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Metacognitive Self-Regulation and Voice AI Interactivity: Mitigating Speaking Anxiety to Boost Oral Fluency in EFL Learners

Ibodullayeva Diyora Orifjon qizi
Samarkand State Institute of Foreign Languages
diyoraibodullayeva50@gmail.com

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Abstract. Speaking anxiety remains a critical psychological barrier that hinders English as a Foreign Language (EFL) learners from developing natural oral fluency. While interactive voice AI tools provide low-stakes practice environments, technology alone is often insufficient to build long-term emotional resilience during speech production. This paper investigates how integrating metacognitive self-regulation strategies with voice AI practice helps undergraduate EFL learners manage communication anxiety and reduce speech hesitation. Utilizing a mixed-methods action research design, students engaged with voice AI platforms alongside structured self-regulation logs to monitor emotional triggers, establish clear communicative goals, and reflect on their progress. The findings reveal that pairing AI interactivity with metacognitive self-regulation significantly lowers foreign language speaking anxiety, enhances self-confidence, and leads to smoother speech execution. The study underscores the pedagogical value of combining AI technologies with affective metacognitive strategies to cultivate autonomous, confident, and resilient EFL speakers.

Keywords. EFL oral fluency, voice AI interactivity, metacognitive self-regulation, foreign language speaking anxiety, affective strategies, communication apprehension, low-stakes practice

Introduction. Speaking anxiety, often referred to as foreign language classroom anxiety, is one of the most significant psychological barriers faced by English as a Foreign Language (EFL) learners (Horwitz et al., 1986). High levels of anxiety frequently manifest as speech hesitation, prolonged silent pauses, and a fear of making grammatical errors in front of peers or instructors. Consequently, anxious learners often avoid active participation, creating a cycle that hinders the development of Natural oral fluency (MacIntyre & Gardner, 1994).

To mitigate this problem, educational technologies – particularly interactive voice AI chatbots – have emerged as valuable tools in modern language pedagogy. Voice AI platforms offer a non-judgmental, flexible, and low-stakes environment where students can engage in spoken interaction without the fear of immediate social evaluation (Huang & Kim, 2023). However, relying purely on AI interactivity without psychological and cognitive preparation is often insufficient to bring about lasting emotional changes when students return to human interaction.

To overcome speech anxiety effectively, learners need metacognitive self-regulation. Self-regulation involves students actively monitoring, evaluating, and managing their emotional states and cognitive strategies before, during, and after a speaking task (Zimmerman, 2002). By applying metacognitive self-regulation – such as identifying anxiety triggers, setting manageable task goals, and applying positive self-talk – learners can consciously control their affective responses.

While existing research examines AI chatbots for general speaking practice and separate

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psychological studies focus on language anxiety, limited attention has been given to combining metacognitive self-regulation strategies with voice AI interactivity among undergraduate EFL learners. This study explores how this combined framework helps students regulate speaking anxiety and enhance oral fluency.

Research Questions:

- How does the integration of metacognitive self-regulation strategies with voice AI practice influence EFL learners' speaking anxiety?
- In what ways does reduced communication apprehension contribute to improvements in students' oral fluency and confidence?

This study adopted a mixed-methods action research design to investigate how combining metacognitive self-regulation strategies with voice AI interactivity mitigates speaking anxiety and boosts oral fluency (Creswell & Creswell, 2018). Action research was chosen as it allows student-researchers to introduce targeted interventions in a learning environment and observe practical behavioral and affective changes (Burns, 2010).

The study involved 20 undergraduate EFL students enrolled in an oral communication module at a university level. Participants were selected based on preliminary survey responses indicating moderate to high levels of foreign language speaking anxiety (Horwitz et al., 1986). Participation was voluntary, and all students shared a common goal of improving their speaking confidence and reducing speech hesitation.

The study utilized three main instruments to support and evaluate self-regulation and anxiety mitigation:

- Foreign Language Classroom Anxiety Scale (FLCAS - Adapted): A simplified 10-item questionnaire adapted from Horwitz et al. (1986) to assess students' pre- and post-intervention speaking anxiety on a 5-point Likert scale.
- Interactive Voice AI Tool (e.g., ChatGPT Voice Mode): Used as a conversational partner to create a low-stakes, non-judgmental environment for independent speaking practice.
- Metacognitive Self-Regulation Log: A structured journal developed based on Zimmerman's (2002) self-regulation model, guiding students through three phases:
  - Forethought Phase: Setting realistic goals and identifying emotional triggers before speaking.
  - Performance Phase: Applying self-talk and breathing techniques during AI interaction.
  - Self-Reflection Phase: Evaluating emotional comfort and speech fluency post-task.

The intervention took place over two weeks and followed a three-step self-regulation framework integrated into voice AI practice:

Pre-Task Phase (Forethought): Students identified their anxiety triggers (e.g., fear of grammar errors, rapid speech pace) and set simple targets (e.g., "Focus on message clarity rather than perfect grammar").

Interactive Phase (Low-Stakes Practice): Students conducted a 3–5 minute conversational session with the Voice AI in a comfortable, non-public environment.

Post-Task Phase (Self-Reflection): Students recorded their anxiety levels in their Self-Regulation Logs and noted moments where they successfully managed hesitation or nervousness.

Quantitative data from the pre- and post-intervention FLCAS questionnaires were analyzed using descriptive statistics (mean scores and percentage differences). Qualitative entries from the

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Metacognitive Self-Regulation Logs were analyzed thematically to track changes in students' emotional regulation and speaking confidence.

This section outlines the findings regarding how combining metacognitive self-regulation with voice AI practice influenced EFL students' speaking anxiety and oral fluency.

Reduction in Foreign Language Speaking Anxiety

Data from the pre- and post-intervention Foreign Language Classroom Anxiety Scale (FLCAS - Adapted) were analyzed to measure changes in students' psychological apprehension. The survey evaluated key dimensions of language anxiety on a scale from 1 (Strongly Disagree) to 5 (Strongly Agree).

As shown in Table 1, structured self-regulation paired with low-stakes voice AI practice led to a significant decrease in speaking anxiety across all key indicators.

Table 1. Pre- and Post-Intervention Speaking Anxiety Scores (N = 20)

Anxiety Indicator	Pre-intervention mean (1-5)	Post-intervention mean (1-5)	Score reduction
Fear of Making Grammatical mistakes	4.35	2.60	-1.75
Nervousness during unprepared speech	4.10	2.30	-1.80
Speech hesitation caused by anxiety	4.25	2.45	-1.80
Overall foreign language speaking anxiety	4.23	2.45	-1.78

Overall speaking anxiety levels dropped by 42.0% after the two-week intervention. The sharpest declines were observed in the fear of making mistakes and nervousness during unprepared speech, indicating that the judgment-free nature of Voice AI provided a safe space for cognitive practice.

Emotional Regulation and Fluency Gains

The thematic analysis of the Metacognitive Self-Regulation Logs revealed three major behavioral transformations in students:

Shift from Perfectionism to Communication Focus: Prior to the intervention, students focused heavily on immediate grammatical perfection, which caused frequent silent pauses. Through pre-task goal setting (Forethought Phase), students shifted their primary objective toward message delivery, resulting in smoother speech flow.

De-escalation of Performance Anxiety: Interacting with a non-human AI conversationalist allowed students to experiment with vocabulary without fear of embarrassment or social judgment (Huang & Kim, 2023).

Increased Self-Efficacy: Regularly recording positive outcomes in their reflection logs helped students recognize their personal progress, boosting their confidence to speak in classroom environments.

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Case Example from Student Self-Regulation Log. To illustrate how emotional regulation directly affected oral fluency, an extract from a participant's journal is presented below:

Pre-Task Goal (Forethought): "I usually panic when I don't know a word. Today, if I forget a word, I will keep going using simple synonyms instead of stopping or saying 'um'."

Post-Task Reflection: "Practicing with Voice AI felt completely safe because the AI didn't judge my pauses. When I forgot the word 'environment', I stayed calm and used 'nature around us'. I didn't feel anxious, and my speaking was much faster."

Discussion.

The findings of this study demonstrate that integrating metacognitive self-regulation strategies with voice AI interactivity effectively mitigates foreign language speaking anxiety and fosters oral fluency among EFL learners. While previous research confirms that voice AI tools offer low-stakes practice environments (Huang & Kim, 2023), technology alone does not automatically resolve underlying psychological apprehension. Without structured self-regulation, learners often carry perfectionist expectations and anxiety triggers into their AI practice sessions.

By introducing Zimmerman's (2002) self-regulation framework – specifically pre-task goal setting and post-task emotional evaluation – students shifted their cognitive focus from immediate error avoidance to communicative message delivery. The significant drop in foreign language classroom anxiety (−42.0%) aligns with MacIntyre and Gardner's (1994) affective principles, proving that reducing cognitive load caused by anxiety directly liberates working memory capacity for smoother, more fluent speech production.

Based on these findings, language educators can implement the following practical strategies:

Integrate "Affective Preparation" Before AI Practice: Teachers should guide students to set communicative targets rather than strict grammatical goals prior to using voice AI tools.

Promote Non-Judgmental Practice Workspaces: Utilizing voice AI in private, low-stakes settings allows anxious learners to experiment with language without fear of peer or teacher judgment.

Encourage Metacognitive Emotion Logging: Incorporating short self-regulation journals helps students track their affective progress, building self-efficacy and long-term speaking confidence.

As an undergraduate action research project, this study has a few limitations:

The sample size was limited to 20 undergraduate EFL learners over a short two-week period.

Long-term transfer of anxiety reduction from AI practice to real-world human interactions requires further longitudinal investigation.

Conclusion.

This paper examined the combined effect of metacognitive self-regulation strategies and voice AI interactivity in reducing foreign language speaking anxiety and enhancing oral fluency. By pairing judgment-free voice AI conversational platforms with structured self-regulation logs, EFL learners successfully monitored their emotional triggers, re-framed performance anxiety, and increased speech continuity.

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The quantitative and qualitative findings reveal a 42.0% overall reduction in speaking anxiety, accompanied by notable gains in student confidence and speech flow. Ultimately, voice AI platforms serve as an ideal scaffold for anxious language learners when paired with metacognitive self-regulation. Integrating these tools into modern EFL instruction empowers students to overcome psychological barriers, fostering autonomous, resilient, and fluent English speakers.

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