

DIGITAL INCLUSIVITY AND SECOND LANGUAGE ACQUISITION: AN EMPIRICAL INVESTIGATION OF ENGLISH WRITING SKILL TRAINING DEVICES FOR FIRST-GENERATION AND MULTILINGUAL LEARNERS

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Abstract

The rapid integration of digital technologies in language education has transformed the process of second language acquisition, particularly in multilingual and socially diverse learning environments. This study investigates the role of English writing skill training devices in promoting digital inclusivity among first-generation and multilingual learners in engineering education. The research focuses on how technology-assisted instructional tools such as language learning applications, multimedia writing platforms, AI-assisted grammar tools, and online collaborative environments influence the writing proficiency of learners who often experience linguistic and socio-economic disadvantages. Adopting an empirical research design, the study was conducted among undergraduate engineering students from rural and urban institutions in Tamil Nadu. Data were collected through pre-tests, post-tests, questionnaires, classroom observations, and learner feedback. The findings reveal that digital writing tools significantly improve vocabulary usage, sentence construction, grammatical accuracy, coherence, and learner confidence. The study further highlights that inclusive digital pedagogies reduce language anxiety and encourage active participation among multilingual learners. Moreover, the research emphasizes the importance of equitable technological access and teacher guidance in enhancing second language acquisition. The study contributes to the growing discourse on inclusive language education by demonstrating how digitally mediated writing instruction can support diverse learners in higher education contexts.

1.INTRODUCTION

The twenty-first century has witnessed a significant transformation in the field of language education due to the rapid advancement of digital technologies and communication platforms. English, as a global language of communication, science, technology, and higher education,

has become an essential medium for academic and professional success. In multilingual societies such as India, English language proficiency plays a crucial role in determining learners' educational opportunities, employability, and social mobility. However, access to quality

English language education remains uneven, especially among first-generation learners and students from linguistically diverse backgrounds. These learners often encounter challenges related to socio-economic disadvantages, limited exposure to English, inadequate educational support, and restricted access to technological resources. In this context, digital inclusivity has emerged as an important educational concern that seeks to ensure equal access to technological tools and learning opportunities for all learners irrespective of their social, linguistic, or economic background.

Digital inclusivity refers to the process of enabling equitable access to digital technologies, online resources, and technology-assisted learning environments. It emphasizes the idea that every learner should have the opportunity to participate meaningfully in digitally mediated educational systems. In language education, digital inclusivity becomes particularly significant because technology can bridge gaps in learning by providing interactive, learner-centered, and personalized instructional experiences. The emergence of English writing skill training devices such as AI-assisted grammar tools, language learning applications, multimedia writing platforms, online collaborative spaces, speech-to-text systems, and virtual learning environments has reshaped the

traditional approaches to second language acquisition. These technological tools create opportunities for learners to improve writing proficiency through immediate feedback, self-paced learning, peer interaction, and multimodal communication.

Second language acquisition is a complex cognitive and social process influenced by multiple factors including linguistic background, motivation, exposure, socio-cultural environment, and educational practices. For multilingual learners and first-generation students, acquiring proficiency in English writing can be particularly demanding. Many learners enter higher education institutions with limited exposure to formal English communication due to differences in schooling systems, regional language dominance, and family educational backgrounds. First-generation learners, who are often the first members of their families to pursue higher education, may lack academic support structures and guidance that are available to learners from more privileged educational environments. Similarly, multilingual learners frequently negotiate between multiple linguistic systems, which can influence their vocabulary usage, grammar, sentence formation, and writing fluency in English.

In engineering education, English writing proficiency assumes greater

importance because students are expected to engage in technical writing, academic reporting, project documentation, professional communication, and research-oriented activities. The inability to communicate effectively in English may hinder academic achievement and reduce confidence among learners. Consequently, educational institutions have increasingly adopted technology-assisted instructional methods to enhance language learning experiences and support learners from diverse backgrounds. Digital writing tools offer opportunities for individualized learning, continuous practice, collaborative engagement, and autonomous learning, thereby making language instruction more accessible and inclusive.

The integration of digital technologies into language education has gained momentum after the global shift toward online and blended learning environments. Educational institutions across the world have recognized the importance of technology-enhanced pedagogy in promoting learner engagement and improving language outcomes. In India, the National Education Policy (NEP) 2020 strongly advocates the integration of technology in education to ensure accessibility, inclusivity, and quality learning experiences. The policy highlights the need to support learners from rural,

marginalized, and socio-economically disadvantaged communities through digital educational initiatives. In this regard, digital writing skill training devices have emerged as valuable pedagogical resources that can facilitate second language acquisition among diverse learner populations.

English writing skill training devices encompass a wide range of technological tools and applications designed to improve learners' writing abilities. These include grammar correction software, vocabulary enhancement applications, online writing laboratories, collaborative writing platforms, multimedia storytelling tools, AI-based language learning systems, and mobile-assisted language learning applications. Such tools provide learners with opportunities to engage actively with language through interactive exercises, automated feedback, guided writing activities, and peer collaboration. Unlike traditional classroom methods that may focus primarily on teacher-centered instruction, digital tools encourage learner autonomy, experimentation, and continuous revision, which are essential components of effective writing development.

One of the significant advantages of digital learning environments is their ability to provide immediate and personalized feedback. Writing is often considered one

of the most challenging aspects of second language acquisition because it requires mastery over grammar, vocabulary, syntax, coherence, organization, and critical thinking. Traditional classroom environments may not always provide sufficient time for individualized feedback due to large class sizes and limited instructional hours. Digital writing platforms address this limitation by offering automated corrections, suggestions for sentence improvement, vocabulary recommendations, and real-time error analysis. Such features enable learners to recognize their mistakes, revise their writing, and gradually improve their language proficiency.

For multilingual learners, digital writing tools can also facilitate translanguaging practices and cross-linguistic understanding. Many technology-based applications support multilingual interfaces and contextual language support, allowing learners to connect their prior linguistic knowledge with English learning processes. This can reduce language anxiety and increase learner confidence. Additionally, multimedia-based instructional methods that incorporate audio, video, visual aids, and interactive activities cater to diverse learning styles and enhance learner engagement. Such approaches are particularly beneficial for students from rural and underprivileged

educational backgrounds who may have had limited exposure to communicative English practices during their earlier schooling.

Despite the growing popularity of digital technologies in education, issues related to digital inequality and technological accessibility continue to affect many learners. Digital inclusivity is not merely about providing devices and internet connectivity; it also involves ensuring digital literacy, pedagogical support, and meaningful participation in learning environments. Students from economically weaker sections may lack access to high-quality devices, stable internet connections, or conducive learning environments. Similarly, learners from rural areas may face infrastructural limitations that hinder effective participation in digital learning activities. Therefore, understanding how digital writing skill training devices influence second language acquisition among first-generation and multilingual learners becomes an important area of educational research.

The present study seeks to examine the role of digital inclusivity in enhancing English writing proficiency among first-generation and multilingual learners through technology-assisted instructional tools. The study focuses specifically on engineering students because technical

education increasingly demands effective communication skills alongside subject-specific competencies. Engineering students are expected to prepare laboratory reports, technical descriptions, project proposals, seminar presentations, and research documentation in English. Hence, improving English writing skills through digitally inclusive pedagogical strategies can significantly contribute to students' academic and professional development.

The study also aims to explore how digital tools can reduce educational disparities and create equitable learning opportunities for linguistically diverse learners. By examining learners' writing performance, engagement levels, attitudes toward digital learning, and perceptions of technology-assisted instruction, the research intends to provide empirical insights into the effectiveness of digital pedagogies in second language acquisition. Furthermore, the study investigates the extent to which digital learning environments foster learner confidence, collaboration, autonomy, and motivation among students from diverse socio-cultural backgrounds.

Another important aspect of this research is its emphasis on inclusive education. Inclusive educational practices recognize the diversity of learners and seek to create supportive learning environments that accommodate different linguistic,

cognitive, and socio-economic needs. Digital technologies have the potential to democratize education by making learning resources accessible beyond traditional classroom boundaries. However, successful implementation requires appropriate teacher training, institutional support, learner orientation, and pedagogical planning. Therefore, this study also highlights the role of educators in facilitating digitally inclusive language learning experiences.

The significance of this research lies in its contribution to the fields of English Language Teaching (ELT), second language acquisition, educational technology, and inclusive pedagogy. The findings may help educators, curriculum designers, policymakers, and researchers understand the potential of digital writing skill training devices in supporting marginalized and multilingual learner communities. The study may also offer practical recommendations for integrating technology-assisted writing instruction into engineering education and other higher education contexts.

Moreover, the study aligns with contemporary educational trends that emphasize learner-centered pedagogy, digital transformation, and skill-based education. As educational institutions increasingly adopt hybrid and online learning models, understanding the

relationship between digital inclusivity and language acquisition becomes essential for designing effective instructional frameworks. Technology-assisted writing instruction can empower learners to become active participants in their learning journey, enabling them to communicate effectively in academic and professional settings.

In conclusion, the intersection of digital inclusivity and second language acquisition represents a critical area of inquiry in contemporary language education. English writing skill training devices have the potential to transform traditional pedagogical practices by offering accessible, interactive, and learner-centered learning experiences. For first-generation and multilingual learners, such technologies can reduce linguistic barriers, enhance writing proficiency, and foster academic confidence. However, the success of digitally inclusive language education depends on equitable access, institutional support, teacher preparedness, and learner engagement. By investigating the impact of digital writing tools on English language learning among diverse learner populations, the present study seeks to contribute to the development of inclusive, technology-driven educational practices that support equitable learning opportunities in higher education.

2. OBJECTIVES OF THE STUDY

1. To examine the impact of digital writing skill training devices on the English writing proficiency of first-generation and multilingual learners.
2. To analyze the role of digital inclusivity in facilitating second language acquisition among engineering students from diverse linguistic and socio-economic backgrounds.
3. To investigate the effectiveness of technology-assisted learning tools in improving learners' grammar, vocabulary, coherence, and overall writing performance in English.
4. To identify the perceptions, attitudes, and levels of engagement of first-generation and multilingual learners toward digitally mediated English writing instruction.
5. To explore the challenges and opportunities associated with the use of digital learning technologies in promoting inclusive English language education in higher education institutions.

3. REVIEW OF LITERATURE

The growing integration of digital technologies into language education has significantly transformed the field of second language acquisition (SLA), particularly in multilingual and inclusive learning environments. Recent studies in

educational technology, computer-assisted language learning (CALL), artificial intelligence (AI)-assisted pedagogy, and multilingual education have emphasized the importance of digital inclusivity in improving language proficiency among diverse learner populations. The present review examines recent scholarly contributions related to digital inclusivity, English writing skill development, multilingual learning, and technology-assisted second language acquisition.

One of the major developments in recent language education research is the increasing recognition of technology-supported language learning as an effective pedagogical approach. A comprehensive review by researchers in the field of technology-supported language learning found that digital learning activities positively influenced learners' motivation, engagement, interaction, and language performance. The study highlighted that multimedia learning environments, online collaborative activities, and mobile-assisted language learning applications improved learners' writing and communication skills through active participation and immediate feedback mechanisms. The researchers also emphasized that technology-assisted learning environments support autonomous learning and encourage learners to participate more confidently in second language communication.

Recent research has particularly focused on multilingual learners and students from linguistically diverse backgrounds. A 2026 quasi-experimental study on inclusive mobile learning demonstrated how technology-enabled language choice supports multilingual learners in digital educational environments. The researchers observed that learners who were allowed to use both local languages and English showed higher participation rates and better learning engagement. The study also revealed that multilingual digital instruction increased accessibility for rural and educationally disadvantaged learners, helping them achieve comparable academic outcomes despite initially lower proficiency levels. These findings are highly relevant to multilingual learners in India, where students often negotiate between regional languages and English in educational settings.

The concept of digital inclusivity has become increasingly significant in educational research because access to digital technologies remains uneven across socio-economic and geographical contexts. Studies conducted in India have shown that technological integration in English language learning provides opportunities for flexible, learner-centered, and self-regulated learning. Researchers have identified several benefits of digital

technologies, including improved learner engagement, wider access to educational resources, enhanced multimedia exposure, and opportunities for independent learning beyond the classroom. At the same time, these studies also highlighted persistent challenges such as infrastructural inequalities, inadequate internet access, and limited digital literacy among students from rural and economically disadvantaged communities.

The relationship between digital inclusivity and multilingual education has also gained considerable attention in recent years. Research on multilingual digital pedagogy suggests that technology-assisted instruction enables learners to connect their prior linguistic knowledge with second language learning processes. The pedagogical concept of translanguaging has emerged as an important theoretical framework in this context. Translanguaging allows learners to use multiple linguistic systems simultaneously to facilitate comprehension and communication. Scholars have argued that multilingual learners benefit from instructional approaches that recognize linguistic diversity as an educational resource rather than a barrier. Technology-supported translanguaging practices enable learners to switch between languages, interpret meaning contextually, and gradually improve second language proficiency.

Several studies have explored the effectiveness of AI-assisted language learning tools in improving English writing skills. Recent advancements in artificial intelligence have introduced grammar correction systems, AI-powered writing assistants, adaptive learning platforms, and automated feedback mechanisms into language classrooms. Research has shown that AI-assisted learning tools provide learners with personalized instruction, immediate error correction, vocabulary enhancement suggestions, and writing organization support. These tools are particularly beneficial for learners who lack continuous teacher support or who require individualized learning opportunities. Scholars have further argued that AI-based systems can reduce writing anxiety and improve learner confidence by allowing students to revise their work independently.

The growing role of AI in language education has also been associated with increased educational inclusivity. Studies examining AI-supported inclusive education indicate that language-focused AI tools promote multilingual participation, improve communication skills, and reduce instructional inequalities. Researchers have observed that AI-assisted platforms create supportive learning environments for linguistically diverse learners by adapting to individual learning needs and proficiency

levels. However, scholars also caution against over-dependence on AI technologies and emphasize the need for ethical implementation, teacher supervision, and balanced pedagogical integration.

Research in Computer-Assisted Language Learning (CALL) and Intelligent Computer-Assisted Language Learning (ICALL) has further contributed to understanding technology-mediated second language acquisition. CALL environments are designed to facilitate interactive learning experiences through multimedia tools, language games, collaborative writing tasks, and virtual communication platforms. ICALL systems, which incorporate artificial intelligence and natural language processing, are capable of detecting grammatical and syntactic errors in learner-generated texts and providing corrective feedback. Scholars have reported that these systems enhance learner autonomy, encourage self-correction, and improve writing fluency through repeated practice and individualized learning support.

Another important area of recent research concerns the writing difficulties experienced by multilingual and first-generation learners. Studies have shown that learners from multilingual backgrounds often face challenges related to grammar, sentence construction,

vocabulary usage, coherence, and academic writing conventions. First-generation learners, who may not have access to educational support structures at home, frequently struggle with English language communication in higher education contexts. Research indicates that technology-assisted writing platforms can address some of these challenges by offering guided learning activities, peer collaboration opportunities, and continuous feedback. Such platforms create inclusive learning environments where learners can practice writing skills at their own pace and develop confidence in second language communication.

Teacher readiness and pedagogical support also play a significant role in successful digital language education. Recent studies emphasize that technology integration alone cannot guarantee improved learning outcomes unless educators are adequately trained to use digital tools effectively. Researchers have argued that teachers require professional development opportunities to design inclusive technology-based learning environments that support multilingual learners. Teachers must also adopt culturally responsive pedagogies that recognize linguistic diversity and encourage collaborative learning practices.

The literature further indicates that digital learning environments support

learner motivation and engagement more effectively than traditional instructional methods. Technology-assisted classrooms often incorporate interactive activities such as multimedia presentations, collaborative writing tasks, online discussions, digital storytelling, and gamified language learning exercises. Such approaches create dynamic and learner-centered educational experiences that encourage participation and creativity. Researchers have found that learners exposed to multimedia-rich environments demonstrate improved writing performance, greater vocabulary retention, and enhanced communicative competence.

Studies on mobile-assisted language learning (MALL) have also contributed significantly to recent SLA research. Mobile devices provide learners with continuous access to educational resources, allowing them to practice language skills beyond classroom boundaries. Mobile applications designed for language learning often include vocabulary exercises, grammar activities, pronunciation practice, and writing tasks that support self-regulated learning. Scholars have reported that mobile learning environments are especially beneficial for students from remote and rural areas because they increase educational accessibility and flexibility. However, researchers also note that successful mobile

learning depends on internet connectivity, device availability, and learners' digital literacy skills.

Recent literature has increasingly focused on inclusive education and equity in digital learning environments. Researchers argue that digital inclusivity involves more than providing technological devices; it also includes ensuring meaningful participation, digital literacy, and equitable access to educational opportunities. Studies examining migrant learners and multilingual communities have demonstrated that digitally inclusive pedagogies promote learner participation, social integration, and language development. The use of multilingual digital resources, localized instructional materials, and collaborative online activities helps learners engage more actively in educational processes.

Another emerging area of research involves generative AI and academic writing support. Recent large-scale empirical studies have shown that AI-assisted writing tools are increasingly used by non-native English speakers and learners from less privileged educational backgrounds. Researchers observed that AI writing systems help reduce language barriers by lowering drafting and revision difficulties, thereby increasing learners' writing productivity and academic participation. These findings suggest that

AI-assisted writing technologies may contribute to reducing linguistic inequalities in global educational contexts.

The theoretical foundations of digital language learning are closely connected with the concept of multiliteracies. The multiliteracies framework emphasizes the importance of linguistic diversity, multimodal communication, and digital literacy in contemporary education. Scholars argue that language learning in the digital era extends beyond traditional reading and writing practices to include multimedia interpretation, visual communication, and digital interaction. This perspective supports the integration of multimedia tools, digital storytelling platforms, and online collaborative environments into language pedagogy.

Despite the growing body of research on technology-assisted language learning, there remains a need for empirical investigations focusing specifically on first-generation and multilingual learners in engineering education contexts. Much of the existing literature has concentrated on general language learning environments without adequately addressing the unique socio-linguistic and educational challenges faced by learners from rural, multilingual, and economically disadvantaged backgrounds. Furthermore, there is limited

research examining how digital writing skill training devices influence English writing proficiency among engineering students who require specialized academic and professional communication skills.

The present study attempts to address this research gap by investigating the relationship between digital inclusivity and second language acquisition among first-generation and multilingual learners. The study specifically examines the effectiveness of English writing skill training devices in improving learners' writing proficiency, engagement, confidence, and participation in higher education settings. By focusing on technology-assisted writing instruction within multilingual educational contexts, the research contributes to contemporary discussions on inclusive pedagogy, digital equity, and learner-centered language education.

In summary, the reviewed literature demonstrates that digital technologies have significantly reshaped second language acquisition by creating interactive, accessible, and learner-centered educational environments. Technology-assisted language learning tools, AI-powered writing systems, multilingual instructional approaches, and mobile learning platforms have shown considerable potential in improving English writing proficiency among diverse learners.

However, issues related to digital inequality, teacher preparedness, infrastructural limitations, and equitable access continue to influence the effectiveness of technology-based language education. The present study builds upon these scholarly discussions by exploring how digitally inclusive writing skill training devices can support first-generation and multilingual learners in acquiring English writing proficiency within engineering education contexts.

4. METHODOLOGY OF THE STUDY

The present study adopts a systematic and empirical research methodology to investigate the impact of digital inclusivity on second language acquisition through English writing skill training devices among first-generation and multilingual learners. The study primarily focuses on undergraduate engineering students studying in higher educational institutions in Tamil Nadu. The methodology has been carefully designed to examine the effectiveness of technology-assisted writing instruction in improving English writing proficiency, learner engagement, confidence, and participation among linguistically and socio-economically diverse learners.

4.1 Research Design

The study employs a mixed-method research design that combines both quantitative and qualitative approaches.

The use of a mixed-method design enables the researcher to obtain comprehensive insights into learners' writing performance as well as their perceptions and experiences regarding digitally mediated language learning. The quantitative component of the study measures the improvement in learners' English writing skills through pre-tests and post-tests, while the qualitative component explores learners' attitudes, experiences, and challenges associated with digital learning environments.

An experimental research framework with pre-test and post-test analysis is adopted to evaluate the effectiveness of English writing skill training devices. The study uses a quasi-experimental design involving experimental and control groups. The experimental group receives technology-assisted writing instruction through digital learning tools, whereas the control group continues learning through conventional classroom-based instructional methods. This comparison enables the researcher to identify the extent to which digital writing tools contribute to second language acquisition and writing proficiency development.

4.2 Population of the Study

The population of the study consists of undergraduate engineering students enrolled in first-year and second-year courses in selected engineering colleges in

Tamil Nadu. The study particularly focuses on first-generation learners and multilingual learners who come from rural, semi-urban, and socio-economically disadvantaged educational backgrounds. These learners often experience difficulties in English communication due to limited exposure to English language environments during their schooling.

The participants represent different linguistic backgrounds, including Tamil-medium and regional-language-medium schooling systems. Many of the students use English primarily within academic settings rather than in daily communication. Therefore, the selected population is highly relevant to the objectives of the study, which aim to investigate the role of digital inclusivity in facilitating English writing skill development among diverse learner communities.

4.3 Sample Selection

A purposive sampling technique is used for selecting the participants of the study. The researcher identifies students who meet the criteria of being first-generation learners and multilingual learners. A total of 240 students from four engineering colleges are selected for the study. The participants are divided equally into experimental and control groups.

- Experimental Group: 120 students
- Control Group: 120 students

The participants are selected from various engineering disciplines such as Computer Science Engineering, Mechanical Engineering, Electronics and Communication Engineering, Civil Engineering, and Information Technology. The inclusion of learners from multiple disciplines ensures diversity in academic backgrounds and learning experiences.

The experimental group receives digital writing skill training through technology-assisted learning tools, while the control group receives traditional writing instruction through textbook-oriented and teacher-centered methods.

4.4 Variables of the Study

The study includes both independent and dependent variables.

4.5 Independent Variables

1. Digital writing skill training devices
2. Technology-assisted instructional methods
3. Multimedia-based writing activities
4. AI-assisted grammar and vocabulary tools
5. Online collaborative writing platforms

4.6 Dependent Variables

1. English writing proficiency
2. Vocabulary usage
3. Grammatical accuracy
4. Sentence construction
5. Writing coherence and organization

6. Learner confidence and participation

immediate feedback, collaborative interaction, and autonomous writing practice.

4.8 Research Instruments

The study uses multiple research instruments for collecting reliable and comprehensive data.

4.8.1. Pre-Test and Post-Test

A standardized English writing proficiency test is administered before and after the intervention period. The tests evaluate learners' writing performance in the following areas:

- Grammar
- Vocabulary
- Sentence formation
- Paragraph organization
- Coherence and cohesion
- Academic writing style

The writing tasks include paragraph writing, essay writing, report writing, and descriptive writing activities. The scores obtained from the pre-test and post-test are used to measure learners' improvement in writing proficiency.

4.8.2. Questionnaire

A structured questionnaire is designed to collect learners' perceptions regarding digital learning environments and technology-assisted writing instruction. The questionnaire consists of Likert-scale items focusing on:

- Learner engagement
- Confidence in English writing

4.7 Digital Writing Skill Training Devices Used in the Study

The experimental group is exposed to various English writing skill training devices and digital platforms designed to improve writing proficiency. The selected tools are chosen based on accessibility, educational relevance, and learner-friendliness.

The following digital tools are incorporated into the instructional process:

1. **Grammarly** – for grammar correction and vocabulary enhancement
2. **Google Docs** – for collaborative writing activities and peer editing
3. **QuillBot** – for sentence restructuring and paraphrasing practice
4. **Duolingo English Modules** – for language reinforcement activities
5. **Canva Writing Templates** – for visual writing presentations
6. **Learning Management Systems (LMS)** – for assignment submission and feedback
7. **Multimedia Writing Platforms** – for audio-visual learning support

These tools provide learners with opportunities for self-paced learning,

- Accessibility of digital tools
- Ease of technology usage
- Motivation toward language learning
- Attitudes toward multimedia learning

The questionnaire helps identify learners' experiences and opinions regarding digitally inclusive language education.

4.3.3. Classroom Observation

The researcher conducts systematic classroom observations during the instructional process. Observation schedules are prepared to examine:

- Learner participation
- Interaction levels
- Collaborative learning practices
- Technology usage patterns
- Classroom engagement
- Peer communication

Observation data provide qualitative insights into learners' behavioral responses to digital instructional methods.

4.4. Interview

Semi-structured interviews are conducted with selected participants and faculty members. The interviews explore:

- Learners' experiences with digital writing tools
- Challenges faced during language learning
- Perceived benefits of technology-assisted instruction

- Teacher perspectives on digital inclusivity
- Suggestions for improving digital language education

The interview responses provide detailed qualitative data that complement the quantitative findings.

4.5. Pilot Study

Before conducting the main study, a pilot study is carried out with 30 students to test the reliability and validity of the research instruments. The pilot study helps identify ambiguities in the questionnaire, evaluate the difficulty level of the writing tests, and determine the feasibility of the digital instructional activities.

Necessary modifications are made based on the pilot study findings to ensure the effectiveness of the research instruments and procedures.

4.6. Procedure of the Study

The study is conducted over a period of twelve weeks. The instructional procedure is systematically organized into different phases.

Phase 1: Pre-Test Administration

At the beginning of the study, both experimental and control groups are administered a pre-test to assess their initial English writing proficiency levels. The scores obtained serve as baseline data for subsequent comparison.

Phase 2: Orientation Programme

The participants in the experimental group are given an orientation regarding the use of digital writing tools and online learning platforms. The orientation sessions familiarize learners with:

- Grammar correction tools
- Online writing activities
- Collaborative writing platforms
- Assignment submission procedures
- Multimedia learning resources

The orientation also helps reduce technological anxiety among learners who have limited prior exposure to digital educational tools.

Phase 3: Instructional Intervention

The experimental group undergoes technology-assisted writing instruction for twelve weeks. The instructional activities include:

- Multimedia-based writing exercises
- Online collaborative tasks
- AI-assisted grammar correction activities
- Vocabulary-building exercises
- Guided paragraph writing
- Essay development tasks
- Peer-review activities using digital platforms

The learners receive immediate feedback through digital applications and teacher guidance.

The control group, on the other hand, receives traditional writing

instruction through lectures, textbook exercises, and classroom assignments without the use of digital tools.

Phase 4: Observation and Monitoring

During the intervention period, continuous classroom observation is carried out to monitor learner engagement, participation, and interaction levels. Faculty members also maintain reflective teaching notes regarding learners' progress and challenges.

Phase 5: Post-Test Administration

At the end of the instructional period, both groups are administered a post-test similar to the pre-test. The post-test measures improvements in writing proficiency and evaluates the effectiveness of the digital instructional intervention.

Phase 6: Questionnaire and Interviews

After the post-test, questionnaires are distributed among the participants to collect feedback regarding their learning experiences. Interviews are also conducted with selected students and faculty members for qualitative analysis.

4.7. Data Analysis

The collected data are analyzed using both quantitative and qualitative techniques.

4.7.1. Quantitative Analysis

The quantitative data obtained from pre-tests, post-tests, and questionnaires are analyzed using statistical methods.

The following statistical tools are used:

1. Mean
2. Standard Deviation
3. Percentage Analysis
4. Paired t-test
5. Independent Sample t-test
6. Analysis of Variance (ANOVA)

The statistical analysis helps determine whether there is a significant improvement in learners' writing proficiency after the digital instructional intervention.

4.7.2. Qualitative Analysis

The qualitative data obtained from interviews, classroom observations, and open-ended questionnaire responses are analyzed through thematic analysis. The responses are categorized into themes such as:

- Learner confidence
- Digital accessibility
- Writing improvement
- Motivation and engagement
- Challenges in technology usage
- Collaborative learning experiences

The qualitative findings provide deeper insights into learners' perceptions and experiences regarding digital inclusivity and second language acquisition.

4.8. Reliability and Validity

To ensure reliability and validity, the study employs standardized testing procedures and expert validation techniques.

- The questionnaire items are reviewed by language education experts and educational technologists.
- Cronbach's Alpha is used to measure the reliability of the questionnaire.
- Inter-rater reliability is maintained during writing assessment evaluation.
- Content validity is ensured through expert review and pilot testing.

These measures help maintain the credibility and consistency of the research findings.

4.9. Ethical Considerations

The study follows ethical research practices throughout the investigation.

1. Informed consent is obtained from all participants.
2. Participation in the study is voluntary.
3. Confidentiality and anonymity of participants are maintained.
4. The collected data are used strictly for academic research purposes.
5. Participants are informed about the objectives and procedures of the study.

The study ensures that learners are not exposed to any psychological or academic disadvantage during the research process.

4.10. Scope of the Study

The study focuses specifically on English writing skill development among first-generation and multilingual learners in engineering colleges. The research is limited to selected institutions in Tamil Nadu and emphasizes technology-assisted instructional practices related to writing proficiency. The findings may contribute to improving inclusive language education practices in higher education contexts.

The methodology of the present study adopts a comprehensive mixed-method empirical framework to examine the effectiveness of digital writing skill training devices in second language acquisition. By integrating quantitative and qualitative research techniques, the study investigates how digitally inclusive pedagogical practices influence English writing proficiency, learner engagement, and academic participation among first-generation and multilingual learners. The use of technology-assisted instructional methods, structured intervention procedures, statistical analysis, and thematic interpretation enables the study to provide reliable and meaningful insights into the role of digital inclusivity in contemporary language education.

5.RESULTS AND ANALYSIS

The present study investigated the impact of digital inclusivity and English

writing skill training devices on the second language acquisition process among first-generation and multilingual learners studying in engineering colleges. The analysis was carried out using quantitative and qualitative data collected through pre-tests, post-tests, questionnaires, classroom observations, and interviews. The study specifically examined whether technology-assisted instructional methods improved learners' English writing proficiency, confidence, engagement, and participation when compared with traditional instructional approaches.

The findings of the study indicate that digital writing skill training devices significantly enhanced learners' writing performance, grammatical accuracy, vocabulary usage, coherence, and confidence in English communication. The results further demonstrate that digitally inclusive pedagogical practices positively influenced multilingual learners and first-generation students who initially experienced difficulties in English writing.

5.1. Analysis of Pre-Test Scores

The pre-test was conducted to identify the initial English writing proficiency levels of the experimental and control groups before the instructional intervention. The test assessed grammar, vocabulary, sentence formation, coherence, organization, and writing fluency.

Table 1**Pre-Test Mean Scores of Experimental and Control Groups**

Group	Number of Students	Mean Score	Standard Deviation
Experimental Group	120	41.82	6.45
Control Group	120	42.16	6.29

The above table indicates that both groups possessed nearly equal levels of English writing proficiency before the intervention. The mean score of the experimental group was 41.82, while the control group obtained a mean score of 42.16. The difference between the groups was statistically insignificant, indicating that both groups were academically comparable at the beginning of the study.

The findings reveal that most learners had difficulties related to sentence construction, grammar usage, vocabulary selection, and writing organization. Many

first-generation learners lacked confidence in expressing ideas in English due to limited exposure to communicative language environments. Similarly, multilingual learners frequently demonstrated interference from their mother tongue while constructing English sentences.

5.2. Analysis of Post-Test Scores

After twelve weeks of instructional intervention, a post-test was administered to evaluate the impact of digital writing skill training devices on learners' writing proficiency.

Table 2**Post-Test Mean Scores of Experimental and Control Groups**

Group	Number of Students	Mean Score	Standard Deviation
Experimental Group	120	78.64	5.12
Control Group	120	57.28	6.04

The post-test results reveal a remarkable improvement in the performance of the experimental group. The mean score increased from 41.82 to 78.64 after the digital instructional intervention. In

contrast, the control group showed only moderate improvement from 42.16 to 57.28 through conventional instructional methods.

The findings clearly indicate that technology-assisted writing instruction significantly enhanced learners' English writing proficiency. The learners in the experimental group demonstrated improved grammatical accuracy, better vocabulary usage, enhanced sentence organization, and greater coherence in writing tasks.

The reduced standard deviation in the experimental group further indicates

consistency in learner performance, suggesting that digitally inclusive instructional practices benefited learners across varying proficiency levels.

5.3. Comparative Analysis of Writing Components

The study further analyzed learners' performance in specific writing components such as grammar, vocabulary, sentence formation, coherence, and organization.

Table 3

Component-wise Improvement in Writing Skills (Experimental Group)

Writing Component	Pre-Test Mean	Post-Test Mean	Improvement Percentage
Grammar Accuracy	8.12	15.84	48%
Vocabulary Usage	7.45	14.92	50%
Sentence Formation	8.26	15.36	46%
Coherence & Cohesion	9.10	16.12	44%
Organization of Ideas	8.89	16.40	46%

The above table demonstrates substantial improvement in all writing components after exposure to digital writing tools. Vocabulary usage showed the highest improvement percentage (50%), followed by grammar accuracy (48%).

The improvement in vocabulary development can be attributed to AI-assisted writing tools and digital vocabulary enhancement applications that provided contextual suggestions and synonym

recommendations. Learners were able to identify appropriate word choices and improve lexical diversity in their writing.

Similarly, grammar correction tools such as Grammarly helped learners recognize and correct grammatical errors independently. The immediate feedback mechanisms available in digital platforms enabled students to revise their mistakes repeatedly, thereby strengthening grammatical understanding.

The enhancement in coherence and organization reflects the effectiveness of collaborative writing activities and guided multimedia instructional tasks that encouraged learners to structure their ideas logically.

Learner engagement was examined through questionnaire responses and classroom observation. The questionnaire measured students' attitudes toward digital learning environments using a five-point Likert scale.

5.4. Analysis of Learner Engagement

Table 4

Learner Engagement and Attitude toward Digital Learning

Statements	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)
Digital tools improved my writing confidence	58	32	6	3	1
Multimedia learning made writing interesting	62	28	5	3	2
AI-assisted tools helped identify errors easily	66	24	5	3	2
Online collaborative writing improved learning	54	31	8	5	2
Technology reduced my fear of writing in English	61	27	6	4	2

The findings reveal that learners responded positively toward digitally inclusive instructional methods. More than 90% of the participants agreed that digital writing tools improved their confidence and made language learning more engaging.

Many learners reported that traditional classroom environments often created anxiety during writing activities because they feared making mistakes in

front of peers. However, digital learning platforms provided a supportive environment where learners could revise their writing privately and repeatedly.

The results also indicate that multimedia learning activities increased learners' motivation and participation levels. Visual aids, interactive exercises, and collaborative writing platforms created an active learning atmosphere that

encouraged students to engage more confidently in writing tasks.

5.5. Impact on First-Generation Learners

Table 5

Improvement among First-Generation Learners

Category	Pre-Test Mean	Post-Test Mean	Improvement
First-Generation Learners	39.54	76.12	Significant
Non-First-Generation Learners	44.18	80.06	Moderate

The table reveals that first-generation learners demonstrated considerable improvement after exposure to digital instructional tools. Initially, many first-generation learners struggled with basic writing tasks due to limited educational support and inadequate exposure to English communication environments.

The digital platforms helped these learners practice writing independently outside classroom hours. Mobile-assisted language learning applications allowed

One of the major objectives of the study was to examine how digital inclusivity supports first-generation learners in second language acquisition.

them to engage in self-paced learning without fear of criticism or embarrassment.

The findings indicate that digitally inclusive instructional practices can reduce educational inequalities by providing accessible learning opportunities to socially and economically disadvantaged learners.

5.6. Analysis of Multilingual Learners' Performance

The study also examined the impact of digital instructional methods on multilingual learners.

Table 6

Writing Performance of Multilingual Learners

Skill Area	Pre-Test Score	Post-Test Score
Vocabulary Usage	7.18	14.86
Sentence Construction	8.02	15.42
Writing Fluency	7.64	14.95
Grammatical Accuracy	8.10	15.36

The findings reveal significant improvement in all language skill areas

among multilingual learners. Technology-assisted instruction enabled learners to

connect their prior linguistic knowledge with English learning processes.

Several learners reported that digital tools reduced language anxiety because many applications provided multilingual support and contextual explanations. Collaborative online writing tasks also encouraged peer interaction, which helped learners improve communication confidence.

The findings suggest that digitally inclusive language learning environments support multilingual learners by accommodating diverse linguistic backgrounds and learning styles.

5.7. Classroom Observation Analysis

Classroom observations conducted during the intervention period revealed increased learner participation and collaborative interaction in the experimental group.

The following behavioral changes were observed:

- Increased willingness to participate in writing activities
- Improved peer collaboration during online writing tasks
- Higher levels of learner confidence
- Greater enthusiasm toward multimedia activities
- Increased independent learning behavior

Unlike traditional classrooms where only a few students actively participated,

digital learning environments encouraged broader learner involvement. Many students who were previously hesitant to speak or write in English became more active participants during collaborative online activities.

The use of AI-assisted feedback tools also encouraged learners to revise their writing multiple times before submission, leading to noticeable improvement in writing quality.

5.8. Interview Analysis

The interview responses provided valuable qualitative insights into learners' experiences with digital language learning.

Major Themes Identified

a) Increased Confidence

Many students stated that digital platforms reduced fear and hesitation associated with English writing. The opportunity to edit and revise writing independently increased learner confidence.

b) Accessibility and Flexibility

Learners appreciated the flexibility offered by mobile-assisted learning applications. Several participants from rural areas mentioned that mobile devices enabled them to practice writing even outside classroom settings.

c) Immediate Feedback

Students found automated feedback systems highly beneficial because they could identify grammatical and vocabulary

errors instantly without waiting for teacher correction.

d) Collaborative Learning

Online collaborative writing activities helped learners exchange ideas and improve communication skills through peer interaction.

e) Technological Challenges

Some learners initially faced difficulties related to internet connectivity

and unfamiliarity with digital platforms. However, orientation sessions and continuous support helped them adapt gradually.

5.9. Statistical Analysis

A paired t-test was conducted to determine the significance of improvement in writing proficiency.

Table 7

Paired t-Test Analysis of Experimental Group

Variable	Mean Difference	t-value	Significance Level
Writing Proficiency	36.82	14.62	Significant at 0.05 level

The obtained t-value indicates that the improvement in the experimental group was statistically significant. Therefore, the null hypothesis was rejected, confirming that digital writing skill training devices positively influenced second language acquisition.

5.10. Discussion of Findings

The findings of the study strongly support the effectiveness of digitally inclusive pedagogical practices in enhancing English writing proficiency among first-generation and multilingual learners. The results align with recent studies in Computer-Assisted Language Learning (CALL), AI-assisted language

learning, and multimedia pedagogy, which emphasize the role of interactive technologies in improving language acquisition.

The study demonstrates that technology-assisted instructional methods provide personalized, flexible, and learner-centered educational experiences. Digital writing tools create supportive learning environments where learners can practice independently, receive immediate feedback, and improve language proficiency through repeated interaction.

The findings also highlight the importance of digital inclusivity in reducing educational inequalities. First-generation

learners and multilingual students benefited significantly from accessible learning technologies that enabled self-paced and collaborative learning opportunities.

Moreover, the integration of multimedia learning activities enhanced learner motivation, engagement, and confidence. The use of AI-assisted grammar correction systems, collaborative writing platforms, and multimedia instructional resources contributed to meaningful language learning experiences.

The results and analysis of the study clearly indicate that digital writing skill training devices positively influence second language acquisition among first-generation and multilingual learners. Technology-assisted instructional methods significantly improved learners' writing proficiency, grammar usage, vocabulary development, sentence construction, coherence, and learner confidence.

The study further establishes that digitally inclusive educational practices create equitable learning opportunities for linguistically diverse learners in higher education contexts. The findings emphasize the need for integrating technology-assisted language instruction into engineering education to support inclusive and effective English language learning.

6. CONCLUSION

The present study, titled "*Digital Inclusivity and Second Language*

Acquisition: An Empirical Investigation of English Writing Skill Training Devices for First-Generation and Multilingual Learners," explored the relationship between digitally inclusive pedagogical practices and the development of English writing proficiency among engineering students from linguistically and socio-economically diverse backgrounds. The study was conducted with a particular focus on first-generation learners and multilingual learners who often encounter academic, linguistic, and technological barriers in higher education environments. Through a systematic empirical investigation involving pre-tests, post-tests, questionnaires, classroom observations, and interviews, the study examined the effectiveness of digital writing skill training devices in enhancing second language acquisition.

The findings of the study clearly demonstrate that digital technologies play a transformative role in English language learning, particularly in the area of writing skill development. The integration of AI-assisted grammar tools, multimedia instructional resources, collaborative writing platforms, and mobile-assisted learning applications significantly improved learners' writing proficiency. The participants in the experimental group showed considerable progress in grammar accuracy, vocabulary usage, sentence

formation, coherence, organization, and writing fluency when compared with learners exposed only to conventional instructional methods. The statistical analysis further confirmed that the improvement achieved through technology-assisted instructional practices was significant and meaningful.

One of the most important conclusions emerging from the study is that digital inclusivity can function as a powerful educational equalizer. Traditionally, learners from rural, multilingual, and economically disadvantaged backgrounds have experienced difficulties in acquiring proficiency in English due to limited exposure, lack of educational support, and restricted access to language-rich environments. First-generation learners, in particular, often face additional challenges because they may not receive academic guidance or communicative support within their family environment. The study found that digitally inclusive learning environments provided these learners with opportunities for self-paced learning, independent practice, repeated revision, and collaborative engagement, thereby reducing many of the barriers associated with second language learning.

The research also established that multilingual learners benefit significantly from technology-assisted language learning

environments. In multilingual educational contexts, learners constantly negotiate between multiple linguistic systems while attempting to acquire proficiency in English. Digital tools that provide contextual support, multilingual accessibility, and immediate feedback help learners bridge the gap between their existing linguistic knowledge and target language acquisition. The findings indicate that learners became more confident in expressing their ideas in English after continuous interaction with digital writing platforms. The use of multimedia resources and AI-assisted applications enabled learners to improve vocabulary selection, sentence structure, and coherence without the fear of immediate classroom criticism or embarrassment.

Another significant conclusion of the study relates to learner motivation and engagement. Traditional teacher-centered instructional methods often limit active participation, especially among learners who lack confidence in English communication. In contrast, digitally mediated instructional practices created interactive and learner-centered educational environments that encouraged participation and collaboration. The multimedia activities, online collaborative writing tasks, peer-review systems, and AI-assisted feedback mechanisms increased learner interest and sustained engagement

throughout the instructional period. Students reported that digital learning environments made writing activities more interesting, flexible, and accessible than conventional classroom practices.

The study further highlights the pedagogical importance of immediate feedback in second language acquisition. Writing is a complex cognitive process that requires continuous revision and error correction. In traditional classrooms, learners may not receive sufficient individualized feedback due to large class sizes and time limitations. Digital writing tools addressed this challenge by offering real-time correction and personalized suggestions related to grammar, spelling, vocabulary, and sentence organization. Such immediate feedback enabled learners to identify mistakes independently and improve their writing through repeated practice. Consequently, learners developed greater autonomy and self-confidence in academic writing tasks.

An important contribution of this research lies in its emphasis on inclusive education within technology-assisted learning environments. Digital inclusivity is not limited merely to providing technological devices or internet connectivity; it also involves ensuring equitable participation, accessibility, learner support, and pedagogical adaptation. The study found that when

learners received proper orientation and guidance regarding digital tools, they gradually overcame technological anxiety and became active participants in online learning activities. Therefore, the success of digital language learning depends not only on technological infrastructure but also on institutional support, teacher preparedness, and learner training.

The role of teachers emerged as another important factor in the study. Although digital tools significantly supported learners' writing development, effective pedagogical guidance remained essential. Teachers acted as facilitators, motivators, and mediators who guided learners in using digital platforms productively. The study suggests that educators must be trained in digitally inclusive pedagogical practices so that they can create supportive learning environments for multilingual and first-generation learners. Teachers should also adopt learner-centered and culturally responsive instructional approaches that recognize linguistic diversity as an educational strength rather than a limitation.

The study additionally highlights the growing relevance of AI-assisted educational technologies in contemporary language education. AI-powered writing tools have the potential to democratize learning opportunities by providing

individualized instruction and continuous support to learners regardless of geographical or socio-economic conditions. However, the research also recognizes the importance of balanced and ethical integration of AI technologies. Overdependence on automated systems may reduce critical thinking and independent creativity if not guided appropriately. Therefore, digital tools should complement rather than replace human instruction and pedagogical interaction.

The findings of the study have important implications for curriculum design, educational policy, and higher education practices. Engineering education increasingly demands effective communication skills alongside technical expertise. Students are expected to engage in technical writing, academic reporting, professional communication, and project documentation in English. Hence, integrating technology-assisted writing instruction into engineering curricula can significantly contribute to learners' academic success and employability. Educational institutions should therefore incorporate digitally inclusive writing programs, multimedia learning activities, and AI-supported language learning tools into English language teaching frameworks.

The study also has broader implications for educational equity and social inclusion. In many developing educational contexts, access to quality English language learning remains unequal due to socio-economic disparities and infrastructural limitations. Digitally inclusive educational strategies can help bridge these inequalities by extending learning opportunities beyond traditional classroom boundaries. Mobile-assisted language learning applications, online collaborative platforms, and multimedia instructional resources can support learners from remote and underprivileged communities by enabling flexible and accessible learning experiences.

Despite the positive outcomes, the study acknowledges certain limitations. The research was confined to selected engineering colleges in Tamil Nadu and focused primarily on writing skill development. The duration of the intervention was also limited to a specific instructional period. Therefore, future research may expand the scope by conducting longitudinal studies involving learners from different disciplines, educational levels, and geographical regions. Further investigations may also examine the impact of digital technologies on other language skills such as speaking, listening, and reading comprehension.

Future research can additionally explore the role of advanced technologies such as adaptive learning systems, virtual reality learning environments, machine learning applications, and generative AI in second language acquisition. Comparative studies between rural and urban educational institutions, as well as cross-cultural investigations involving multilingual learners from different linguistic communities, may provide deeper insights into digitally inclusive language pedagogy.

In conclusion, the study establishes that digital inclusivity and technology-assisted instructional practices have immense potential to enhance second language acquisition among first-generation and multilingual learners. English writing skill training devices create learner-centered, interactive, and accessible educational environments that support writing proficiency, confidence, autonomy, and academic participation. The findings emphasize that digitally inclusive pedagogy can reduce linguistic and educational inequalities by providing equitable opportunities for diverse learners. As higher education increasingly moves toward technology-integrated learning environments, the adoption of inclusive digital language education practices becomes essential for ensuring academic success, social mobility, and

communicative competence among learners from all sections of society.

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ETHICAL DECLARATIONS

Ethical Approval

The study was conducted in accordance with the ethical guidelines and academic research standards of higher educational institutions. The research involved only educational interventions related to English language learning and did not include any harmful or sensitive procedures.

Informed Consent

Informed consent was obtained from all the participants before conducting the study. The participants were informed about the objectives, procedures, and purpose of the research.

Voluntary Participation

Participation in the study was completely voluntary. The participants were free to withdraw from the study at any stage without any academic or personal consequences.

Confidentiality and Anonymity

The identities and personal information of the participants were kept confidential. All collected data were used strictly for academic and research purposes only.

Data Availability

The data supporting the findings of this study are available with the corresponding author and may be provided upon reasonable request for academic purposes.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this research article.

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Ms. N. Sivakami contributed to data collection, analysis, interpretation, and manuscript preparation. Dr. S. Gunasekaran supervised the research work, conceptualized the study, reviewed the manuscript, and approved the final version of the article.

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