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AI-Assisted Flipped Classroom to Enhance Speaking Skills and Self-Regulated Learning in EFL Contexts

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ABSTRACT

The growing demand for communicative competence in English as a Foreign Language (EFL) contexts has positioned speaking skills and self-regulated learning (SRL) as central outcomes in language education research. Despite their importance, limited practice time and teacher-centered instruction continue to hinder both speaking development and learner autonomy in many EFL settings. This study examined the effects of an AI-Assisted Flipped Classroom on students' speaking skills and self-regulated learning in EFL contexts. A quantitative approach with a quasi-experimental pretest-posttest control group design was employed, involving 60 students (experimental group n = 28; control group n = 32) from a senior high school in Indonesia. Speaking skills were assessed using an analytic rubric comprising five dimensions (fluency, accuracy, pronunciation, vocabulary, and content), while SRL was measured using a 30-item questionnaire across five dimensions adapted from Pintrich and De Groot's MSLQ. The results demonstrated that the experimental group achieved significantly higher posttest speaking scores ($M = 89.50$, $SD = 4.70$) than the control group ($M = 74.94$, $SD = 9.03$), with an independent samples t-test yielding $t(58) = 7.97$, $p < .001$, and a large effect size ($d = 2.02$). The experimental group's normalized gain (N-Gain = 0.76) was in the high category compared to the control group's medium-category N-Gain of 0.37. Regarding SRL, both groups demonstrated high levels post-intervention, with the experimental group scoring higher in goal-setting and self-evaluation dimensions. These findings indicate that integrating AI support into a flipped classroom was associated with substantial improvement in speaking proficiency, while its contribution to SRL was limited to selected dimensions, particularly goal-setting and self-evaluation, within the context of this study.

Keywords: AI-assisted learning, EFL, flipped classroom, self-regulated learning, speaking skills

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INTRODUCTION

In the contemporary global landscape, English proficiency has become an indispensable competency for academic, professional, and social participation, particularly in non-English-speaking countries. English as a Foreign Language (EFL) education faces the ongoing challenge of preparing learners for authentic communication, which demands not only grammatical competence but also the ability to engage meaningfully in oral discourse (Cahyono & Widiati, 2021; Nunan, 2020). The rapid advancement of digital technology and the widespread

adoption of blended learning environments have further emphasized the need for instructional models that are both flexible and communicatively oriented (Sari & Wahyudin, 2021). In this context, EFL educators are increasingly called upon to adopt innovative approaches that align with twenty-first century learning demands and effectively bridge the gap between classroom instruction and real-world language use (Widodo & Savova, 2021).

Speaking is widely recognized as the most demanding yet most valued productive skill in language learning, requiring learners to simultaneously manage phonological, lexical, grammatical, and pragmatic aspects of language in real time (Anjarsari & Muflihah, 2022). Unlike receptive skills such as reading and listening, speaking demands active cognitive processing, affective management, and spontaneous language production under social pressure, making it particularly challenging to develop within formal instructional settings (Yuliani & Lengkanawati, 2021). Research consistently indicates that speaking proficiency is a primary indicator of communicative competence and a key factor in learners' academic and professional success (Wulandari, 2020). In EFL contexts, however, students frequently struggle to develop adequate speaking fluency, accuracy, and confidence, largely due to insufficient practice opportunities, oral performance anxiety, and limited quality feedback (Nurfidoh et al., 2022).

Alongside speaking skills, self-regulated learning (SRL) has emerged as a critical competency in modern language education. SRL refers to learners' capacity to proactively set learning goals, select and deploy appropriate cognitive strategies, monitor their progress, and regulate their motivation and affect in pursuit of academic objectives (Pintrich, 2004; Zimmerman, 2000). In the domain of language learning, SRL is particularly significant because the development of communicative competence requires sustained engagement beyond formal classroom settings, extending to autonomous practice and self-directed exploration of language resources (Suparno & Kusumawati, 2022). Learners with high SRL capacity are more likely to engage in deliberate practice, seek formative feedback, and utilize available resources independently qualities essential for long-term language proficiency (Kusumaningrum & Zubaidi, 2022). The integration of digital tools in language instruction has created new opportunities to cultivate SRL by providing learners with greater agency over their learning pace, content selection, and self-assessment.

Despite the theoretical recognition of speaking skills and SRL as essential learning outcomes, significant challenges persist in their practical development within EFL classrooms. Speaking instruction in many EFL settings is constrained by limited class time, large class sizes, unequal student participation, and teacher-dominated instructional patterns that reduce opportunities for authentic oral practice (Nurazizah et al., 2021; Arung, 2020). Students frequently receive insufficient feedback on their speaking performance, and the pace of conventional instruction leaves little room for individualized practice or self-directed learning (Pratama & Yunus, 2020). Furthermore, many EFL learners remain dependent on teacher guidance and lack the metacognitive awareness and self-monitoring strategies needed to develop language proficiency independently (Kusumaningrum & Zubaidi, 2022). These persistent challenges underscore the urgent need for instructional innovations that can simultaneously expand speaking practice opportunities and cultivate learner autonomy in EFL contexts.

Flipped classroom an instructional model in which content delivery is moved outside the classroom through pre-recorded videos or digital materials while in-class time is dedicated to active learning—has gained considerable attention as a promising approach to language education (Lo & Hew, 2020; Bergmann & Sams, 2012). By repositioning content exposure to the pre-class phase, the flipped model creates additional in-class time for communicative activities such as discussion, role-play, and collaborative speaking tasks (Hew et al., 2020). This structural shift is particularly beneficial for EFL speaking instruction, as it allows teachers to focus class time on facilitating meaningful interaction and providing targeted feedback rather than on content presentation (Zheng et al., 2021). Empirical studies have demonstrated that flipped classroom approaches positively influence speaking performance, engagement, and learner motivation in EFL contexts (Anjarsari & Muflihah, 2022; Saputra & Kurniawan, 2023; Chen Hsieh et al., 2017). Additionally, the pre-class preparation inherent in the flipped model naturally promotes SRL behaviors including goal-setting, time management, and self-monitoring (Yang et al., 2020).

The integration of artificial intelligence (AI) tools into language learning has opened new possibilities for extending and enhancing flipped classroom practices. AI-powered applications—including intelligent chatbots, automated pronunciation trainers, and conversational agents—allow learners to practise spoken language independently, receive immediate and personalized feedback, and rehearse communicative tasks outside regular

classroom time (Kohnke & Moorhouse, 2023; Huang et al., 2022). Within the flipped classroom framework, AI tools function as pre-class scaffolds that support the forethought phase of SRL through goal-setting, task planning, vocabulary preparation, and pronunciation rehearsal. During in-class activities, AI-generated prompts and communicative scaffolds support the performance phase by helping learners monitor language use and participate in guided interaction. In the post-class phase, reflective journals, AI-mediated feedback, and self-assessment checklists facilitate self-reflection and self-evaluation. Thus, the convergence of AI support and flipped learning is theoretically positioned to create a more autonomous, practice-rich, and responsive EFL learning environment that is aligned with SRL processes (Zou et al., 2022; Godwin-Jones, 2022).

A substantial body of literature has investigated flipped classroom approaches in language education and, separately, the role of AI-assisted tools in language learning. Studies on flipped classroom in EFL contexts have demonstrated positive effects on vocabulary acquisition, reading comprehension, and learner engagement (Rahmawati et al., 2022; Nurazizah et al., 2021). Similarly, research on AI-assisted language learning has highlighted its potential for improving pronunciation, vocabulary retention, writing fluency, and speaking confidence (Nurfidoh et al., 2022; Zahroh & Kurniawan, 2023). Research on SRL in EFL settings has likewise underscored its relevance as a predictor of long-term language success (Pertiwi & Saukah, 2021; Hidayati, 2022). However, previous studies have generally examined flipped classroom strategies, AI-assisted language learning, and SRL as separate lines of inquiry, with limited attention to how AI-supported pre-class and post-class activities may interact with in-class speaking tasks in formal EFL instruction (Jia et al., 2022; Rido & Sari, 2021). This limitation indicates a specific research gap concerning the combined pedagogical contribution of AI support and flipped learning to speaking performance and selected self-regulatory dimensions in EFL classrooms.

The present study addresses this critical research gap by examining an integrated, AI-Assisted Flipped Classroom model within a senior high school EFL context in Indonesia. While previous studies have generally treated flipped classroom instruction and AI-assisted language learning as isolated interventions—often focusing narrowly on vocabulary, reading, writing, pronunciation, or general engagement—this research maps their combined effects within a structured pre-class, in-class, and post-class instructional sequence. Specifically, the model integrates pre-class AI-mediated pronunciation practice and chatbot-based conversation rehearsal, followed by interactive in-class communicative tasks, and concludes with post-class self-reflection. Consequently, the distinct novelty and empirical contribution of this study lie in its simultaneous investigation of speaking sub-skills and specific Self-Regulated Learning (SRL) dimensions as dual outcome variables, thereby clarifying how a cohesive pedagogical design and AI-supported practice jointly affect EFL learners.. This study is expected to contribute to the growing body of literature on digital pedagogy and innovation in EFL instruction (UNESCO, 2023). Therefore, this study aimed to examine the effects of an AI-Assisted Flipped Classroom on students' speaking skills and self-regulated learning in EFL contexts. Based on this objective, the following hypotheses were proposed: H_1: There is a significant effect of an AI-Assisted Flipped Classroom on students' speaking skills in EFL contexts; H_2: The AI-Assisted Flipped Classroom has a positive effect on students' self-regulated learning in EFL contexts.

METHOD

This study employed a quantitative approach using a quasi-experimental pretest-posttest control group design. This design was selected because it allows systematic comparison between two non-randomly assigned groups before and after an educational intervention, making it particularly appropriate for classroom-based research in which full randomization of participants is not feasible due to institutional constraints (Creswell & Creswell, 2023). The experimental group received instruction through the AI-Assisted Flipped Classroom model, while the control group received conventional English instruction without AI integration or a flipped learning structure. Both groups underwent pretest and posttest assessments to measure changes in speaking skills and self-regulated learning. The research design is presented in Table 1.

Table 1. Research design

Group	Pretest	Treatment	Posttest
Experimental	O_1	X (AI-Assisted Flipped Classroom)	O_2
Control	O_1	C (Conventional Instruction)	O_2

Note: O_1 = pretest; O_2 = posttest; X = AI-Assisted Flipped Classroom intervention; C = conventional instruction

The participants of this study were 60 Grade X students from a private Islamic senior high school in Panyipatan, Tanah Laut Regency. They were selected through purposive sampling based on three operational criteria designed to ensure they met the necessary technological and instructional prerequisites: enrollment in the same English course level, full availability during the eight-week intervention, and regular access to a smartphone or personal computer with stable internet connectivity for AI-assisted learning activities.

Because random assignment at the individual level was not feasible within the school setting, the study utilized intact classes, which means potential selection bias and limited external validity are acknowledged. Consequently, one existing class was assigned as the experimental group ($\boldsymbol{n = 28}$), while another comparable class served as the control group ($\boldsymbol{n = 32}$).

To address potential confounding variables, an independent samples t-test was conducted on the pretest speaking scores prior to the intervention. The results confirmed the baseline equivalence of both groups ($\boldsymbol{t(58) = 1.53, p = .13}$), indicating that initial differences in speaking skills did not confound the subsequent results. However, it is important to note that equivalence in initial motivation and Self-Regulated Learning (SRL) was not statistically established because SRL was measured exclusively after the intervention; this timing is acknowledged as a methodological limitation of the study.

The experimental group participated in an AI-Assisted Flipped Classroom intervention over eight instructional meetings (approximately eight weeks). The intervention was structured around three interlocking phases pre-class, in-class, and post-class each supported by specific pedagogical activities and AI tools, as outlined in Table 2. In the pre-class phase, students accessed instructional videos and structured speaking rehearsal activities through AI-powered applications (ELSA Speak for pronunciation training and ChatGPT as a conversational partner), which provided immediate pronunciation feedback, vocabulary scaffolding, and guided conversation practice (Kohnke & Moorhouse, 2023). During in-class sessions, students engaged in communicative speaking tasks, including role-plays, peer feedback rounds, and teacher-facilitated group discussions. In the post-class phase, students completed reflective journals and continued AI-mediated speaking practice, supporting the self-monitoring and goal-setting processes central to SRL (Hidayati, 2022). The control group received conventional teacher-fronted English instruction without flipped learning activities or AI integration.

Table 2. AI-assisted flipped classroom framework

Phase	Learning Activity	AI Support	Pedagogical Purpose
Pre-Class	Students access video materials and speaking prompts independently before class.	ELSA Speak / ChatGPT: pronunciation training, vocabulary scaffolding, guided conversation rehearsal.	Build content knowledge; reduce cognitive load; activate prior knowledge.
In-Class	Communicative tasks: role-plays, pair/group discussions, teacher-facilitated speaking practice, and peer feedback.	AI-generated conversation topics and sentence starters as scaffolding prompts.	Deepen communicative skills; provide feedback; strengthen interactive speaking.

Phase	Learning Activity	AI Support	Pedagogical Purpose
Post-Class	Reflective journals, self-assessment checklists, and continued AI speaking practice.	AI chatbot dialogue practice; automated feedback on fluency and accuracy.	Consolidate learning; promote self-monitoring and goal-setting; reinforce SRL.

Note: The AI tools used in the intervention were ELSA Speak for pronunciation-focused practice and ChatGPT for guided conversational rehearsal and AI-mediated dialogue activities

Two primary instruments were used to measure the dependent variables (Table 3). Speaking skills were assessed using an analytic speaking rubric adapted from the ACTFL Oral Proficiency Guidelines, comprising five dimensions: fluency, accuracy, pronunciation, vocabulary, and content. Each dimension was rated on a five-point scale (1 = very poor; 5 = excellent) by two trained raters independently, yielding a maximum total score of 25, which was subsequently converted to a 100-point scale (score/25 × 100). SRL was measured using a 30-item questionnaire adapted from Pintrich and De Groot's (1990) Motivated Strategies for Learning Questionnaire (MSLQ), distributed across five dimensions: goal setting (7 items), self-monitoring (7 items), self-evaluation (5 items), strategy use (6 items), and motivation (5 items), rated on a five-point Likert scale (1 = strongly disagree; 5 = strongly agree), yielding a maximum total score of 150.

Table 3. Instrument indicators, items, and types

Variable	Indicators	No. of Items	Instrument Type	Source
Speaking Skills	Fluency, Accuracy, Pronunciation, Vocabulary, Content (5-point scale each)	5 dimensions (scored)	Analytic Speaking Rubric (oral test)	ACTFL OPG (adapted)
Self-Regulated Learning	Goal Setting, Self-Monitoring, Self-Evaluation, Strategy Use, Motivation	30 items (Likert 1–5)	Questionnaire (MSLQ adapted)	Pintrich & De Groot (adapted)

Note: ACTFL OPG = American Council on the Teaching of Foreign Languages Oral Proficiency Guidelines; MSLQ = Motivated Strategies for Learning Questionnaire

Both instruments underwent content and construct validation prior to implementation. The speaking rubric was reviewed by two EFL experts with over five years of experience in oral assessment, while the SRL questionnaire was evaluated by two experts in educational psychology and language education. Revisions were incorporated based on expert feedback. Reliability was assessed through a pilot study involving 20 students from a non-participating class. The Cronbach's alpha coefficient for the SRL questionnaire yielded $\alpha = .87$, indicating high internal consistency (Saputra & Kurniawan, 2023). Inter-rater reliability for the speaking rubric was calculated using Cohen's kappa ($\kappa = .82$), reflecting strong rater agreement. The intervention procedure followed this sequence: (1) pretest administration; (2) eight-session intervention for the experimental group concurrent with conventional instruction for the control group; and (3) posttest administration using the same instruments under equivalent conditions.

Data analysis was conducted in two stages. First, descriptive statistics including mean, standard deviation, minimum, maximum, and normalized gain (N-Gain) were computed for both groups. N-Gain was calculated as (posttest − pretest) / (maximum − pretest), with categories of high (> 0.70), medium (0.30–0.70), and low (< 0.30) according to Hake (1999). Second, the Shapiro-Wilk test was used to assess normality, and Levene's test was employed to examine homogeneity of variance. Given that assumptions were satisfied, an independent samples t-test was used to compare posttest scores between groups ($\alpha = .05$), and paired t-tests were used to assess within-group change. Effect size was calculated using Cohen's d (small ≥ 0.2; medium ≥ 0.5; large ≥ 0.8). This study obtained ethical clearance from the institutional review board of the participating institution. All participants provided written informed consent acknowledging voluntary participation, the right to withdraw without penalty,

and the confidential treatment of personal data. No identifying information was used in analysis or reporting, and all data were stored securely in accordance with institutional data protection protocols.

RESULTS AND DISCUSSION

The findings of this study are presented in accordance with the two primary outcome variables: speaking skills and self-regulated learning. Each outcome is analyzed through descriptive statistics, within-group paired t-tests, between-group independent t-tests, N-Gain analysis, and effect size estimates. Results are followed by interpretation and discussion in relation to relevant theoretical frameworks and empirical literature.

Prior to the intervention, the experimental group (M = 57.21, SD = 11.31) and control group (M = 61.56, SD = 10.57) demonstrated comparable pretest speaking performance. An independent samples t-test on pretest scores confirmed the absence of a statistically significant baseline difference between groups ($t(58) = 1.53$, $p = .13$), establishing the necessary prerequisite for attributing posttest differences to the intervention. The pretest score range of 36–92 across both groups reflects the natural heterogeneity of speaking proficiency within a typical EFL classroom, further validating the representativeness of the sample. Table 4 presents the descriptive statistics for both groups.

Table 4. Descriptive statistics speaking skills (pretest and posttest)

Group	n	Pre M	Pre SD	Post M	Post SD	Gain	N-Gain	Category
Control	32	61.56	10.57	74.94	9.03	13.38	0.37	Medium
Experimental	28	57.21	11.31	89.50	4.70	32.29	0.76	High

Note: M = mean; SD = standard deviation; Gain = Post M − Pre M; N-Gain categories based on Hake (1999): high > 0.70; medium 0.30–0.70; low < 0.30. Speaking scores converted to 100-point scale

Following the eight-week intervention, both groups demonstrated improvement in speaking skills; however, the experimental group's improvement was substantially greater. The experimental group recorded a mean posttest score of 89.50 (SD = 4.70), reflecting a mean gain of 32.29 points, while the control group recorded a mean posttest score of 74.94 (SD = 9.03), reflecting a gain of 13.38 points. The experimental group's N-Gain of 0.76 falls in the high category, indicating that AI-Assisted Flipped Classroom instruction produced markedly stronger learning gains than conventional instruction, whose N-Gain of 0.37 falls in the medium category (Hake, 1999). Analysis of posttest score distribution further underscores this distinction: 75% of experimental students (21 of 28) scored in the Excellent category (88–100), compared to only 3.1% of control students (1 of 32). The majority of control group students (65.6%, or 21 of 32) scored in the Good category (72–87), with 31.3% (10 of 32) in the Adequate category (56–71). No students in either group scored in the Poor or Very Poor categories on the posttest. Table 5 presents the results of hypothesis testing.

Table 5. Results of hypothesis testing speaking skills and SRL

Hypothesis	Test	Comparison	t	df	p	d
H_1: Speaking	Paired t-test	Control (Pre vs. Post)	15.66	31	< .001	2.77
H_1: Speaking	Paired t-test	Experimental (Pre vs. Post)	21.67	27	< .001	4.10
H_1: Speaking	Independent t-test	Control vs. Experimental (Post)	7.97	58	< .001	2.02
H_2: SRL	Independent t-test	Control vs. Experimental (Post)	0.45	58	.65	0.13

Note: All tests two-tailed; $\alpha = .05$. Cohen's d: small ≥ 0.2; medium ≥ 0.5; large ≥ 0.8 (Cohen, 1988). N-Gain Control = 0.37 (Medium); N-Gain Experimental = 0.76 (High)

Paired t-test analysis confirmed significant within-group improvement for both groups. For the experimental group, $t(27) = 21.67$, $p < .001$, $d = 4.10$ (large). For the control group, $t(31) = 15.66$, $p < .001$, $d = 2.77$ (large). Crucially, the independent samples t-test comparing posttest scores between groups revealed a statistically significant difference in favor of the experimental group, $t(58) = 7.97$, $p < .001$, $d = 2.02$, indicating a large effect. These results confirm H_1: the AI-Assisted Flipped Classroom had a significant and practically meaningful positive effect on speaking skills in EFL contexts.

Table 6 presents the descriptive statistics for SRL across five dimensions for both groups. Both the experimental group (M = 92.25, SD = 9.00) and the control group (M = 91.25, SD = 8.02) demonstrated high SRL levels post-intervention. The dimension-level analysis reveals a nuanced pattern: the experimental group scored higher in Goal Setting (M = 22.11, 63.2% vs. M = 20.50, 58.6%), Self-Evaluation (M = 16.21, 64.9% vs. M = 14.69, 58.8%), and Motivation (M = 15.96, 63.9% vs. M = 15.28, 61.1%), while the control group scored higher in Self-Monitoring (M = 22.47, 64.2% vs. M = 20.68, 59.1%) and Strategy Use (M = 18.31, 61.0% vs. M = 17.29, 57.6%).

Table 6. Descriptive statistics self-regulated learning by dimension (post-intervention)

Dimension (Max)	n	Control M (SD)	%	Experimental M (SD)	%
Goal Setting (35)	32/28	20.50 (3.27)	58.6%	22.11 (4.24)	63.2%
Self-Monitoring (35)	32/28	22.47 (3.57)	64.2%	20.68 (3.80)	59.1%
Self-Evaluation (25)	32/28	14.69 (3.21)	58.8%	16.21 (2.87)	64.9%
Strategy Use (30)	32/28	18.31 (3.30)	61.0%	17.29 (3.80)	57.6%
Motivation (25)	32/28	15.28 (3.92)	61.1%	15.96 (3.18)	63.9%
Total SRL (150)	32/28	91.25 (8.02)	60.8%	92.25 (9.00)	61.5%

Note: % = percentage of maximum possible score. Both groups fall in the Tinggi (High) SRL category

The independent samples t-test comparing total Self-Regulated Learning (SRL) scores between groups yielded $\boldsymbol{t(58) = 0.45, p = .65, d = 0.13}$, indicating that the between-group difference in overall SRL was not statistically significant. Therefore, $\boldsymbol{H_2}$ was not supported at the aggregate SRL level.Despite the lack of statistical significance at the global level, the dimension-level analysis revealed noteworthy descriptive tendencies. Specifically, the experimental group obtained relatively higher mean scores in goal-setting and self-evaluation. These specific dimensions are arguably the ones most directly aligned with and reinforced by the structured pre-class preparation and post-class reflection embedded within the AI-assisted flipped learning cycle. However, because this study did not employ an SRL pretest and the total SRL difference remained nonsignificant, these findings must be interpreted strictly as indicative tendencies within selected dimensions rather than as conclusive evidence of confirmed improvement in overall SRL. Accordingly, while the integrated AI-Assisted Flipped Classroom model may be considered to support specific SRL-related behaviors, establishing stronger, more definitive evidence would require a rigorous pretest-posttest SRL design and a longer intervention period.

The substantial improvement in speaking skills within the experimental group can be interpreted through the convergence of three complementary pedagogical mechanisms inherent in the AI-Assisted Flipped Classroom model. First, the pre-class AI-assisted preparation phase—utilizing tools such as ELSA Speak for pronunciation training and ChatGPT for conversational scaffolding—enabled students to build foundational speaking confidence and reduce communication anxiety before engaging in in-class activities. This aligns with research demonstrating that pre-exposure to communicative content significantly reduces cognitive load during in-class speaking tasks (Zheng et al., 2021; Lo & Hew, 2020). Learners who arrive at class having already rehearsed key linguistic structures and pronunciation patterns are cognitively better positioned to participate in spontaneous, interactive speaking tasks (Bergmann & Sams, 2012; Chen Hsieh et al., 2017).

Second, the reallocation of in-class time to active communicative tasks including role-plays, collaborative discussions, and teacher-facilitated speaking activities maximized meaningful oral practice in an environment recognized as the primary determinant of speaking gains (Anjarsari & Muflihah, 2022; Nurazizah et al., 2021). The

combined use of pre-class preparation and in-class communicative tasks substantially increased opportunities for structured speaking practice compared with conventional instruction, thereby addressing one of the commonly identified barriers to EFL speaking development: insufficient practice time (Arung, 2020). Third, post-class AI-mediated dialogue and automated feedback extended learning opportunities beyond institutional constraints, enabling students to self-monitor and iteratively refine their speaking performance (Moorhouse & Kohnke, 2023; Zou et al., 2022). This tripartite structure created an immersive, feedback-rich learning environment that conventional EFL instruction cannot replicate within equivalent time constraints.

The differential SRL outcomes require more nuanced interpretation. The experimental group's stronger performance in goal-setting and self-evaluation dimensions reflects the inherent structural demands of the flipped classroom model: students must independently set learning targets before accessing pre-class materials and evaluate their performance after AI-assisted practice sessions. These activities directly scaffold goal-setting and self-evaluation behaviors without necessarily producing equivalent gains in self-monitoring or strategy use—dimensions that may require more sustained instructional scaffolding to develop (Pintrich, 2004; Zimmerman, 2000). The relatively high pre-existing SRL levels in both groups suggest a potential ceiling effect that may have limited observable between-group SRL differentiation. This interpretation is consistent with Hidayati's (2022) finding that EFL students with prior experience in digital learning environments tend to enter blended interventions with already-established SRL strategies, reducing the incremental SRL benefit attributable to any single intervention.

The present findings are broadly consistent with existing literature on flipped classroom and AI-assisted language learning in EFL contexts, but they also reveal an important distinction between speaking outcomes and SRL outcomes. The strong effect on speaking skills can be explained by the close alignment between the intervention activities and the measured speaking dimensions: pronunciation rehearsal, guided conversation practice, role-play, peer feedback, and teacher-facilitated speaking tasks directly corresponded to fluency, accuracy, pronunciation, vocabulary, and content. By contrast, the nonsignificant aggregate SRL result indicates that self-regulatory development may require longer-term metacognitive scaffolding, explicit strategy instruction, and repeated reflection cycles beyond an eight-week intervention. Anjarsari and Muflihah (2022) similarly reported significant speaking improvements in EFL students following a flipped classroom intervention, while the present study suggests that AI-assisted rehearsal may further intensify practice opportunities. However, unlike studies that report broader self-regulatory gains, the present findings indicate that the effect of AI-Assisted Flipped Classroom instruction on SRL should be interpreted as dimension-specific and preliminary rather than comprehensive.

Regarding SRL, Pertiwi & Saukah (2021) ; Suparno & Kusumawati (2022) identified SRL as a significant predictor of EFL language success, though both noted the context-dependence of specific SRL dimensions. Yang et al. (2020) found that flipped learning's benefits on self-regulatory variables were most pronounced among learners with initially lower SRL levels, suggesting a moderating relationship that future research might systematically investigate. Zheng et al. (2021) similarly reported significant effects of flipped learning on EFL learners' academic self-efficacy alongside speaking achievement a combined outcome pattern that parallels the present study's findings of strong speaking gains alongside differential SRL dimension effects.

These findings carry several theoretical and practical implications for EFL pedagogy. Theoretically, the results support the potential complementarity of flipped classroom pedagogy and AI-assisted learning as an integrated framework for expanding EFL speaking practice and supporting selected SRL competencies. The model aligns with socio-cognitive perspectives on language learning through its progression from AI-mediated preparation to peer-facilitated interaction, and it also corresponds with SRL theory (Zimmerman, 2000; Pintrich, 2004) through the use of goal-setting prompts, self-assessment, and reflective feedback. Practically, the findings suggest that EFL teachers may integrate accessible AI tools such as ELSA Speak and ChatGPT into speaking curricula when pedagogical scaffolding, task design, and monitoring are provided. However, implementation should not be assumed to require no technical preparation; it requires basic digital literacy, teacher supervision of AI feedback quality, ethical attention to learner data, and carefully designed prompts and speaking tasks. For curriculum designers and institutional policymakers, this study provides preliminary empirical support for hybrid learning infrastructure that enables AI-mediated speaking practice beyond formal class time (UNESCO, 2023).

This study is subject to several limitations that directly affect the interpretation and generalizability of the findings. First, the sample was drawn from a single institution in South Kalimantan and may not fully represent the diverse population of EFL learners across Indonesia or other global EFL contexts; therefore, generalization to broader educational settings should be made cautiously. Second, the eight-week intervention period, while sufficient to produce significant speaking improvements, may have been too brief to generate detectable aggregate SRL changes. Self-regulated learning behaviors often require prolonged engagement to internalize; thus, longer interventions spanning 12–16 weeks would likely be necessary to allow for more stable and measurable self-regulatory development. Third, Self-Regulated Learning (SRL) was assessed exclusively as a post-intervention measure rather than through a pretest-posttest design. This measurement timing directly limits the strength of the causal claims that can be made, meaning the findings cannot be interpreted as definitive evidence of an actual *change* or growth in SRL attributable to the pedagogical intervention. Consequently, the results concerning $\boldsymbol{H_2}$ must be treated as preliminary, representing only post-intervention differences and descriptive, dimension-level tendencies rather than confirmed developmental improvement. Fourth, the specific AI tools employed may not be universally accessible across contexts with different technology access. Future research should address these limitations by employing larger, multi-institutional samples; adopting pretest-posttest SRL measurement designs; investigating differential effects of specific AI platforms on individual speaking sub-skills; and exploring the long-term sustainability of speaking gains six to twelve months post-intervention.

CONCLUSION

This study examined the effects of an AI-Assisted Flipped Classroom on students' speaking skills and self-regulated learning in EFL contexts through a quasi-experimental pretest-posttest design involving 60 students. The findings show that the experimental group achieved higher speaking proficiency outcomes than the control group, as indicated by a mean posttest score of 89.50 versus 74.94, a high-category N-Gain of 0.76 compared with a medium-category N-Gain of 0.37, and a large between-group effect size (d = 2.02). These results provide empirical support for H_1 and indicate that the AI-Assisted Flipped Classroom can be considered a promising instructional approach for enhancing speaking skills in the investigated EFL context. Regarding self-regulated learning, both groups demonstrated high SRL levels post-intervention, and the experimental group showed higher mean scores in goal-setting and self-evaluation, although these dimension-level patterns did not translate into a statistically significant difference in total SRL. While overall between-group SRL differences did not reach statistical significance, the observed dimension-level pattern should be interpreted as preliminary and indicative, suggesting that further studies with pretest-posttest SRL measurement are needed before stronger conclusions can be drawn. This study contributes empirical evidence on the integration of AI support and flipped learning in EFL language education, particularly as a pedagogically grounded model for expanding speaking practice opportunities, while its implications for learner autonomy should be interpreted cautiously. EFL practitioners and curriculum designers are encouraged to explore AI-assisted flipped learning as a meaningful and accessible innovation for EFL classrooms, with attention to systematic scaffolding, sufficient intervention duration, and ongoing assessment of both speaking and SRL outcomes.

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