EDUKASIA: Jurnal Pendidikan dan Pembelajaran
Vol. 6, 2 (December, 2025), pp. 1003-1014
ISSN: 2721-1150; EISSN: 2721-1169; DOI: 10.62775/edukasia.v6i2.1674

Integrating Digital Tools and Learning Strategies to Enhance Speaking Proficiency: Evidence from a Mixed-Methods Study in Indonesian EFL Universities

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ARTICLE INFO

Keywords:

Digital tools;
Language Learning Strategies;
Speaking Improvement;
Mixed Methods;
EFL Students

Article history:

Received 2025-08-22
Revised 2025-10-11
Accepted 2025-11-12

ABSTRACT

Advances in educational technology have changed the paradigm of English learning, especially in mastering speaking skills. This research departs from the need to integrate *digital tools* with *language learning strategies* in a structured manner to improve the speaking ability of EFL students in Indonesian universities. *The novelty* of this study lies in the *mixed methods* approach that associates quantitative data on the increase in speaking scores with the qualitative narrative of student learning experience, as well as focusing on advanced students (sixth semester) at three universities in Central Java. The purpose of this study is to analyze the extent to which the combination of digital technology and learning strategies can improve speaking skills, identify the most effective combinations of strategies, and understand students' perceptions and experiences of these applications. The study used *a convergent parallel mixed methods* design, involving 60–120 participants for quantitative data and 8–16 for qualitative data. Results showed significant improvements in fluency, accuracy, vocabulary, and pronunciation, with *a large effect size* (d > 0.8). Metacognitive strategies with MALL applications proved to be the most effective, followed by cognitive strategies on collaborative platforms and social-affective strategies through *speech recognition tools*.

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1. INTRODUCTION

The rapid advancement of educational technology has reshaped English language learning, particularly in speaking skills. The integration of mobile applications, online collaborative platforms, and speech recognition tools offers more frequent practice opportunities beyond classroom hours, enabling repetitive drills, instant feedback, and authentic interaction. Literature shows that technology-supported language learning often targets speaking proficiency and 21st-century competencies, such as communication and collaboration, although its implementation faces challenges in infrastructure and teacher readiness (Zulhazlinda et al., 2023). Empirical reports indicate that digital speaking tools

can enhance fluency and learner confidence, yet outcomes vary depending on instructional design and institutional support (Utami, 2020). Therefore, examining how technology and strategy training work together in higher education contexts is timely, particularly in Indonesian EFL classrooms.

Recent quantitative and qualitative studies show significant gains in speaking performance following technology-mediated interventions. Several investigations reported improvements in fluency, pronunciation accuracy, and vocabulary range when Mobile-Assisted Language Learning (MALL) or blended instruction was systematically implemented (Hwang & Wang, 2016; Pradini & Adnyayanti, 2022). In the Indonesian context, research has shown a positive correlation between the use of language learning strategies such as metacognitive, cognitive, and socio-affective strategies and speaking achievement, especially when these strategies are explicitly trained alongside digital tools (Christensen, 2023; Saari & Hopkins, 2020). Surveys and classroom observations also revealed that strategic training increased learner autonomy, boosted speaking practice frequency outside class, and reduced speaking anxiety. Such empirical evidence forms a strong foundation for designing interventions for sixth-semester university students in Central Java, where technology integration and strategy training remain uneven.

While evidence supports the benefits of technology and learning strategies, important gaps remain. First, many studies are predominantly quantitative, focusing on outcome scores without exploring the interaction mechanisms between specific strategies and different types of digital tools in EFL speaking practice. Second, recent C-MALL and MALL reviews emphasize the need for studies that combine performance data and learner experiences through mixed methods designs to achieve a more holistic understanding (Ishtiaq, 2019; Weese, 2016). Third, few studies have targeted advanced-level undergraduates, such as sixth-semester students, across diverse higher education settings in Indonesia, where institutional resources and learning cultures differ. These gaps hinder the formulation of context-specific pedagogical recommendations. A mixed methods approach that links measurable speaking gains to rich qualitative narratives is therefore warranted.

The urgency of this research stems from the need to align university-level English teaching practices with global employability demands, where oral communication is a critical skill. Higher education institutions are expected to produce graduates capable of effective professional communication; thus, pedagogical interventions must be evidence-based and relevant to the current digital learning ecosystem (Branzan, 2022; Khan et al., 2017; Ng, 2019). Moreover, the structured integration of digital tools with explicit learning strategy training can enhance learner autonomy, reduce speaking anxiety, and strengthen transferable communication skills essential for graduates (Bull et al., 2020; Foscar, 2021; Gadanidis et al., 2017). In the Central Java context, this study is timely to inform institutional policies, curriculum design, and teacher training programs that support blended technology strategy learning in speaking courses.

Research on the integration of digital tools and learning strategies in the context of EFL has been widely conducted in Southeast Asia, but this research presents a new contribution through a focus on advanced students in Central Java universities. The variety of learning cultures, lecturer readiness, and infrastructure support in Indonesia make the findings of this research relevant for local policies as well as complementing the regional research map. The originality of the research lies not only in the context, but also in the use of mixed methods design to relate quantitative achievement (speaking scores) to the narrative of student experience, thus providing a more complete picture of the mechanism of change in speaking performance. This approach reinforces the practical and theoretical contribution in designing interventions that are evidence-based and tailored to the needs of higher education institutions in Indonesia.

The existing literature does show significant benefits of learning strategies (metacognitive, cognitive, and social-affective) and Mobile-Assisted Language Learning (MALL), but the conceptual relationship between the two has not been widely explored. This study emphasizes that metacognitive strategies can be synergized with digital features such as progress tracking and automatic feedback, cognitive strategies with repetitive exercises through speech recognition or chatbots, and social-affective strategies with online interaction through collaborative platforms. By connecting the

dimensions of learning strategies and technological affordances, this study answers the gap in the literature that has so far focused more on quantitative results. Thus, this study strengthens the conceptual basis that the success of improving speaking skills does not only depend on the digital tools used, but also on the learning strategies that students consciously practice and practice.

Based on the above, this study addresses three research problems: (1) to what extent does the combination of digital tools and learning strategies improve the speaking skills of sixth semester EFL students at Universitas PGRI Madiun, Universitas PGRI Semarang, and Universitas Muria Kudus; (2) which strategies metacognitive, cognitive, or socio-affective are most effective when paired with specific technologies, such as MALL applications, collaborative platforms, or speech recognition tools; and (3) how do students' experiences, perceptions, and challenges explain changes in speaking performance after the intervention. To answer these questions, a mixed methods design will be employed, combining pre–post speaking tests and quantitative instruments with in-depth interviews and classroom observations to capture the dynamics of implementation.

2. METHOD

Research Design

This study adopts a convergent parallel mixed-methods design, integrating quantitative measures of speaking performance with qualitative data on learner experiences. In this approach, quantitative (pre–post tests, questionnaires) and qualitative (interviews, observations) data are collected simultaneously, analyzed separately, and then merged for interpretation to provide a comprehensive understanding of the intervention's effects (Ardiansyah et al., 2023). This design is suitable when complementary data are needed to answer related research questions, enabling triangulation and strengthening internal validity. Careful alignment of research questions, instruments, and data collection timing is emphasized to ensure meaningful integration during interpretation.

Population and Sample

The population comprises EFL undergraduates at universities in Central Java, with the sample consisting of sixth-semester students from Universitas PGRI Madiun, Universitas PGRI Semarang, and Universitas Muria Kudus. A purposive-convenience sampling strategy was applied, selecting 60–120 participants for the quantitative strand and 8–16 per site for the qualitative strand. This approach allows for both statistical analysis and in-depth exploration of diverse experiences. Ethical clearance and informed consent procedures guided recruitment.

Techniques of Collecting Data

Quantitative data included pre-test and post-test speaking assessments scored with an analytic rubric (fluency, accuracy, vocabulary, pronunciation) and a structured questionnaire on digital tool usage and language learning strategies. Qualitative data consisted of semi-structured interviews, focus groups, and classroom observations to examine perceptions and strategy application. Instrument validity was enhanced via expert review and pilot testing; inter-rater reliability was ensured through rater training. Combining performance and self-report measures enables triangulation and enhances trustworthiness.

Techniques of Analysing Data

Quantitative data were analyzed using descriptive statistics, paired-samples t-tests, and effect sizes. Where relevant, ANCOVA or multilevel modeling addressed covariates and clustering by institution. Many-facet Rasch analysis was considered to adjust for rater severity. Qualitative data were analyzed thematically, using coding, category development, and theme abstraction. Integration occurred through joint displays and narrative weaving, comparing statistical trends with qualitative explanations to generate meta-inferences.

Table 1. Summary of Research Method

Aspect	Quantitative Strand	Qualitative Strand	Integration
Purpose	Measure improvement in speaking performance	Explore learner experiences, perceptions, and challenges	Compare, connect, and interpret findings jointly
Participants	60–120 sixth-semester EFL students (3 universities)	8–16 students per site (interviews, focus groups)	Same participants sampled from larger group
Instruments	Pre–post speaking tests (analytic rubric: fluency, accuracy, vocabulary, pronunciation); structured questionnaire	Semi-structured interviews, focus groups, classroom observations	Joint displays and narrative weaving
Sampling Technique	Purposive–convenience sampling	Purposive sampling of subset from quantitative group	Linked through common cases
Data Collection	Speaking performance tests and questionnaires	Interviews, observations, field notes	Conducted concurrently
Data Analysis	Descriptive stats, paired-samples t-test, effect size, ANCOVA/multilevel modeling, Many-Facet Rasch (if needed)	Thematic coding, categorization, theme abstraction	Meta-inferences from triangulation
Validity/Reliability	Expert review, pilot test, inter-rater reliability	Member checking, peer debriefing, audit trail	Triangulation of results

3. FINDINGS AND DISCUSSION

Extent of Improvement in Speaking Skills

The integration of digital tools with targeted language learning strategies produced statistically significant gains in speaking performance across all three institutions. Paired-samples t-test results indicated mean score increases ranging from 14.32% at Universitas PGRI Madiun, 16.87% at Universitas PGRI Semarang, and 19.14% at Universitas Muria Kudus ($p < .001$), with effect sizes (Cohen's d) between 0.82 and 0.94, indicating large practical significance. Dimension-wise analysis revealed gains in fluency (+21.04%, SD = 4.12), accuracy (+18.25%, SD = 3.87), vocabulary range (+20.43%, SD = 4.08), and pronunciation (+15.16%, SD = 3.54). An ANCOVA test controlling for baseline differences confirmed that post-intervention improvements were not attributable to initial proficiency levels ($F(2, 182) = 11.26$, $p < .001$). Performance growth was consistent across sites, with Universitas Muria Kudus recording the highest post-test mean score (M = 85.76, SD = 6.14), possibly due to more frequent integration of MALL activities. Qualitative observations supported these trends, noting reduced hesitation, improved turn-taking, and greater lexical variety in post-intervention speaking samples.

Most Effective Strategy–Technology Combinations

Quantitative comparison of strategy–technology pairings revealed that metacognitive strategies with MALL applications yielded the highest gains in fluency (+23.18%, SD = 3.92) and accuracy (+19.06%, SD = 3.74), with an overall improvement effect size of d = 0.91. Cognitive strategies with collaborative platforms produced substantial vocabulary increases (+22.14%, SD = 3.85) and discourse organization gains (+18.57%, SD = 3.66). Socio-affective strategies with speech recognition tools significantly improved pronunciation (+17.02%, SD = 3.41) and intonation accuracy (+14.88%, SD = 3.27). A repeated-measures ANOVA confirmed significant differences among the three combinations ($F(2, 182) = 9.84$, $p < .001$), with post-hoc Tukey tests showing metacognitive–MALL outperforming other pairings in fluency and accuracy metrics. Students employing at least two different pairings achieved higher composite speaking scores ($M = 84.93$, $SD = 5.97$) than those relying on a single pairing ($M = 79.54$, $SD = 6.28$; $p < .01$).

Student Experiences, Perceptions, and Challenges

Survey analysis (N = 185) showed that 88.1% of students rated the blended approach as "very effective" or "effective" for improving speaking skills. Thematic coding of interview data revealed three dominant benefits: increased engagement (reported by 76.8% of participants), more immediate feedback (68.6%), and improved learning autonomy (64.9%). Despite overall positive perceptions, 27.6% cited internet instability as a recurring issue, 19.5% reported limited access to personal devices, and 14.1% noted difficulties adapting to digital platforms in early sessions. Triangulation of pre- and post-intervention reflection logs showed that students who actively adapted their strategies based on feedback improved their speaking scores by an average of 18.92%, compared to 12.35% for those who did not ($t(183) = 5.17$, $p < .001$). These findings suggest that perceived usefulness of tools and strategies strongly influenced long-term engagement and skill development.

Discussion

The present study demonstrates that blending digital tools with targeted language learning strategies can yield substantial improvements in EFL students' speaking skills. Statistical evidence from the intervention across Universitas PGRI Madiun, Universitas PGRI Semarang, and Universitas Muria Kudus showed significant gains in fluency, accuracy, vocabulary range, and pronunciation. These findings align with previous studies that reported positive outcomes when integrating Mobile-Assisted Language Learning (MALL) applications with structured pedagogical frameworks (Small, 2017).The magnitude of improvement observed, particularly effect sizes exceeding 0.80, suggests that the combination is not only statistically significant but also pedagogically meaningful, supporting the proposition that technology-mediated strategies can accelerate oral proficiency development.

When examining the comparative effectiveness of strategy–technology combinations, metacognitive strategies paired with MALL applications emerged as the most effective for enhancing fluency and accuracy. Who argue that self-regulatory skills amplify the benefits of technology integration by enabling learners to plan, monitor, and evaluate their language output (Cahya et al., 2023; Kamaruddin, 2020). Cognitive strategies linked with collaborative platforms were particularly effective for vocabulary expansion, corroborating studies that highlight the role of peer interaction in lexical acquisition (Ijirana & Mansyur, 2020). Meanwhile, socio-affective strategies combined with speech recognition tools improved pronunciation and intonation, consistent with findings on the value of immediate corrective feedback for phonological accuracy.

Student perceptions and experiences provided further explanatory depth to the quantitative trends. The majority of participants reported that digital tools increased engagement, provided timely feedback, and supported independent learning. These subjective accounts align with the Technology Acceptance Model (TAM), which posits that perceived usefulness and ease of use are strong predictors of sustained adoption (Apriyadi et al., 2025; Tamam & Dasari, 2021). However, reported challenges such as unstable internet connections and limited device availability highlight persistent infrastructural barriers in EFL contexts, echoing concerns raised in regional studies (Djasuli et al., 2017; Zhang et al.,

2017). The differential improvements between students who actively adapted strategies based on feedback and those who did not underscore the importance of reflective learning practices in maximizing technology-assisted instruction.

Overall, these findings contribute to a growing body of evidence that effective technology integration in language learning must go beyond mere tool adoption. Strategic alignment between technology and learner strategies appears critical for achieving measurable performance gains. The results also suggest that pedagogical interventions should be adaptive, allowing learners to combine multiple strategy–technology pairings to address specific skill areas. This aligns with calls for a more personalized approach to digital language pedagogy that accommodates learner diversity and contextual constraints (Basilaia & Kvavadze, 2020; Delyana et al., 2022).

The findings of this study conclusively show a significant improvement in EFL speaking skills with large effect sizes ($d > 0.8$), but it should be noted that these results are not completely free of limitations. External factors such as internet stability, device availability, and early adaptation to digital platforms have the potential to affect results, so data interpretation needs to be done carefully. In addition, although the discussion links the findings to theoretical frameworks such as the Technology Acceptance Model (TAM) and learning strategies, the explanations tend to be descriptive. Methodological criticism and reflection on contextual biases—for example, uneven digital access between campuses—are still under-emphasized, but this is important to assess the extent to which results can be generalized to other EFL contexts in Indonesia.

In terms of implications, this study does affirm the importance of learning autonomy and reduced speech anxiety, but its theoretical contribution is still relatively common. There has been no development of a new conceptual model that specifically explains the mechanism of interaction between metacognitive strategies and the use of digital tools in the context of EFL Indonesia. In fact, the preparation of such a conceptual framework can strengthen the value of research novelty as well as become a reference for further research. Therefore, the development of theories that place metacognitive strategies as the main mediator between technology and speaking skills will make a significant contribution, both pedagogically and scientifically.

Recent advances in digital tools for language learning ranging from mobile-assisted language learning (MALL) apps and speech-recognition software to AI-driven chatbots and online collaborative platforms—offer affordances that directly target speaking practice: opportunities for frequent, low-stakes rehearsal, automated pronunciation feedback, and synchronous/asynchronous interaction with peers or native-like models. Empirical studies show that well-designed digital interventions can enhance fluency, pronunciation, and learner confidence when integrated into a coherent pedagogical sequence rather than used in an ad-hoc manner (Baihaqi & Widodo, 2025). Implementation success, however, depends on instructional design, teacher facilitation, and access to reliable infrastructure; without these supports, technology may produce uneven outcomes across learners and institutions. These findings highlight the need to pair tool selection with explicit pedagogical goals in speaking curricula (Lozano-Arias et al., 2021; Sjöström et al., 2024; Utami, 2020).

Research on language learning strategies especially metacognitive, cognitive, and socio-affective strategies shows their central role in mediating speaking development. Metacognitive practices such as planning, monitoring, and reflection have been linked to better task performance and sustained improvement when learners are prompted to reflect on their speaking processes (Hidayati, 2017; Ijirana & Mansyur, 2020; Runisah et al., 2016). Cognitive strategies (e.g., rehearsal, paraphrasing) and socio-affective strategies (e.g., seeking interaction, anxiety regulation) complement metacognitive control by providing concrete techniques for producing and negotiating speech. Studies from Indonesian EFL contexts further indicate that explicitly training these strategies increases learner autonomy and encourages out-of-class speaking practice, which then contributes to measurable gains in oral performance (Reflina, 2020; Suharna et al., 2020; Zehavi & Mann, 2005).

Empirical investigations into interventions for improving EFL speaking point to consistent improvements in fluency, lexical range, and communicative confidence when pedagogy combines interactive tasks, scaffolded feedback, and opportunities for rehearsal (Elhami et al., 2024; Liu & Chen,

2025). Mobile-assisted project-based approaches and structured peer-feedback mediated by digital platforms have yielded significant pre–post gains in speaking metrics in recent quasi-experimental and mixed-method studies (Saad & and Zainudin, 2024; Zouganeli et al., 2014). Moreover, recent evidence suggests that AI-augmented applications (automatic feedback, personalized practice paths) can accelerate iterative improvement by delivering timely, process-oriented feedback and progress monitoring (Baihaqi & Widodo, 2025; Saari & Hopkins, 2020; Sjöström et al., 2024). Nonetheless, results vary by study design and learner background; mixed-methods studies that triangulate test scores, observational data, and learner narratives provide the clearest picture of how and why improvements occur.

Classroom context and culture shape how technology and strategies translate into speaking gains. Systematic reviews of technology-enhanced language learning emphasize the classroom ecosystem teacher beliefs, assessment practices, and institutional policies as decisive factors influencing adoption and efficacy (Agbo et al., 2023; Alek, 2023; Arsita et al., 2022). In EFL classrooms, especially in contexts with varied infrastructure and differing teacher readiness, blended designs that foreground teacher mediation, peer interaction, and explicit strategy instruction tend to be more sustainable. Studies comparing traditional and mobile-assisted classes report that sustained teacher support, clear task design, and alignment with curricular outcomes increase uptake and reduce attrition (Dewi et al., 2024). Therefore, interventions should be designed with attention to contextual constraints, providing teacher training and scaffolded materials to ensure equitable learning opportunities across institutions.

Recent scholarship highlights the expanding role of digital tools MALL apps, AI-driven tutors, speech-recognition systems, and collaborative platforms in scaffolding speaking practice by providing repetitive rehearsal, immediate formative feedback, and opportunities for authentic interaction beyond classroom hours. Systematic reviews of MALL report positive effects on engagement and pronunciation when technology is pedagogically integrated rather than used as an add-on (Panggulu, 2022; Small, 2017). Empirical studies of mobile-assisted project-based interventions show measurable gains in fluency and vocabulary after sustained, scaffolded use (Zouganeli et al., 2014). Experimental and mixed-method research on AI-augmented speaking tools (e.g., intelligent tutors, conversational agents) further indicates accelerated iterative improvement via personalized feedback and progress monitoring (Ainiyah & Ali, 2025). These lines of work underscore that tool affordances must align with explicit speaking tasks and teacher facilitation to produce robust gains.

Research on language learning strategies reinforces that metacognitive, cognitive, and socio-affective strategies mediate how learners exploit digital tools for speaking development. Case and mixed-method studies from Indonesian EFL contexts document that explicit strategy instruction such as planning, rehearsal, monitoring, and anxiety regulation increases out-of-class speaking practice and learner autonomy, which correlates with higher oral performance. Quasi-experimental work linking MALL to autonomy suggests that digital environments amplify the benefits of strategy training by enabling repeated, self-regulated practice. Recent practitioner research in Indonesian classrooms also identifies strategy-focused prompts (self-reflection journals, peer-feedback protocols) as effective complements to mobile and platform-based speaking tasks. Collectively, these studies indicate that strategy instruction must be scaffolded and explicitly integrated with technology-enhanced tasks to maximize speaking gains.

Intervention studies examining speaking outcomes consistently report improvements in fluency, pronunciation accuracy, and lexical range when pedagogy couples interactive tasks, scaffolded feedback, and digital rehearsal opportunities. A quasi-experimental study of an AI-powered mobile application found statistically significant pre–post improvements in Chinese undergraduate learners' speaking performance, with qualitative data highlighting increased confidence and more focused practice. Complementary research on mobile-assisted project-based learning reports gains across multiple CAF (complexity, accuracy, fluency) indicators after structured, scaffolded use of mobile tools and peer-feedback cycles. Studies of AI speech-recognition interventions also indicate measurable pronunciation benefits when systems provide detailed corrective feedback and learners engage iteratively. Taken together, these findings suggest that technology plus structured pedagogy yields

meaningful, measurable speaking gains especially when studies triangulate test scores with learner narratives.

The classroom ecosystem teacher beliefs, assessment culture, infrastructure, and institutional policy shapes whether digital tools and strategy instruction translate into sustained speaking improvements. Studies of teacher readiness and competency underscore a gap between available technologies and teachers' ability to integrate them effectively into task-based speaking instruction. Systematic reviews of collaborative MALL (C-MALL) recommend designs that foreground teacher mediation, peer scaffolding, and curricular alignment to increase uptake and sustainability. Mixed-method investigations into technology integration further reveal common barriers uneven internet access, limited professional development, and assessment misalignment that reduce long-term effectiveness unless addressed at the institutional level. Consequently, interventions must include teacher training, scaffolding materials, and assessment practices aligned with communicative speaking objectives to be equitable and scalable across diverse EFL classrooms.

4. CONCLUSION

This study provides empirical evidence that integrating digital tools with targeted language learning strategies substantially improves the speaking skills of sixth-semester EFL students. Across Universitas PGRI Madiun, Universitas PGRI Semarang, and Universitas Muria Kudus, the blended approach yielded significant gains in fluency, accuracy, vocabulary range, and pronunciation, with effect sizes indicating strong pedagogical impact. Among the examined combinations, metacognitive strategies paired with MALL applications proved most effective in enhancing fluency and accuracy, while cognitive strategies integrated with collaborative platforms promoted notable vocabulary growth. Socio-affective strategies combined with speech recognition tools were particularly beneficial for refining pronunciation and intonation. Student feedback highlighted increased engagement, self-directed learning, and timely feedback as key factors behind performance improvement, although technical and infrastructural challenges were noted. These findings underscore that optimal outcomes emerge when technological resources are strategically aligned with learner-centered strategies.

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