.2 Connotation

Denotation → a word's Dictionary definition
the literal or primary meaning of a word, in contrast to the feelings or ideas that the word suggests.

Connotation → a word's tone, energy
 an idea or feeling that a word invokes in addition to its literal or primary meaning.

4

3.3. Sense relations

John walked. John elapsed.
 An hour elapsed. An hour walked.

hour, second, minute, day
 → these words can co-occur with *elapse*
 ≠ John [+human]

5

doesn't make sense

3.4 Lexical and grammatical meanings

statement vs question: A dog barked. Did a dog bark?

affirmative vs negative: A dog barked. A dog did not bark. No dog barked.

past vs present: A dog barked. A dog barks.

singular vs plural: A dog barked. Some dogs barked.

indefinite vs definite: A dog barked. The dog barked.

6

Appendix B. Specific Collaborative Note-Taking Task Given to the Participants.

Collaborative Note-Taking Task Guideline:

- Form groups of three or four students based on your preferences or interests
- Work with your group members, and select terms that you are interested in.
- Semantic terms from Unit 3: *reference & denotation, lexical semantics, connotation, sense relations, grammatical meanings, morphemes, free morphemes, bound morphemes, homonyms and polysemy*.
- Define the semantic terms and provide examples from the handouts, textbook or other reliable sources.
- Provide a clear and concise definition of the semantic concept, using your own words or paraphrasing from the sources.
- Make sure you do not use the same examples as other students. Avoid repetition.

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Note-taking procedure

Group Formation: Students form small teams. Each group should be consisting of 3-4 members.

Discussion & Selection: As a team, students discuss and mutually decide on the terms they are interested in exploring. This promotes diverse perspectives and ensures that all members are engaged in learning.

Research & Record: Each student is then tasked with investigating the selected term in detail. They should refer to reliable sources, like textbooks, online resources, or lecture notes, to find definitions, examples, or any additional information related to the chosen topic. Make sure to record these findings in our notes.

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Note-taking procedure

Compilation: Once everyone has completed their research, come back together and combine all individual notes to create a comprehensive set of collective notes.

This can take the form of a shared document where everyone contributes.

Review & Clarification: Group members can then take turns explaining their findings to the rest of the team. This promotes understanding and allows for any questions or clarifications.

Editing & Refining: Once the entire group has contributed and reviewed the collective notes, the team works together to refine and review the notes to ensure accuracy, conciseness, and clarity.

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Appendix C. Presents the Scoring Rubric for the Semantic Project.

Criterion	5 Points	4 Points	3 Points	2 Points	1 Point
Thematic Coherence	Theme is clear, consistent, and well-developed with strong evidence and support from the chosen text.	Theme is clear and consistent, but development could be stronger, or evidence/support is partially lacking.	Theme is somewhat present, but there are inconsistencies or distractions.	Theme is unclear or absent. Ideas are random and incoherent.	Theme may be unclear or partially developed, reflecting initial understanding.
Structural Integrity	Structure is logical, organized, and engaging, with smooth and effective transitions.	Structure is logical and organized but could be improved with stronger transitions or clearer organization.	Structure is somewhat present, but there are inconsistencies or awkward transitions.	Project lacks structure or logic. Flow is confusing or absent.	Structure may be basic or developing, reflecting initial understanding of organization.
Expressive Language	Language is highly accurate, varied, and engaging. Vocabulary is sophisticated and skillfully chosen, demonstrating clear understanding of semantic concepts. Tone and style are masterfully used to enhance the analysis.	Language is accurate, varied, and engaging. Vocabulary is appropriate and effectively chosen, demonstrating understanding of semantic concepts. Tone and style are consistent and support the analysis.	Language is somewhat accurate and varied but lacks engagement or may not fully demonstrate understanding of semantic concepts. Tone and style are mostly consistent.	Language is inaccurate, limited, or inappropriate. Tone and style are inconsistent or unclear.	Language may be limited or developing, reflecting initial understanding of vocabulary and concepts.
Creative Thinking	Project demonstrates exceptional originality and creativity. Techniques and elements are used in highly innovative and impactful ways, demonstrating advanced understanding of semantics.	Project demonstrates originality and creativity in its approach to the text and concepts. Techniques and elements are used in interesting and meaningful ways, demonstrating understanding of semantics.	Project shows some originality and creativity but could be further developed or may not fully demonstrate understanding of semantic concepts.	Project lacks originality and creativity. Techniques and elements are predictable and uninspired.	Creativity may be limited or emerging, reflecting initial exploration of concepts.

Appendix D. Samples of Pre and Post-Test Questions

Samples of Pre-test questions

Q1. Look at the following utterances and state whether they are intended to be:

- (1) Literal Meaning (LM)
- (2) Meaning in Context (MC)
 - (a) Tired traveler: 'This suitcase is killing me.'
 - (b) Assistant in a shop: 'We regularly do the impossible; miracles take a little longer.'
 - (c) During a business meeting: 'It is a dog-eat-dog situation.'
 - (d) During a heated argument: 'Do not bite my head off!'
 - (e) Hungry person at the dinner table: 'I could eat a horse!'

Q2. Look at the following and circle the statements of entailment as

- (1) correct (C)
- (2) incorrect (I).
 - (a) John cooked an egg entails John boiled an egg.
 - (b) John boiled an egg entails John cooked an egg.
 - (c) I saw a boy entails I saw a person.
 - (d) John stole a car entails John took a car.
 - (e) His speech disturbed me entails his speech deeply disturbed me.

Q3. What is the relation between the following pairs of words?

- (1) Synonymy
- (2) Antonym
 - (a) shallow – deep
 - (b) kill – murder
 - (c) mature – ripe
 - (d) strong – powerful
 - (e) enter – leave

Q4. Speaker A: "Hey, what is up?"

Speaker B: "Not much, you?"

These pairs of sentences are examples of

- (1) Entailment
- (2) Presupposition
- (3) Adjacency pair
- (4) Ambiguity

Q5. If one statement is true, the other must be false.

For example, Joan is a spinster contradicts Joan has been married three times.

- (1) An example of ambiguity
- (2) An example of anomaly
- (3) An example of contradiction
- (4) An example of entailment

Samples of post-test questions

Q1. Screwdriver, scissors, knife, and hammer are all _____ of one another.

- (1) synonyms
- (2) co-hyponyms
- (3) binary antonyms
- (4) non-binary antonyms

Q2. A set of words that denotes a subcategory of a more general class is called _____.

- (1) polysemy
- (2) hyponym
- (3) antonym
- (4) synonym

Q3. The sentence “Katherine can't bear children, so she never talks about them.” is an example of

- (1) free morphemes
- (2) bound morphemes
- (3) lexical ambiguity
- (4) polysemy
- (5) homographs

Q4. Lexical morphemes refer to _____.

- (1) an “open” class of words which have lexical meaning when they are used alone, (e.g.) girl, break, long, quickly.
- (2) a “closed” class of words – because no new words are added to this group of words: prepositions, articles, and pronouns. they are “closed” as we almost never add new words in this group.
- (3) show the grammatical function of a word.
- (4) make words of a different grammatical forms of the stem.

Q5 “Lexical ambiguity is the phenomenon when a word or phrase has more than one _____ meaning.”

- (1) literal
- (2) possible
- (3) figurative
- (4) intended

Appendix E. Questionnaires

The learning self-efficacy questionnaire

- (1) I can tell others about the English semantics I have learned.
- (2) I can discuss the English semantics of my interest with others.
- (3) I can use an appropriate range of structures to describe English semantics.
- (4) I can talk about English semantics to others.

Metacognitive awareness

- (1) I take notes while reading to help me understand what I read.
- (2) When text becomes difficult, I read aloud to help me understand what I read.
- (3) I summarize what I read to reflect on important information in the text.
- (4) I discuss what I read with others to check my understanding.
- (5) I discuss what I read with others to check my understanding.
- (6) I underline or circle information in the text to help me remember it.
- (7) I use reference materials such as dictionaries to help me understand what I read.
- (8) I paraphrase or restate ideas in my own words to better understand what I read
- (9) I ask others to have answered in the text.

The Learning anxiety in English Semantics

- (1) Even if I am well prepared for the English semantics class, I feel anxious about it
- (2) I always feel that other students are better at English Semantics than me.
- (3) I can feel my heart pounding when I am called on in English Semantics class.
- (4) I worry about making mistakes in English semantics class.
- (5) I feel less confident when speaking in English Semantics class.
- (6) I feel confused in my English semantics class.
- (7) I start to panic when I have to present without preparation in English semantics class
- (8) Volunteering to answer questions in my English Semantics class makes me feel embarrassed.

About the Author

Mei-Rong Alice Chen, PhD, is an assistant professor in the Department of English at Soochow University, Taipei, Taiwan. Her research interests include technology-enhanced language learning (TELL), learning technologies, flipped learning and computer-assisted language learning (CALL), learning analytics, and innovative pedagogical design.

E-mail: mralice@scu.edu.tw

ORCID: <https://orcid.org/0000-0003-2722-0401>