



Utilizing ELSA Speak and Busuu apps to enhance English for professional purposes among Indian students: An Education 4.0 approach

D. SRI DHIVYA^a  

Dr. K. GURUSAMY^b  

Dr. E. BALAMURALI^c  

^{a,b}Department of English, Kalasalingam Academy of Research and Education, Kirshnankoil 626126, Tamil Nadu, India

^cSri Krishna College of Engineering and Technology, Coimbatore-641008, India

Abstract

In our modern, technology-driven, and interconnected world, providing students with strong English communication skills is essential to prepare them for the future workforce. Education 4.0 refers to the integration of advanced technologies, such as artificial intelligence (AI), virtual reality, and the Internet of Things, to enhance and personalize learning experiences in contemporary educational settings. Education 4.0 integrates these technologies to create personalized and immersive learning experiences that cater to individual needs, emphasizing critical 21st-century skills. Therefore, this study aimed to enhance professional English communication among students using the Education 4.0 applications ELSA Speak and Busuu. It employed a novel approach based on the substitution, augmentation, modification, and redefinition (SAMR) model to enhance communication effectively. The participants, selected through a stratified random sampling technique from the Virudunagar district of Tamil Nadu, India, included final year students ($N = 100$) from the arts, and science, and engineering disciplines, reflecting India's multilingual society and numerous regional languages. After a pilot study, a pre-test using a questionnaire was administered, followed by a 4-week intervention utilizing the ELSA Speak and Busuu apps, and a post-test using another questionnaire. Data analysis included paired-sample t -tests and independent sample t -tests. The results revealed a significant improvement in the participants' listening, speaking, reading, and writing skills before and after the intervention. Future recommendations include further explorations of Education 4.0 tools and techniques, and longitudinal studies to assess their sustained impact.

Keywords: Education 4.0; English as a second language; English for professional purposes; professional English communication; language learning platforms

Introduction

Industry 4.0, commonly referred to as the fourth industrial revolution, refers to the integration of automation, digitalization, and data utilization into industrial processes, aiming to enhance the efficiency and quality of production (Umachandran et al., 2018). This paradigm shift has spread beyond the industrial sectors to different fronts of the economy, even the educational domain. Thus Education 4.0 has emerged from Industry 4.0. Education 4.0 is a step in the evolution of educational models for the requirements of Industry 4.0, using new technologies and diverse methods (Moraes et al., 2023).

The primary aim of Education 4.0 is to provide students with the new essential skills and knowledge that are required to face the difficulties of Industry 4.0 in the digital world. Leaving aside the conventional approaches to education, defined by the teacher's primary role of transferring information to the learners, Education 4.0 stresses the importance of nurturing students' skills and stimulating their problem-solving abilities (Dhivya, Hariharasudan, & Nawaz, 2023). A student-centered approach tries to enhance motivation, self-development, and improvement in the quality of the students (Panneerselvam & Karthikeyan, 2021).

Education 4.0 represents a change in the education system, with a focus on approaches such as personalized learning and the prospective use of artificial intelligence (AI), virtual reality (VR), and similar resources. This shift is taking education to another level, where the students' interest is improved and where communication and learning activities are being transformed (Aleru & Saliu, 2016). Since the possession of English language skills is growing more essential in the present high-tech world, Education 4.0 has become significant for equipping English as a second language (ESL) students with key language competencies (Martín et al., 2019).

English is used worldwide in the internet, education, science, technology, medicine, business, engineering, tourism, etc., making English a lingua franca in the globalized world (Dhivya, Hariharasudan, Ragmoun, et al., 2023). In the professional field, as a medium of communication that connects different speakers all over the world, employees need to master English for professional purposes (EPP) (Hafner & Pun, 2020). Whereas EPP targets employees, professional English communication (PEC) is a subset of EPP which targets students. Mastery of PEC makes the students learn the basic set of skills for smooth communication with professional contacts, with a strong focus on communication through minimal emails, striking presentations, and successful networking (Rafafie, 2021). These skills encompass building relationships, cooperation, and the achievement of career mobility across various disciplines, including arts and sciences, engineering, law, and medicine (Torres & Zeidler, 2002). Mastery of PEC develops the competence of communicating professionally, presenting ideas confidently, and interacting with various stakeholders to solve problems, innovate, and advance professional fields.

Out of all the apps available to support Education 4.0, ELSA (English Language Speech Assistant) Speak and Busuu are some of the most popular that are used to enhance learners' professional communication skills (Winans, 2020). ELSA Speak is an application that helps improve the accent and the fluency of a speaker in English through personalized feedback and an accurate speech recognition system using AI technology (Dhivya, Hariharasudan, & Nawaz, 2023). It provides individual lessons aimed at providing the learners with fluency and confidence when speaking English. On the other hand, Busuu (a mobile app) offers detailed courses in various languages, including English, that entail various lessons, grammar exercises, writing practice, and the opportunity to exchange with native speakers or fluent users of the language that the learner is learning (Shibata, 2020). Both the apps are supported by Education 4.0, which integrates AI technology and is associated with assessing learners' various proficiency levels, proving themselves to be the most essential applications for developing PEC skills (listening,

speaking, reading, and writing). Moreover, these applications assess learning using AI-driven speech recognition during the log-in process and provide exercises tailored to the student's proficiency level. This adaptive feature ensures that learners receive personalized feedback and targeted practice, enhancing their PEC skills more effectively.

The purpose of this study stems from the desire to enhance the implementation of PEC in arts and science, and engineering students in the Virudunagar district of Tamil Nadu, India, through the Education 4.0 tools ELSA Speak and Busuu. The study used a quasi-experimental research design and analyzed the results with IBM SPSS version 21 via paired-sample *t*-tests and independent sample *t*-tests to compare the efficiency of the results regarding improvements in language proficiency. This research aimed to assess the effectiveness of these Education 4.0 tools and techniques for teaching PEC skills to the students.

Literature Review

Education 4.0

Education 4.0 integrates advanced technologies and innovative pedagogical approaches to enhance teaching and learning processes rooted in Industry 4.0 principles to prepare learners for success in a rapidly evolving knowledge-based society (Dhivya, Gurusamy, et al., 2024). Education 4.0 refers to the radical change in the educational process caused by the use of new technologies, including AI, big data, the Internet of Things and VR (Udvaros et al., 2023). This paradigm focuses on student-centered learning, where education is delivered in a way that responds to the needs, time, strengths, and preferences of the learners. It is characterized by a shift towards a more innovative, student-oriented model, which is based on the use of technologies such as learning analytics, adaptive learning environments, and intelligent tutoring systems to monitor performance and deliver personalized support (Dhivya, Hariharasudan, & Nawaz, 2023). For instance, if a student is having difficulties in understanding a given concept, an AI tutor can recommend certain exercises to solve them. Mobile applications such as Khan Academy and Duolingo are good examples of Education 4.0 apps in which AI is used for learning a language (Wijaya et al., 2020). Google Classroom, integrated with smart boards, is used in educational institutions to enhance teaching and learning experiences (Himmetoglu et al., 2020). Additionally, global cooperation between students and educators is facilitated by platforms like eTwinning, promoting international collaboration and cultural exchange (Miranda et al., 2021). Learning analytics help in shaping instructional approaches and improving interventions for learning a language. The tutoring and augmented reality (AR) apps of IBM Watson Education have redefined the way people interact with content, thus increasing their digital literacy and critical thinking skills (Kanduri and Suripeddi, 2018).

Additionally, Education 4.0 apps facilitate global collaboration by allowing students to connect and communicate with peers, experts, and other individuals from around the world through the internet, enhancing opportunities for peer learning (Dhivya, Hariharasudan, Balamurali, Dacko-Pikiewicz et al., 2023). Moreover, Education 4.0 incorporates aspects of the real world into its curriculum, thereby guiding learners towards readiness to face the challenges of contemporary workplaces by enhancing the aspects of critical thinking, creativity, and digital skills. It emphasizes digitalization, interactivity, flexibility, and lifelong learning, incorporating digital tools to enhance access to information (Fitria & Suminah, 2020). Education 4.0 fosters a culture of lifelong learning, acquiring skills for personal and professional development, as supported by the Mayer Multimedia Theory of integrating multimedia for engaging learning experiences (Mayer, 2014). It improves the process of understanding and acquiring knowledge, minimizing distraction by providing learning environments that can suit different learning styles and approaches (Abdulrahman et al., 2020).

English as a Second Language

English is critical in the contemporary world, in that it acts as the medium of communication across different areas, including business, academics, science, technology, and diplomacy (Muttaqin & Chuang, 2022). This facilitates global cooperation, sales, and the sharing of ideas, culture, and information. This is another advantage to learning English and being fluent in it as a global language (Mehrajuddin & Wani, 2022). Moreover, it is important to recognize that with the development of digital communication platforms and the globalization of economies, the role of English as a medium for international communication and information exchange has significantly increased (Walsh & Rísquez, 2020).

English is widely spoken in India and is used as a second language. English is one of the two official languages of the central government, with Hindi being the other, and it is widely used in India's educational, commercial, government and legal systems (Vilalta-Perdomo et al., 2022). This widespread use of English helps in overcoming linguistic barriers, since the nation is heir to a variety of languages. The fact that India remains one of the countries with a multilingual population presents rich data on how learners switch between languages. English is a vital necessity in higher education institutions and for career opportunities as India opens up for socioeconomic development (Shepard & Morrison, 2021). Therefore, the historical and social context of India can also shed light on the use of English as a means of breaking language barriers and promoting access. Thus, India provides an appropriate setting for analyzing the challenges of ESL education, as well as the effects of such education on communities.

In English language teaching (ELT), because English is a complex language, many different orientations of ELT have been developed, depending on the context and modes (Hasan et al., 2022). Among these, English for specific purposes (ESP) is one of the widely-recognized branches which makes the learners proficient in the language, necessary knowledge, and experience of particular domains for their specific purposes (Bojovic, 2010). ESP is a branch of English language education, which is divided into related areas that are relevant to the subjects and professions studied or practiced by the learners (Wallner & Wagner, 2016). ESP consists of more specific branches, such as English for business purposes, medical purposes, tourism purposes, and more (Hyland, 2009). ESP is divided into various subcategories, with EPP being one of them.

English for Professional Purposes

EPP is the branch of ESP that caters especially to the needs of business professionals, engineers, and teachers. The primary purpose of EPP is to foster language-learning abilities as well as to intercultural skills needed for successful interactions in the professional environment (Gavrilova & Trostina, 2014). It also defines the language skills related to professional activities such as meetings, negotiations, presentations, reports, and communication with clients and co-workers (Hariharasudan et al., 2021). Moreover, EPP is centered on competencies that may help one get a better job, such as networking, interviewing, and working in an international environment (Shepard & Morrison, 2021). Finally, EPP plays a central role in ensuring that a person is ready to face the existing and emerging routines of the global workplace, and facilitates the improvement of career prospects in the context of the globalized world (Bhatia & Bremner, 2012).

Learning EPP helps to fulfil the communication needs of persons in the workplace at different levels within the scope of various professions and disciplines (Symonenko, 2020; Demydovych & Holik, 2020). EPP offers English courses for executives in employment areas such as art, science, commerce, law, engineering, and airlines (Allam, 2016). Thus, the acquisition of language skills and applicable communication strategies like persuasion and knowledge within the learner's chosen field are crucial for professional advancement (Mahesar, et al., 2020).

Education 4.0 Language Learning Platforms

In the era of Education 4.0, English language learning apps leverage advanced technologies to offer personalized and immersive learning experiences (Van et al., 2021), contributing significantly to the global rise in digital education (Rus, 2020). The global language learning application market, valued at USD 3696.78 million in 2022, is expected to grow at a compound annual growth rate of 15.95%, reaching USD 8985.18 million by 2028 (Lytras et al., 2022). This growth is fueled by increasing smartphone penetration, demand for personalized learning, and the rising importance of English proficiency across education, business, and international communication (Habók et al., 2022).

Education 4.0 focuses on personalized language learning. Applications such as Duolingo and Babbel utilize AI to learn about the learners' ability levels and the kind of content that the learners would prefer (Fleaca & Stanciu, 2019). These apps use various forms of learning that help and modify the level of challenge in response to the users' learning progress, thus making the learning process engaging and effective (Hasan et al., 2022). Furthermore, apps incorporate social aspects to foster learning and cooperation among students, as seen in Tandem and HelloTalk, which offer language exchange and live talks by connecting individuals from different parts of the globe (Pikhart, 2020).

English language learning applications (e.g., MondlyVR) make use of virtual learning experiences including VR and AR to make the lessons more interactive, where the learner uses English in simulated real-life situations (Saidani Neffati et al., 2021). These experiences improve language acquisition as they provide contextual and cultural practice environments. From game-based teaching to videos, audio, flashcards, and an array of websites such as Anki and Quizlet, learners engage with various forms of media to enhance their vocabulary, grammar, comprehension, and usage across various learning modalities (Francisco, 2021).

ELSA Speak and Busuu

ESLA Speak and Busuu are two leading language learning applications which have assumed a crucial role in improving English among learners. ELSA Speak currently uses AI to enhance the users' pronunciation and speaking capabilities by informing them of the percentage of correct pronunciation and fluency (Dhivya, Hariharasudan, Balamurali, Athithan et al., 2024). It is especially useful for people who wish to improve their intonation and pronunciation for career and academic advancement or simply to be able to sound more professional during interviews, presentations, and other key events (Kholis, 2021). By targeting only the area of speaking, ELSA Speak equips the user with the ability to communicate effectively and professionally.

On the other hand, Busuu provides all types of language acquisition modalities, which include reading, writing, listening, and speaking (Bonfield et al., 2020). It has an organized learning format following the Common European Framework of Reference for Languages to allow learners to systematically monitor the transition from one level to another from beginner to advanced (Sophonhiranrak, 2021). Furthermore, through the Busuu platform, interactions with native speakers are encouraged, thus enabling learners to practice real-life conversations to improve their business English (Kholis, 2021). Engaging and combining the lessons with the practice, Busuu has proved to be a helpful tool to develop language skills and to prepare the learners for the challenging context of professional communication.

Problem Statement

In the following study, the authors identified a gap in the literature regarding the teaching of PEC skills using Education 4.0 and the applications ELSA Speak and Busuu. Although these applications have various features for language learning, there is no specific research on PEC

skills in areas like EPP using these apps, especially in India. Furthermore, it is also uncertain whether they are appropriate for fulfilling the needs of professionals across different disciplines or academic disciplines, thus creating a gap. Subsequent studies should analyze the design and utilization of PEC modules, such as those focusing on listening, speaking, reading, and writing (LSRW), and explore how these apps can enhance professional communication while accommodating their multifaceted responsibilities. Closing this gap can result in improved blended digital learning solutions that enable professionals to enhance their performance in the current world market.

The current study explored and applied strategies within the framework of Education 4.0 to enhance PEC skills among higher education institutions in the Virudhunagar district of Tamil Nadu, India. The following were the objectives of this study:

- Investigating the effectiveness of Education 4.0 in enhancing learners’ PEC skills;
- Assessing the productive competency of learners within the context of Education 4.0;
- Analyzing the receptive competency of learners in the framework of Education 4.0.

Hypothesis

The hypothesis framework depicted in Figure 1 outlines the core hypotheses driving this study. Since this study focused on the participants’ perceptions of Education 4.0 tools and techniques for learning PEC skills, it is important to record their views on all four LSRW skills to accurately assess the outcomes. Thus, we formulated hypotheses (H1–H5) that predict significant improvements in learners’ skills across various domains through the utilization of Education 4.0 tools. The formulated hypotheses are as follows:

- H1: The use of Education 4.0 tools leads to significant improvements in learners’ listening skills.
- H2: The use of Education 4.0 tools leads to significant improvements in learners’ speaking skills.
- H3: The use of Education 4.0 tools leads to significant improvements in learners’ reading skills.

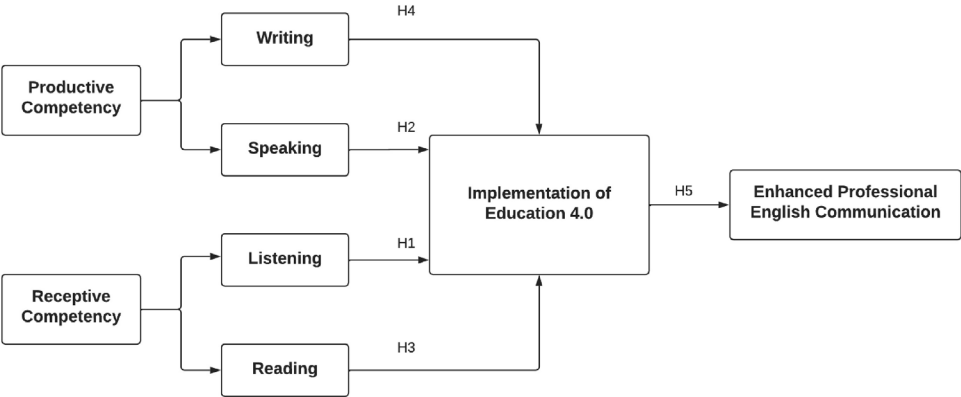


Figure 1 Hypothesis framework.

- H4: The use of Education 4.0 tools leads to significant improvements in learners’ writing skills.
- H5: The use of Education 4.0 tools leads to significant improvements in learners’ PEC skills.

Methodology

This study utilized a quasi-experimental research design. Figure 2 illustrates a schematic diagram of this study. Participants were selected from higher education institutions in the Virudhunagar district of Tamil Nadu, India, using a stratified random sampling technique from co-educational institutions, resulting in a total sample size of 100 students from arts and science, and engineering colleges. Before the main study, a pilot study was conducted on 20 students, 10 students from the arts and science disciplines, and 10 students from the engineering discipline. The pilot study data were collected offline to know the challenges faced in the process. Following the pilot study’s reliability analysis, a pre-test was designed, and data were collected using a questionnaire employing a 5-point Likert scale. The intervention phase spanned approximately 4 weeks and included an exploration of Education 4.0 applications such as ELSA Speak and Busuu. The intervention phase took approximately 4 weeks, where the students engaged in using Education 4.0 applications like ELSA Speak and Busuu. In a perception-based study, this period may be adequate for capturing changes in participants’ reported perceptions because changes normally happen rapidly when people are exposed to as well as encouraged to use new tools or ways of doing things. Given that the study focused on participants’ subjective assessments of their skills, the 4-week period may have allowed enough time for them to notice and report changes in their perceptions, thus making it adequate for capturing the initial impacts and providing valuable insights into how the intervention influences their views on skill development (Dunlosky et al., 2013. After the intervention, a post-test using a similar questionnaire format was administered. Collection and analysis of the data were conducted using IBM SPSS Statistics version 21.

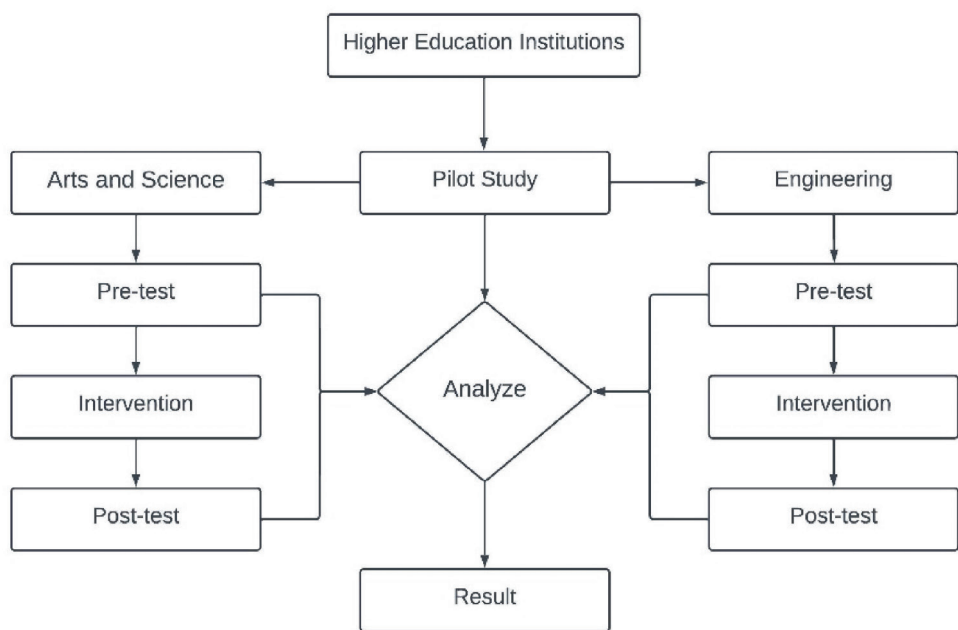


Figure 2 Schematic diagram of the study.

Participants

Having received the participants’ consent during the survey through Google Forms and clearly explaining that data must be submitted concisely, the questionnaire was launched. This made the participants aware of the various processes of the study, thus increasing the standards of the study, and also ensured that the studies complied with the recommended ethical standards in the data collection process. The sample for this study was meticulously selected using stratified random sampling with a proportional allocation method from various colleges in the Virudhunagar district of Tamil Nadu, India. Because the paper deals with issues of privacy and security, the names of the particular institutions are not provided to abide by the current ethical protocols and requirements to cover sensitive data which may pertain to endangered individuals or groups. Thus, this anonymity helps to maintain ethical standards in the research process while assisting in the enhancement of the knowledge base in the subject area. PEC is the ability to communicate effectively in English, and the participants in the study were selected by recruiting 10% of the final-year arts and science, and engineering students within the Virudhunagar district, since they are more academically inclined and ready to improve their PEC. The participants selected were 100 students, of whom 50 had a background in arts and science, and the remaining 50 had an engineering profile. The participants had been exposed to the English language for more than 15 years; therefore, the participants were considered to have intermediate English language proficiency. Moreover, the participants’ English proficiency level was also ascertained in the questionnaire alongside the demographic details. Detailed demographic information about the participants, which is essential for understanding their readiness for developing professional communication, is provided in Table 1, gathered through a dedicated section in the questionnaire.

Instruments

A custom-designed perception-based questionnaire for this study was meticulously crafted, integrating elements from reliable sources (see Appendices A and B), and was structured using Google Forms. Section A provided an overview of the study, Section B gathered demographic details, and Section C captured the participants’ perceptions using a 5-point Likert scale (ranging from 1 for “strongly disagree” to 5 for “strongly agree”). The questionnaire focused on gauging perceptions with the questions strategically organized as follows. The first five addressed PEC skills, Questions 6–9 focused on listening, Questions 10–15 on speaking, Questions 16–18 on reading, and Questions 19–20 on writing skills. All fields were mandatory to ensure comprehensive data collection. The reason for this distribution is that PEC skills and speaking are usually regarded as more important and demanding in a professional context and therefore, need more comprehensive evaluation. For listening, reading, and writing skills, which can also

Table 1 Demographic details.

Demographic category	Details
Gender	Male = 65; female = 35
Age	20–23 = 66; above 23 = 34
Region	Urban = 46; rural = 54
Mother tongue	Tamil = 66; Telegu = 14; others = 20
Designation	Arts and science = 50; engineering = 50

be claimed to require higher-order thinking ability, it may be easier to assess these with fewer questions. This weighted approach helps to provide a more accurate assessment of the most critical competencies for professional communication.

Content validation by field experts, including language educators in higher education, ensured relevance and accuracy. After a successful pilot study, we confirmed the questionnaire’s reliability, with a high Cronbach’s alpha value of .964 (Table 2).

After the pilot study, the validated questionnaire was distributed to all participants. The collected data were carefully stored for analysis. Following the intervention period, a separate post-test questionnaire was administered. Data from both the pre-test and post-test phases were analyzed rigorously using IBM SPSS version 21 to derive meaningful insights and conclusions.

Procedure

Participants were briefed about the study, and a dedicated WhatsApp group facilitated ongoing communication. The intervention, conducted entirely online with support from their final-year undergraduate personality development class, began with a baseline pre-test. Scheduled weekday webinars on Google Meet were held alternately (Monday, Wednesday, and Friday), each lasting 1 hour. Language educators from the different colleges monitored students’ participation and engagement in these sessions to ensure accountability. The intervention phase followed the substitution, augmentation, modification, and redefinition (SAMR) model of Dr. Ruben Puentedura, structuring the integration of transformative technology (Romrell et al., 2014). Figure 3 is the conceptual framework of the study based on the SAMR model.

Table 2 Reliability statistics.

Cronbach's alpha	N
.964	20

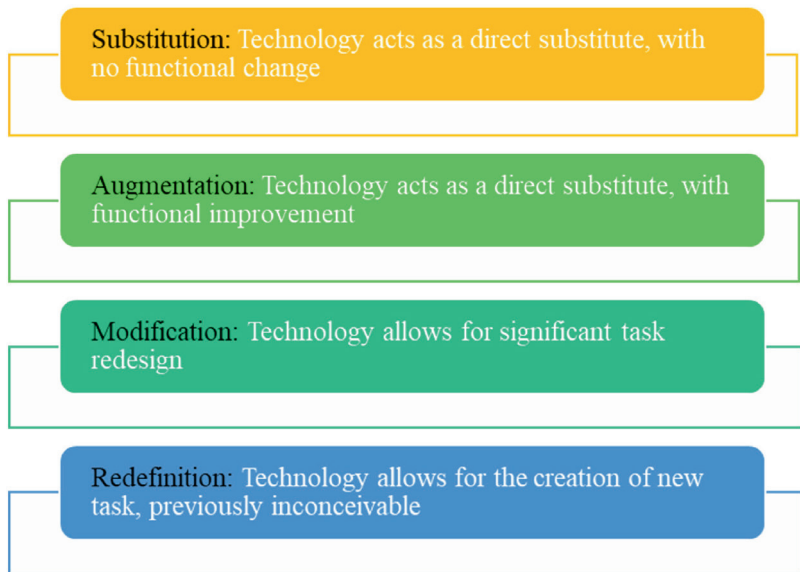


Figure 3 Conceptual framework.

The study’s design plan, detailed in Table 3, guided participants in using the ELSA Speak and Busuu applications, aligned with a pre-designed syllabus to enhance language learning. The following paragraphs provide a comprehensive description of the intervention.

Week 1 (substitution): Education 4.0 and its effects on language acquisition and usage were introduced in the first week, when the class was informed of the course expectations in general terms. They investigated some of the language learning applications, such as ELSA Speak and Busuu, among others. These tools were applied to concentrate on professional communication, which provided some background and examples regarding information technology’s current possibilities to contribute to language development. For example, ELSA Speak offered features for speech recognition for the improvement of pronunciation, whereas Busuu offered lessons on business communication.

Week 2 (augmentation): In the second week, the emphasis was on diagnostic checks of foreign language communication abilities based on activity. There were flash cards and missing letter games in order to revise the language skills of the participants. These activities were accompanied by dictionaries integrated within them to allow translations of new terms and illustrations of use. Furthermore, the participants analyzed examples of sentences and demonstrated their understanding of the rules through the formation of their own study sets (example sentences). For instance, a word on a flashcard could be a sentence with a gap in it, which the participants had to complete, when the integrated dictionary came in handy.

Week 3 (modification): In this approach, modification was considered during the third week. The participants thus went through pre-designed lessons that were expected to elicit language performance at various difficulty levels. In these lessons, the students were grouped with their counterparts, and this made them use the language practically while helping each other. For instance, a lesson might involve creating a business proposal as a group and presenting it to other groups in the class as a way of reinforcing vocabulary acquisition and usage.

Table 3 Design plan of the study.

S.no	Category	Syllabus
1	Substitution	Introduction to Education 4.0 Introduction to ELSA Speak and Busuu Introduction to professional communication
2	Augmentation	Proficiency test of the participants (ELSA Speak, Busuu) Playing games in the applications (ELSA Speak, Busuu) Using a dictionary in the applications (ELSA Speak, Busuu) Studying the study sets (ELSA Speak)
3	Modification	Learning lessons in the applications (ELSA Speak, Busuu) Collaborating with friends in the applications (ELSA Speak) Exploring different levels of words in the applications (ELSA Speak, Busuu)
4	Redefinition	Creating study sets in the application (ELSA Speak) Participating in global online projects (ELSA Speak)

Week 4 (redefinition): The fourth week made use of redefinition, thus embracing a chance for participants to harmonize their learning experience. They generated and personalized their study sessions, depending on their knowledge level and preferred topics. Speaking practice was done through the use of voices, and players were able to listen and correct their pronunciation. Furthermore, they participated in global online activities, for example, communicating with native speakers and friendship with students from different countries. This helped them to improve the learning processes and the range of bilingual students’ exposure to various linguistic and cultural environments, thus contributing positively to the development of richer linguistic skills. For instance, participants could use video calls to speak with native speakers to improve their conversation skills or work on a project with international learners to enhance their international outlook.

Following the 4-week intervention, a post-test was administered via Google Forms and was circulated in the WhatsApp group which was created at the beginning of the research to clarify any doubts and also to send any additional information. Data were rigorously analyzed using IBM SPSS version 21 for comprehensive examination and interpretation of results.

The intervention used Education 4.0 applications (ELSA Speak and Busuu). This was the factor that was introduced in the study to observe its effect. Hence Education 4.0 tools and techniques are considered as the independent variable. The participant’s perceived LSRW skills, as measured by the questionnaire on a Likert scale, reflected the participants’ self-reported perception of their English communication skills before and after the intervention. Hence, PEC skills are considered as the dependent variable.

Results

The study’s results were analyzed using paired-sample *t*-tests in SPSS to assess the improvement from before to after the intervention, providing crucial insights into the intervention’s efficacy. Additionally, an independent sample *t*-test compared the outcomes between the arts and science, and engineering colleges in the district, revealing potential differences in educational effectiveness.

Table 4 displays the means of all factors before and after the intervention period. “F” denotes the post-test values for each factor, representing assessments after intervention, such as “listening” and “F-listening.” The “Mean” column shows the total mean values: listening = 3.6145;

Table 4 Paired-samples statistics.

		Mean	N	Std. Deviation
Pair 1	Listening	3.6145	100	0.62758
	F-listening	4.1575	100	0.63530
Pair 2	Speaking	3.7168	100	0.57100
	F-speaking	4.1954	100	0.64028
Pair 3	Reading	3.6700	100	0.66529
	F-reading	4.1948	100	0.63562
Pair 4	Writing	3.6720	100	0.54496
	F-writing	4.1800	100	0.61661
Pair 5	PEC	3.4500	100	0.80560
	F-PEC	4.0550	100	0.77816

F-listening = 4.1575; speaking = 3.7168; F-speaking = 4.1954; reading = 3.6700; F-reading = 4.1948; writing = 3.6720; F-writing = 4.1800; PEC = 3.4500; F-PEC = 4.0550. *N* indicates the total number of participants (*N* = 100), and standard deviations are provided for each factor.

Table 5 illustrates the paired-sample correlations, employing Pearson’s correlation coefficient to evaluate the strength and direction of the linear relationships between pairs of factors. Correlation values play a crucial role in interpreting meaningful associations among factors, with Pearson’s correlation indicated by “*r*”. In Table 5, correlation values of –1 and 1 indicate perfectly positive and negative correlations, respectively, and correlations of .876, .704, 0.923, .721, and .871 were found for various factors. To determine the statistical significance of these correlations, the *p*-value is examined. A low *p*-value (less than .05) suggests a statistically significant correlation. Notably, Table 5 provides insights into the Pearson’s coefficients and the corresponding *p*-values. For all factors, the *p*-value was recorded as .00, signifying that the correlations are statistically significant.

Table 6 displays the paired-sample differences across all factors. The “Mean” column illustrates the mean differences between the pre- and post-tests for each specific factor, while the “Std. Deviation” column show the standard deviation for these paired-sample differences.

Table 5 Paired-sample correlations.

Factors		<i>N</i>	Correlation	Sig.
Pair 1	Listening and F-Listening	100	.876	.000
Pair 2	Speaking and F-Speaking	100	.704	.000
Pair 3	Reading and F-Reading	100	.923	.000
Pair 4	Writing and F-Writing	100	.721	.000
Pair 5	PEC and F-PEC	100	.871	.000

Table 6 Paired-sample differences.

		Paired-sample differences							
		Mean	Std. Deviation	Std. Error Mean	95% Confidence interval of the difference		<i>t</i>	d.f.	Sig. (2-tailed)
					Lower	Upper			
Pair 1	Listening and F-listening	–0.54300	0.31431	0.03143	–0.60537	–0.48063	–17.276	99	.000
Pair 2	Speaking and F-speaking	–0.47860	0.47023	0.04702	–0.57190	–0.38530	–10.178	99	.000
Pair 3	Reading and F-reading	–0.52480	0.25769	0.02577	–0.57593	–0.47367	–20.366	99	.000
Pair 4	Writing and F-writing	–0.50800	0.43893	0.04389	–0.59509	–0.42091	–11.574	99	.000
Pair 5	PEC and F-PEC	–0.60500	0.40386	0.04039	–0.68514	–0.52486	–14.980	99	.000

Table 7 Group statistics.

	Designation	N	Mean	Std. Deviation
F-listening	Arts and science	50	4.1310	0.63349
	Engineering	50	4.1840	0.64242
F-speaking	Arts and science	50	4.1475	0.57829
	Engineering	50	4.2434	0.69940
F-reading	Arts and science	50	4.1431	0.62090
	Engineering	50	4.2466	0.65215
F-writing	Arts and science	50	4.1080	0.61969
	Engineering	50	4.2520	0.61120
F-PEC	Arts and science	50	4.0700	0.77598
	Engineering	50	4.0400	0.78792

Table 8 Independent sample *t*-test.

<i>t</i> -test for equality of means										
Levene's test for equality of variances (EV)		F	Sig.	<i>t</i>	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
F-listening	EV assumed	0.002	.960	−0.415	98	.679	−0.05300	0.12759	−0.30621	0.20021
	EV not assumed			−0.415	97.981	.679	−0.05300	0.12759	−0.30621	0.20021
F-speaking	EV assumed	0.001	.981	−0.747	98	.457	−0.09593	0.12834	−0.35062	0.15876
	EV not assumed			−0.747	94.658	.457	−0.09593	0.12834	−0.35074	0.15887
F-reading	EV assumed	0.010	.922	−0.813	98	.418	−0.10353	0.12734	−0.35624	0.14917
	EV not assumed			−0.813	97.765	.418	−0.10353	0.12734	−0.35625	0.14918
F-writing	EV assumed	0.600	.441	−1.170	98	.245	−0.14400	0.12309	−0.38827	0.10027
	EV not assumed			−1.170	97.981	.245	−0.14400	0.12309	−0.38827	0.10027
F-PEC	EV assumed	0.097	.756	0.192	98	.848	0.03000	0.15639	−0.28036	0.34036
	EV not assumed			0.192	97.977	.848	0.03000	0.15639	−0.28036	0.34036

Additionally, 95% confidence intervals are provided. The *t*-value plays a crucial role in determining the statistical significance of the differences between the means of the paired samples. In Table 6, *t*-values ranging from −1 to −2 indicate significant differences. The associated *p*-values (2-tailed) were all *p* = .00 for all factors, highlighting their statistical significance.

Table 7 provides the group statistics, showing the mean values of each factor for the arts and science, and engineering students. *N* indicates the total number of participants in each group, with 50 individuals from arts and science, and 50 from engineering. In the “Mean” column, the mean values of the factors after the intervention are presented, ranging from 4.0400 to 4.2466. Standard deviations are presented for all factors across the groups, providing insights into the variability within each group’s data.

Table 8 presents the outcomes of an independent sample *t*-test, revealing the discrepancies in the mean values among each group for the factors post-intervention, including F-listening, F-speaking, F-reading, F-writing, and F-PEC. Table 8 displays the two-tailed significance alongside the mean differences. Notably, the significance values depicted in Table 8 are all greater than 0.00, indicating the absence of significant differences among the groups for all factors assessed.

Hypothesis Testing and Validation

The hypotheses were tested to assess the impact of Education 4.0 tools on improving communication skills among learners. Through a comparison of the pre- and post-test data, and an analysis of the correlations and group differences, the study aimed to evaluate the effectiveness of these tools. Ultimately, this testing yielded insights into how modern educational technology can effectively support learners’ development.

H1: The use of Education 4.0 tools leads to significant improvements in learners’ listening skills.

In the paired-sample statistics, the mean value for listening in the pre-test phase (mean = 3.61454, SD = 0.62758) is observed to be lower than the mean value for F-listening in the post-test phase (mean = 4.1575, SD = 0.63530), as shown in Table 4. Furthermore, the correlation coefficient between listening and F-listening (*r* = .876, Table 5) indicates a strong linear relationship which is below the .9 threshold. The paired-sample correlation for the pre- and post-test values of listening (Table 6) demonstrates a statistically significant *p*-value of .00, indicating a meaningful connection.

In Table 7, the group statistics reveal the mean values for F-listening in arts and science (mean = 4.1310), and engineering (mean = 4.1840). Table 8 examines the mean differences between the two groups, revealing a difference of 0.0530 for F-listening. However, the two-tailed significance value (*p*-value = .679) exceeds .000, suggesting no significant differences between the groups. Consequently, Hypothesis H1 is accepted, implying comparable outcomes for pre- and post-test listening skills among the learners.

H2: The use of Education 4.0 tools leads to significant improvements in learners’ speaking skills.

In the paired-sample statistics, the mean value for speaking in the pre-test phase (mean = 3.7168, SD = 0.57100) is observed to be lower than the mean value for F-speaking in the post-test phase (mean = 4.1954, SD = 0.64028), as shown in Table 4. Furthermore, the correlation coefficient between speaking and F-speaking (*r* = .704, Table 5) indicates a strong linear relationship just below the 0.9 threshold. The paired-sample correlation for the pre-test and post-test values for speaking (Table 6) demonstrates a statistically significant *p*-value of .00, indicating a meaningful connection.

In Table 7, the group statistics reveal the mean values for F-speaking in arts and science (mean = 4.1475), and engineering (mean = 4.2434). Table 8 examines the mean differences between the two groups, revealing a difference of 0.09593 for F-speaking. However, the two-tailed significance value (*p*-value = .457) exceeds .000, suggesting no significant differences between the groups. Consequently, Hypothesis H2 is accepted, implying comparable outcomes for the pre- and post-test speaking skills among the learners.

H3: The use of Education 4.0 tools leads to significant improvements in learners' reading skills.

In the paired-sample statistics, the mean value for reading in the pre-test phase (mean = 3.6700, SD = 0.66529) is observed to be lower than the mean value for F-reading in the post-test phase (mean = 4.1948, SD = 0.63562), as shown in Table 4. Furthermore, the correlation coefficient between reading and F-reading ($r = .923$, Table 5) indicates a strong linear relationship close to the 0.9 threshold. The paired-sample correlation for the pre-test and post-test values of reading (Table 6) demonstrates a statistically significant p -value of .00, indicating a meaningful connection.

In Table 7, the group statistics reveal the mean values for F-reading for arts and science (mean = 4.1431), and engineering (mean = 4.2466). Table 8 examines the mean differences between the two groups, revealing a difference of 0.10353 for F-reading. However, the two-tailed significance value (p -value = .418) exceeds .000, suggesting no significant differences between the groups. Consequently, Hypothesis H3 is accepted, implying comparable outcomes for the pre- and post-test reading skills among the learners.

H4: The use of Education 4.0 tools leads to significant improvements in learners' writing skills.

In the paired-sample statistics, the mean value for writing in the pre-test phase (mean = 3.6720, SD = 0.54496) is observed to be lower than the mean value for F-writing in the post-test phase (mean = 4.1800, SD = 0.61661), as shown in Table 4. Furthermore, the correlation coefficient between writing and F-writing ($r = .721$, Table 5) indicates a strong linear relationship just below the 0.9 threshold. The paired-sample correlation for the pre-test and post-test values of writing (Table 6) demonstrates a statistically significant p -value of .00, indicating a meaningful connection.

In Table 7, the group statistics reveal mean values for F-writing for arts and science (mean = 4.1080), and engineering (Mean = 4.2520). Table 8 examines the mean differences between the two groups, revealing a difference of 0.0530 for F-writing. However, the two-tailed significance value (p -value = .679) exceeds .000, suggesting no significant differences between the groups. Consequently, Hypothesis H4 is accepted, implying comparable outcomes for the pre- and post-test writing skills among the learners.

H5: The use of Education 4.0 tools leads to significant improvements in learners' PEC skills.

In the paired-sample statistics, the mean value for PEC in the pre-test phase (mean = 3.4500, SD = 0.80560) is observed to be lower than the mean value for F-PEC in the post-test phase (mean = 4.0550, SD = 0.77816), as shown in Table 4. Furthermore, the correlation coefficient between PEC and F-PEC ($r = .871$, Table 5) indicates a strong linear relationship just below the .9 threshold. The paired-sample correlation for the pre-test and post-test values of PEC (Table 6) demonstrates a statistically significant p -value of .00, indicating a meaningful connection.

In Table 7, the group statistics reveal the mean values for F-PEC for arts and science (mean = 4.0700), and engineering (mean = 4.0400). Table 8 examines the mean differences between the two groups, revealing a difference of 0.0530 for F-PEC. However, the two-tailed significance value (p -value = .679) exceeds .000, suggesting no significant differences between the groups. Consequently, Hypothesis H5 is accepted, implying comparable outcomes for the pre- and post-test PEC skills among the learners.

Figure 4 serves as a visual representation of the transformative impact of Education 4.0, revealing the nuanced changes observed across various factors. The discernible differences before and after the intervention underscore the efficacy of adopting innovative educational approaches. These findings not only validate the hypotheses but also underscore the broader

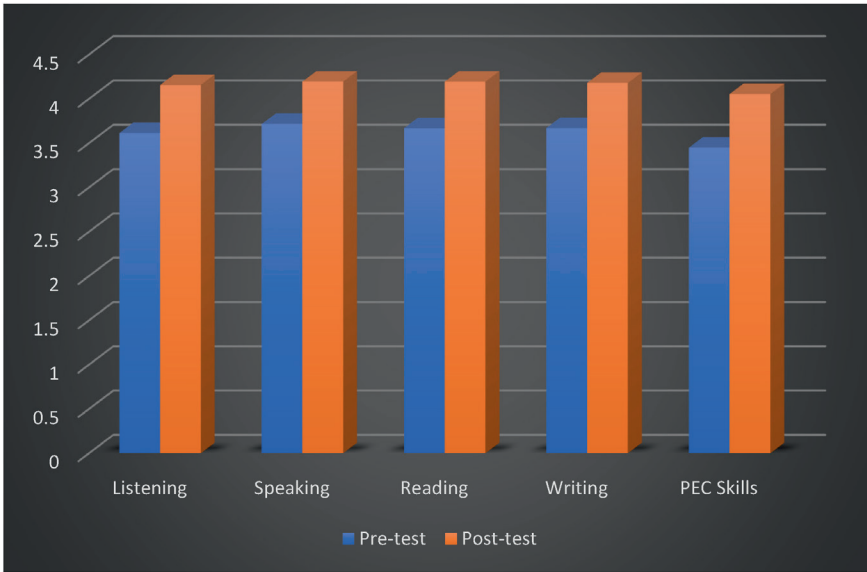


Figure 4 Mean distribution.

potential of Education 4.0 to drive meaningful improvements in skill acquisition and learning outcomes. As such, the emphasis on enhancing PEC skills underscores the alignment of educational interventions with the evolving needs of the digital age.

Discussion

Education 4.0, with its emphasis on embracing technology in education, serves as a framework for incorporating technological advancements into learning processes. Utilizing technology-integrated learning methods proves to be beneficial and efficient for both students and educators, especially in the realm of EPP. The current research focused on leveraging principles of Education 4.0 for learning PEC. ELSA Speak and Busuu are Education 4.0 tools that have emerged as a notable resource for enhancing PEC skills. Their integration within the learning process yields effective results, facilitating improved proficiency in PEC.

Table 9 compares previous research findings with the current results. Earlier studies underscored the positive impact of technology-enhanced learning activities on learners’ comprehension skills, utilizing methods such as podcasting and mobile-based learning with audio and visual media to enhance listening skills (Renukadevi, 2014). The current study aligns with these findings, confirming Education 4.0 as a powerful tool for educators that significantly enhance students’ learning experiences. The integration of gamified learning methodologies further enhances listening skills, demonstrating technology’s diverse benefits in improving language learning outcomes and fostering confidence and proficiency in real-life communication scenarios, particularly listening proficiency.

Previous research has highlighted the role of technology, such as watching YouTube and films, in improving oral communication skills among EFL learners (Torres & Zeidler, 2002). In a way, the current study also highlights and describes ways of using AI in Education 4.0 apps for learning a language. Consequently, previous studies have indicated that modern educational technologies and mobile applications, such as those designed for language learning, enhance students’ ability to communicate in English more fluently, accurately, and confidently, which,

Table 9 Comparative overview of the research outcomes.

	Hypothesis	Existing research		The outcome of the present study
		Finding	References	
H1	The use of Education 4.0 tools leads to significant improvements in learners' listening skills.	Podcasting techniques, mobile-based learning, and audio, and visual media enhance learner's listening skills.	Renukadevi (2014); Nachoua (2012).	Education 4.0 tools drive notable advancements in learners' listening skills, facilitate gamified learning experiences, and contribute to increased confidence and proficiency in real-life communication scenarios.
H2	The use of Education 4.0 tools leads to significant improvements in learners' speaking skills.	Using YouTube, modern technologies, and video conferencing fosters speaking skills.	Moreno & Vermeulen (2015); Torres & Zeidler (2002)	Speech recognition techniques in Education 4.0 applications aid in identifying areas of error and effectively correcting them.
H3	The use of Education 4.0 tools leads to significant improvements in learners' reading skills.	Computer-assisted learning and mobile technology with paper resources are used to enhance reading comprehension.	Krepel et al. (2021); Cho et al. (2021)	Education 4.0 provides cognitively demanding activity, motivates independent reading, and provides scaffolding for language development.
H4	The use of Education 4.0 tools leads to significant improvements in learners' writing skills.	EdTech tools, digital writing, and web-based learning techniques were used to enhance writing skills.	Alobaid (2020); Palese et al. (2023); Sun & Wang (2020)	Enhancing English writing and vocabulary skills among learners through collaboration with native speakers through utilization of digital tools.
H5	The use of Education 4.0 tools leads to significant improvements in learners' PEC skills.	ICT tools, online technology, and Web 2.0 tools are used to enhance communication skills.	Symonenko (2020); Allam (2016); Hafner & Pun (2020)	AI and personalized learning using Education 4.0 apps motivate students to learn regularly and confidently, thereby enhancing PEC skills.

in turn, helps reduce anxiety among students (Moreno & Vermeulen, 2015). However, similar to past research, the current study has also revealed that the speech recognition techniques in Education 4.0 apps have the potential to enable the early detection of errors and enhance the process of correcting pronunciation among learners.

An earlier study underscored computer technology's potential in analyzing reading processes, providing researchers with deeper insights into reading speed, comprehension, and cognitive strategies with enhanced precision (Harwood, 2022; Krepel et al., 2021). Building on this foundation, the current study indicates the significant impact of native speaker-curated reading materials within the ELSA Speak platform, notably improving the participants' reading skills. Additionally, previous work incorporated mobile technology alongside the conventional paper-based reading tasks to improve the level of understanding (Cho et al., 2021). On the other hand, the present study focused on Education 4.0 for the participants, showing improved personalization in terms of seeking and getting access to information through other mobile aspects such as blogs for reading. This highlights the possibility of Education 4.0 in revolutionizing reading practices, that is, providing the learners with enhanced advanced technological tools for their improved enhanced learning practices.

Prior academic discussions have pointed to the positive influence of EdTech tools in improving English writing skills, motivation, and creativity among learners (Alobaid, 2020). Likewise, the current study improved the participants' writing skills by using Educational 4.0 tools such as ELSA Speak and Busuu, which allowed the participants to communicate with native English speakers using messaging. This approach enhances learner–learner interactions and interactions with people from other geographical locations, making language learning more enjoyable. Further, studies have shown that students and teachers prefer writing in the digital environment to print media, which corresponds with the present research on the positive change in the trend with technologies such as smartphones and tablets in teaching language (Palese et al., 2023). Web-based learning technologies are equally important in writing classes, since students' needs and interests vary significantly (Sun & Wang, 2020). In the same way, applications on mobile devices like ELSA Speak and Busuu can be used to teach vocabulary skills effectively and provide students with affordable and easy-to-use ESL tools for education.

The adoption of information and communication technology tools has also raised students' academic achievement and changed the teacher's authority in the educational process (Symonenko, 2020). Similarly, the current study agrees with the aforementioned findings, since Education 4.0 tools engage students and enhance PEC skills while offering highly relevant personalized education. Previous research has highlighted parameters such as the importance of online technology in teaching English for specific purposes and improving English language proficiency among college students (Allam, 2016). On the other hand, the current research aimed to utilize Education 4.0 applications to improve PEC skills, as these recognize the dynamic needs of the learners. Prior research has described a combined effect between the use of English and thinking skills when it comes to the assessment of students' understanding of science using science, technology, engineering, and mathematics methods (Hafner & Pun, 2020). Likewise, in the current study, the SAMR model implemented with Education 4.0 tools positively contributed to the development of learners' PEC skills, as confirmed by previous studies.

In the current study, descriptive demographics were used to compare and contrast the subject's impact on improving PEC, namely Educational 4.0 tools such as ELSA and Busuu. Out of 100 participants, only 35% of them were females, while 65% of them were males; 66% of them were aged 20–23 years. Furthermore, the participants included 54% rural residents, while 46% of participants were from urban areas. Although there was an imbalance in the distribution, there was no statistically significant difference in the improvements in PEC between the chosen

demographic groups, which would have contradicted prior work (Nachoua, 2012), in which the authors claimed that AI tools in language learning provide a fair platform. This goes further to support capabilities of the platforms to address different learner contexts.

This study explored the novelty of ELSA Speak and Busuu within the context of Education 4.0, specifically targeting the refinement of PEC skills. While these applications are widely used for communication in Education 4.0, this research uniquely examined their effectiveness in enhancing PEC skills through the integration of the SAMR model. By analyzing these approaches, the study aimed to provide significant insights into educational technology and contribute to the field with its novelty.

Conclusion

The study reveals overall improvements in the LSRW and PEC skills among learners using the Education 4.0 apps ELSA Speak and Busuu. Of these tools, it is important to note that they enhance PEC skills and general communicational competence. Professionals who are proficient in English gain substantially, especially given the global undertakings in today's workplace. Education 4.0 has a significant and sustainable role in determining language learning and professional communication in the current society.

The study also suggested that to equip learners with readiness for future workforce requirements, educational organizations need to adopt advanced technologies that are relevant to the principles of Education 4.0. This entails using technology and media, and effectively handling changes in the social learning process. Governments and policymakers must work to redesign curricula towards this end, enabling students to develop suitable knowledge and skills as the economy evolves. It is advantageous to individual students and promotes workforce competitiveness and productivity while boosting socioeconomic growth and development. Consequently, subsequent studies could examine how other demographic variables, including regional affiliation, mother tongue, age, or professional aptitude, play a role in the efficiency of app-based language learning tools. Knowledge about whether large differences in learning exist among these groups could be useful in developing more effective educational interventions.

However, while the study offers valuable insights into Education 4.0 tools for enhancing PEC skills, it has limitations. The potential weaknesses include sample selection, the focus on particular software and instruments, the limited time, and environmental factors such as the learners' preferences and available resources. Furthermore, since this is a perception-based study, the results may be skewed by bias and self-interpretation. Static and dynamic recommendations for future research include exploring more tools; investigating longer-term effects; working with different learners based on characteristics like age, region, and language; comparing results; and making these beneficial tools more available.

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