ENHANCING POST-PANDEMIC EFL EDUCATION BY LEVERAGING IMMERSIVE, NLP-DRIVEN, AI-BASED TOOLS THAT PROMOTE COLLABORATION AND INTERACTIVITY WITHIN AN EDUCATIONAL APPROACH

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ABSTRACT

This paper aims to improve post-pandemic English as a Foreign Language (EFL) education by leveraging immersive, NLP-driven, AI-based tools that promote collaboration and interactivity in teaching. It is because the COVID-19 pandemic has significantly disrupted conventional language education, leading to a shift towards online instruction and requiring new language learning strategies. The study used a mixed-methods approach integrating quantitative and qualitative data collection and processing strategies to examine the effectiveness of collaborative and interactive AI-powered natural language processing (NLP) applications on EFL instruction in a post-pandemic online teaching environment. To collect data, teachers, and students at the University of Abomey-Calavi (UAC) in Benin were surveyed, interviewed, and observed during online language learning sessions. The data was analysed using both descriptive and inferential statistical methods. The study used questionnaire surveys to analyze the quantitative data and the thematic (content) analysis method to identify significant trends and themes in the qualitative data collected through semi-structured interviews and online class observations. The results revealed the advantages and disadvantages of using AI-supported collaborative and interactive language learning in EFL instruction, the learning methodologies and assessment approaches used in AI-supported online collaborative learning, the role of technology in supporting lifelong learning, and the impact of ICT teacher training on the integration of AI-supported online collaborative learning in EFL instruction. The outcomes provide new insights into the impact of AI-assisted collaborative and interactive language learning on EFL instruction and its implications for EFL teachers and students in the post-COVID-19 era.

KEYWORDS

AI-based tools, post-pandemic era, EFL education, Immersive educational system, NLP-driven technologies

1. INTRODUCTION

The advent of the COVID-19 pandemic has been disruptive to English as a Foreign Language (EFL) education, forcing traditional classroom learning to shift to online language learning. Consequently, collaborative and interactive AI-based language learning is emerging as an increasingly vital tool for EFL instruction in the post-pandemic era, as pointed out by numerous scholars (Abd-Alrazaq et al., 2020; Warschauer, 1996 & 1997).

Recent research has shown that AI-powered language learning systems offer personalized learning experiences and facilitate collaborative and interactive learning, enabling students to engage in problem-solving and participate in a more meaningful manner (Holmes et al., 2022;

McArthur et al., 2005; Ouyang & Jiao, 2021). The effectiveness of AI-powered collaborative and interactive language learning is based on three theoretical frameworks: connectivism, social constructivism, and cognitive load theory (Siemens, 2005). These frameworks suggest that language learning is a social and cultural process where learners construct their understanding of the target language by negotiating meaning. AI-based tools, such as chatbots, virtual assistants, and playful learning environments, facilitate authentic task-based interactions and provide real-time feedback from peers and teachers. Social constructivism emphasizes social interactions, while connectivism emphasizes networks and connections in learning (Siemens, 2005; Vygotsky and Cole, 1978). Cognitive load theory posits that well-designed teaching materials aid students in learning (Sweller, 1988, Sweller, Van Merrienboer, and Paas, 1998).

The context of online EFL instruction post-pandemic can gain significant benefits from AI-assisted collaborative and interactive language learning, as confirmed by recent studies (Chen, Chen, & Lin, 2020). The use of AI-supported collaborative e-learning can foster greater engagement in EFL teaching, enhance learning outcomes for EFL students, and increase teacher satisfaction (Chou and Chen, 2008; Jeong, 2019; Seo et al., 2021; Gopinathan et al., 2022). Moreover, incorporating AI-supported online collaborative learning into EFL instruction can be facilitated by teachers' professional development in ICT (Hennessy et al., 2021), empowering educators to utilize AI-powered tools effectively. Therefore, additional research is necessary to assess the effectiveness of AI-powered language learning systems in the post-pandemic context of online EFL instruction.

The present study aims to promote EFL teaching in the post-pandemic era by leveraging immersive tools using AI and NLP techniques (NLP) that promote collaboration and interactivity in a pedagogical approach. This research study developed the following research questions to provide a framework for investigating the impact of such tools:

1. How do immersive, NLP-driven, AI-based tools that promote collaboration and interactivity impact EFL teaching and learning in the post-pandemic era? What are the associated challenges, opportunities, and implications?
2. How do AI-powered collaborative e-learning methods, assessment approaches, and technology support affect EFL instruction in the post-pandemic era?
3. To what extent can professional development for EFL teachers in ICT facilitate the integration of AI-supported collaborative e-learning tools in the post-pandemic era, and what is the impact of such integration on EFL teaching and learning?

A mixed-methods approach was employed to address these questions, which involved surveys, semi-structured interviews, and observation of online language learning sessions with EFL teachers and students at the University of Abomey-Calavi (UAC) in Benin. Quantitative data were analyzed using descriptive and interpretive statistics, while the qualitative data obtained from online class observations and interviews were analyzed thematically to identify patterns and themes. The study's findings shed light on the potential of AI-based tools to promote collaboration and interactivity in EFL education in the post-pandemic era and their implications for EFL teachers and students.

2. LITERATURE REVIEW

The use of AI in language learning has gained considerable attention, particularly in collaborative and interactive approaches. The COVID-19 pandemic has heightened the demand for effective EFL methods, and immersive AI-based solutions that encourage cooperation and participation have the potential to improve EFL training in the aftermath of the epidemic significantly. This section provides a summary of the study's theoretical framework, reviewing relevant literature, identifying research questions, and highlighting lessons learned from similar studies. The central

focus of the research is to identify new approaches to improve EFL instruction by using AI-driven technologies to promote collaborative and interactive learning.

2.1. Theoretical Framework

Artificial intelligence (AI) use in language learning has grown significantly in response to the COVID-19 pandemic. AI-powered collaborative and interactive language learning tools have the potential to create a more engaging and tailored learning environment, leading to improved language proficiency outcomes. The theoretical framework underpinning the impact of AI-powered collaborative and interactive language learning on enhancing English as a Foreign Language (EFL) teaching in the post-COVID-19 era draws on several key educational theories.

Connectivism, a philosophy of learning that recognizes the power of networks and connections in creating and sharing knowledge, suggests that learners develop their personal comprehension of the target language by actively exploring and creating connections between different concepts and notions (Siemens, 2005; Goldie, 2016). Social constructivism, another educational theory, emphasizes the role of social interactions in learning and posits that acquiring knowledge is a collaborative and social endeavor involving engagement and interaction with others (Vygotsky and Cole, 1978; Lee et al., 2022). Cognitive Load Theory, a learning concept that focuses on the limitations of human working memory and how it affects learning new information, provides insight into how learners process information and suggests that instructional materials should be designed to optimize learning (Sweller, 1988; Sweller, Van Merrienboer, & Paas, 1998). Self-determination theory (SDT) suggests that motivation is critical in education. Research indicates that students are more engaged and willing to participate when they have autonomy, competence, and relatedness in their learning experiences (Deci & Ryan, 1985; Lee et al., 2022).

Furthermore, Kalina and Powell (2009, p.243) suggest that successful classroom teaching and learning rely on constructivist approaches and tools. They identify two main types of constructivism: Cognitive or individual constructivism, grounded on Piaget's (1953) notion that knowledge is formed through a self-driven process, and social constructivism, which is based on Vygotsky's (1962) theory of knowledge being built through interaction with the teacher and other students. Therefore, to be effective, teachers must be familiar with both Cognitive or individual Constructivism and Social Constructivism and apply constructivist teaching methods, strategies, tools, and practices (Kalina and Powell, 2009).

In short, an appropriate conceptual model grounded in the principles of social constructivism and self-determination theory could be utilized to comprehend the implications of incorporating AI-enabled, collaborative, and interactive language learning tools in EFL teaching in the aftermath of the COVID-19 pandemic. Additional exploration is needed to scrutinize how these crucial aspects can be reinforced through the use of AI-driven language learning tools and how they can enhance EFL education in the post-pandemic era. The objective is to elevate EFL education in the post-COVID-19 era by utilizing immersive, NLP-driven, and AI-based instruments that encourage collaboration and interactivity in an educational setting.

2.2. Consideration of other Related Work

The COVID-19 pandemic in Benin Republic has ignited advocacy for artificial intelligence (AI), as demonstrated by the successful hosting of an AI conference in January 2021 and subsequent events such as the Summer School on Artificial Intelligence (Beninwebtv, 2021 and 2022). These initiatives have prompted Benin's Council of Ministers to adopt a national AI and mega-data policy in January 2023 to leverage the potential of AI in various fields, including education,

health, agriculture, and tourism (MND, 2023). The policy aims to make Benin a leader in AI and big data by 2027 and foster innovation and training programs. Thanks to natural language processing technology, AI-based learning platforms such as Google Translate, Lingvist, Duolingo, Rosetta Stone, and Babbel have gained traction in Benin since the pandemic. According to experts (Jiang, 2022; Lee, Kim, and Park, 2022, Pokrivčáková, 2019; Abalkheel, 2022), AI can potentially increase the rate at which a foreign language is learned by emphasizing the learner's intelligence, memory, and cognitive abilities. AI encompasses various approaches, including sentiment analysis, predictive analytics, machine learning, reinforcement learning, deep learning, and supervised/unsupervised learning. These AI concepts are instrumental in AI's potential to mimic human cognitive processes and automate complex tasks. These advances in AI are transforming education and various other sectors, allowing machines to learn and grow independently and opening new possibilities beyond the limits of human capabilities. As highlighted by Whannou (2021), machine learning is a branch of data science that facilitates the optimization of systems through experiential learning without requiring explicit programming. This field has opened up exciting possibilities for collaborative and interactive learning, which are considered among the most effective methods for engaging and motivating students to learn English as a foreign language (EFL).

Drawing insights from experts in the field is crucial for gaining a deeper understanding of artificial intelligence and its foundational concepts. Schmaus (2022), an expert at Talkwalker, a company specializing in developing AI-based programs, provides a quick overview of essential AI terms to enhance knowledge in this area.

According to Schmaus (2022), artificial intelligence (AI) was first introduced at the Dartmouth Conference in 1956. It refers to computer systems that mimic human learning and problem-solving functions. Schmaus (2022) defines artificial intelligence as machines designed to learn, solve problems, and perform tasks using human mental processes as models. He argues that AI automates complex and repetitive tasks, thereby freeing humans to focus on more abstract tasks beyond a machine's capabilities. Dobrev (2012) defines AI as a technology that separates knowledge from intelligence, a program that achieves a level of performance on par with that of human capabilities in any environment. This definition is based on three assumptions: every calculation device can be modeled by a program, AI is a step device that inputs and outputs information, and AI is in an environment that provides information and is influenced by its output. Schmaus (2022) points out that Sentiment analysis combines natural language processing, computational linguistics, and textual analysis to identify and extract subjective information from content. According to the Talkwalker's expert, Predictive analytics leverages previous data to forecast future trends or outcomes through machine learning, statistics, and data mining. He argued that AI improves itself through experience or learning, and deep learning is the most advanced form. Schmaus (2022) asserted that Supervised and unsupervised learning are two methods of educating AI, with the former using human-labeled datasets and the latter allowing the AI to assign categories to the results. This AI expert also provides definitions for additional terms related to AI.

- *Digital Assistants*: These are software applications designed for smartphones, such as Siri, Google Assistant, Cortana, and Alexa. They allow users to make hands-free voice requests and operate phone functions.
- *Big Data*: This term refers to the massive amount of data generated today. It requires powerful computing capabilities and specific data-handling techniques for collection, storage, analysis, and flow.
- *Chatbots*: These are AI programs that simulate human conversation, used in various applications like customer service, messaging, and virtual assistants.

- *ChatGPT*: OpenAI's advanced natural language conversational tool can generate text using AI. It was introduced in November 2022 and represented a breakthrough in natural language processing.
- *Human-Computer Interaction*: This field of study focuses on the interaction between humans and computer technology, incorporating design, psychology, and computer science.
- *Collaborative Apps vs. Interactive Apps*: Collaborative apps are designed to facilitate communication and teamwork between users, while interactive apps offer an immersive and engaging user experience. However, the two concepts are not interchangeable.
- *Algorithm*: An algorithm is a set of predefined protocols for executing a series of actions, from simple calculations to complex data processing and the automation of repetitive tasks.
- *Speech Recognition*: This technology enables machines to understand human speech and convert it into a format that computers can read and process.
- *Artificial Neural Networks*: These are modeled after the human brain and are designed to improve machine learning systems' efficiency.
- *Robot*: A robot is a device that automates repetitive tasks.
- *Computer Learning Theory*: This discipline studies the design and analysis of machine learning algorithms.
- *Automatic Natural Language Processing* (**ANLP**): This approach uses machine learning to enable computers to understand natural language in written or spoken form.
- *Large Language Models* (**LLM**): These advanced linguistic models leverage extensive linguistic patterns to anticipate the next word in a sentence. They can perform tasks like translation, summarization, and answering questions.
- *Natural Language Processing* (**NLP**): This branch of AI focuses on enabling computers to process human language like humans do by developing algorithms and models for natural language text or speech analysis, interpretation, and generation. NLP applications include chatbots, voice assistants, language translation, sentiment analysis, and text summarization, among others, and it uses techniques from computer science, linguistics, and machine learning.

Jiang (2022) discusses the various forms of AI applications in EFL teaching and learning, including Automatic Evaluation Systems (AES), Neural Machine Translation tools (NMT), Intelligent Tutoring Systems (ITS), AI Chatting Robots (ACR), Intelligent Virtual Environments (IVE), and affective computing in ITSs. The author highlights the need for further research to explore AI technology's ethical and pedagogical implications in EFL teaching. Junaidi's (2020) study shows the effectiveness of AI in developing EFL students' speaking abilities using the Lyra Virtual Assistant (LVA) app. Pokrivčáková's (2019) research emphasises the need to prepare foreign language teachers to integrate AI into their teaching to enhance foreign language education. However, these studies also acknowledge AI technology's potential limitations and ethical concerns in language learning.

Abalkheel (2022) proposes using AI and Bloom's Taxonomy to overcome the challenges of online EFL learning in Saudi Arabia, suggesting that AI could create automated formative assessments, provide personalized feedback, and generate customized learning experiences. The study presents a framework for incorporating AI into EFL pedagogy to improve instructional effectiveness, but the study is limited to Saudi Arabia and lacks evidence of the strategy's effectiveness.

Overall, these studies provide valuable insights into the use of AI in EFL teaching and learning. However, further research is necessary to address potential limitations and validate the effectiveness of AI-based strategies. This investigation aims to fill these gaps and validate hypotheses using a rigorous investigative methodology.

2.3. Methodology

A mixed-methods research design was used in this study to investigate the impact of AI-powered collaborative and interactive language learning on EFL teaching in the post-COVID-19 era. The design included both quantitative and qualitative data collection and analysis techniques to provide a comprehensive and in-depth understanding of the topic.

The study received approval from the Institutional Review Board (IRB) of the University of Abomey-Calavi to ensure the study's ethical and responsible conduct and protect participants' privacy and rights. The research was conducted in the English Department and the Beninese Center for Foreign Languages (CE.BE.LA.E) of the University of Abomey-Calavi. A total of 30 EFL teachers and 431 students were recruited using a method of purposive sampling. Among these were 18 EFL teachers and 327 EFL learners from the English Department, and 12 EFL teachers and 104 EFL learners from the Beninese Center for Foreign Languages. All participants provided their consent to participate in the study.

As part of the study's preparation to develop collaborative and interactive learning experiences in English as a Foreign Language (EFL) instruction, a selection of one hundred AI-based programs with gamification and feedback systems was made. Ten out of thirty expert teachers involved in the project were consulted to assist in the selection process, and the two most promising programs were chosen from the following categories: AI-Powered Virtual Classrooms, AI-Powered Chatbots, AI-Powered Sentiment Analysis Tools, AI-Powered Natural Language Processing (NLP) Tools, and Deep Learning Tools. The approved programs included Classcraft, Google Classroom, Lexalytics, VADER, the Natural Language API provided by Google Cloud, and the Natural Language Understanding platform offered by IBM Watson. After a validation process conducted by a committee of teachers, these AI technologies were deemed most suitable for evaluating and implementing EFL learning in sub-Saharan Africa, specifically in Benin. However, the study used only Google Classroom and IBM Watson Natural Language Understanding tools due to budget constraints.

Two distinct groups were formed to carry out the research: the experimental group (ExpG), consisting of 327 EFL learners from the English Department and 104 from CE.BE.LA.E, and the control group (ConG), comprising 203 from the English Department and 108 from CE.BE.LA.E. The study participants were first-year students, mostly with a post-beginner level (CEFR A1-A2+). The study involved EFL face-to-face and distance learning classes, utilizing AI technology for three out of five days, while traditional teaching methods were applied for the remaining days. Both groups underwent pre-test and post-test assessments based on evaluation criteria for the Cambridge English exams, which align with the Common European Framework of Reference (CEFR) for Languages. The evaluation criteria for each skill are as follows:

- **Grammar and Vocabulary**: The ability to use grammatical constructions and vocabulary precisely and appropriately and know common idiomatic expressions.
- **Reading and Writing**: The ability to understand and produce written texts in various genres and styles, using multiple reading and writing strategies to comprehend and produce written texts.

- **Listening**: The ability to comprehend spoken English in diverse circumstances and settings, recognize principal concepts and precise details in oral materials, and follow the development of arguments and narratives.
- **Speaking**: The ability to communicate effectively in spoken English, using appropriate pronunciation, grammar, and vocabulary. Also, appropriate discourse markers and connectors are used to link ideas and maintain coherence in spoken discourse.

Learners were encouraged to attend private classes with their smartphones and computers or use those available at the Beninese Center for Foreign Languages (CE.BE.LA.E) to enhance motivation. Additionally, free internet access was provided to all participants.

During the 12-week experiment, the AI-based EFL course was implemented in both face-to-face and online classes. The experimental group received AI-based training, and the control group received regular courses. Both groups took pre-tests and post-tests based on Cambridge English exams aligned with the CEFR criteria, and the experimental group received AI-based training materials selected by 30 teachers. The experiment was conducted from September 6, 2021, to January 28, 2022, in the 2021/2022 academic year at the English department and language laboratory of the Beninese Center for Foreign Languages. Data was collected through surveys, semi-structured interviews, and observation of online language learning sessions. Statistical analysis was performed using descriptive and inferential statistics, such as T-tests and Kolmogorov-Smirnov and Shapiro-Wilk tests, using SPSS 26. The qualitative data collected from semi-structured interviews and online class observations were analyzed using Thematic Content Analysis (TCA), which is based on Anderson's 6-step procedure. The analysis involved ***Familiarising with data***, ***Identifying themes***, ***Coding data***, ***Charting codes***, ***Interpreting findings***, and ***Verifying validity***.

2.4. Results and Discussion

The outcomes of this study bear significant implications for English as a Foreign Language (EFL) educators and their students in the aftermath of the prevailing global COVID-19 pandemic. Nonetheless, to ensure the validity and credibility of the findings, it is imperative to scrutinize and verify the assumptions made thoroughly.

2.4.1. Results

The findings of this study suggest significant contributions to the development and application of AI-assisted language learning systems in EFL education. Moreover, they can help expand the body of knowledge in the field of AI-assisted collaborative and interactive language learning.

2.4.1.1. Results of the Pre-Test

The data distribution's normality was tested using the Kolmogorov-Smirnova and Shapiro-Wilk tests during the pre-test stage. Due to the sample size, the Kolmogorov-Smirnova test was deemed more suitable. The results of this test (cf. Table 1 and Graph 1) revealed that the experimental and control groups were not significantly different, with p-values of 0.320 and 0.408, respectively. According to the Kolmogorov-Smirnov test, both groups of EFL learners were found to come from a normal distribution. The Shapiro-Wilk test results, however, indicated that it was unlikely for the data from these groups to come from a normal distribution. This difference could be due to the two tests' distinct approaches to normality testing.

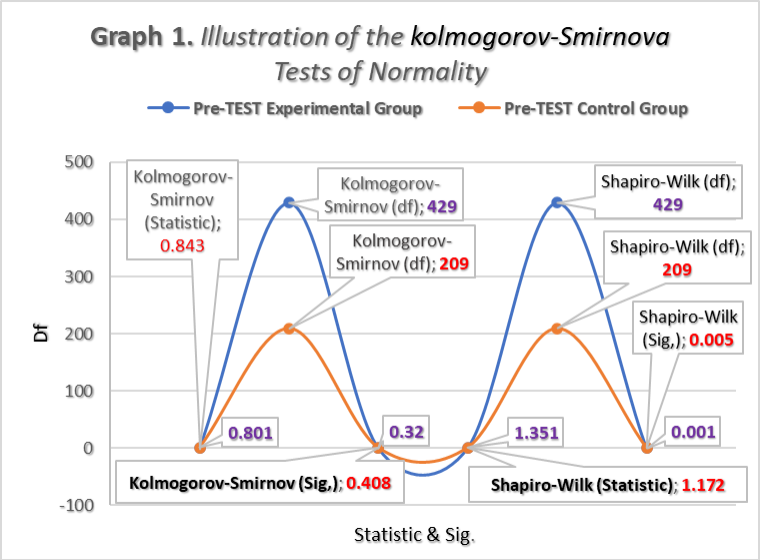


Table 1. *Kolmogorov-Smirnov[a] Tests of Normality*

EFL Learners		Kolmogorov-Smirnov (Statistic)	Kolmogorov-Smirnov (df)	Kolmogorov-Smirnov (Sig.)	Shapiro-Wilk (Statistic)	Shapiro-Wilk (df)	Shapiro-Wilk (Sig.)
Pre-TEST	Experimental Group	0.801	429	0.320	1.351	429	0.001
	Control Group	0.843	209	0.408	1.172	209	0.005

a. Lilliefors Significance Correction
b. Calculated from data

The test for homogeneity of variance (cf. Table 2) was used to compare the variances between the experimental and control groups. The results indicated that the variances between the two groups were equal, as the significance levels (Sig.) for all four test levels were greater than 0.05. Many statistical tests require equal variances, so this result is significant for ensuring that subsequent statistical tests are conducted appropriately. In contrast, unequal variances might compromise the reliability and validity of the results, and a different statistical test may be required.

Table 2. *Results of the test of Homogeneity of Variance*

		Levene Statistic	df1	df2	Sig.
Pre-TEST	Based on Mean	2.347	1	675	.612
	Based on Median	1.081	1	675	1.28
	Based on Median and with adjusted df	1.081	1	667.478	1.28
	Based on trimmed mean	1.629	1	396	.736

As the pre-test data showed a normal and homogenous distribution, a t-test was considered suitable for evaluating whether any observed disparities were statistically significant. The results of three different chi-square tests (cf. Table 3) suggest that there is no significant association between the variables of the experimental and control groups.

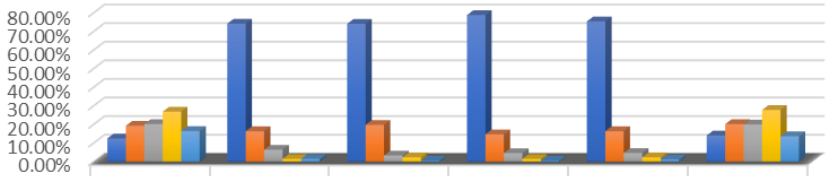
Table 3. *Results of three different Chi-Square Tests*

	Value	df	Asymptotic significance (2-sided)
Pearson Chi-Square	5.741[a]	4	.219
Likelihood Ratio	5.728	4	.220
Linear-by-Linear Association	3.593	1	.058
N of Valid Cases	690		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 13.47.

The results suggest that there is no striking correlation between the variables of the experimental and control groups.

Graph 2. ***Illustration of the Descriptive Statistics Analysis of the Major Variables Related to the Language Skills***



	Grammar	Vocabulary	Listening	Speaking	Reading	Personal Communication
Not at all Confident	12.50%	74.20%	74.10%	78.80%	75.40%	14.10%
Not very Confident	19.30%	16.40%	19.80%	14.70%	16.40%	20.20%
Somewhat Confident	20.20%	6.40%	3.30%	4.60%	4.70%	20%
Fairly Confident	26.90%	1.50%	2.30%	1.50%	2.30%	27.80%
Strongly Confident	16.50%	1.50%	0.50%	0.50%	1.20%	13.70%

Graph 2 displays descriptive statistics related to language skills, indicating that the majority of respondents (71.2% to 71.7%) are "not at all confident" in their language skills across all skills except for grammar, where the majority of respondents (54.5%) are "somewhat confident." There is a gradually increasing trend in confidence levels in grammar and personal communication skills, with most participants feeling fairly confident. However, there is no clear trend in other language skills, and most participants feel unconfident.

Notably, the statistical examination carried out on the control group produced outcomes that were in line with those obtained from the experimental group. The coherence of these findings was affirmed by cross-referencing with qualitative data obtained from a thematic content analysis of both the experimental and control groups. Furthermore, the results from the Cambridge test, presented in Table 4, corroborate the initial findings.

Figure 1. Control Group's EFL learners CEFR-based English language proficiency level

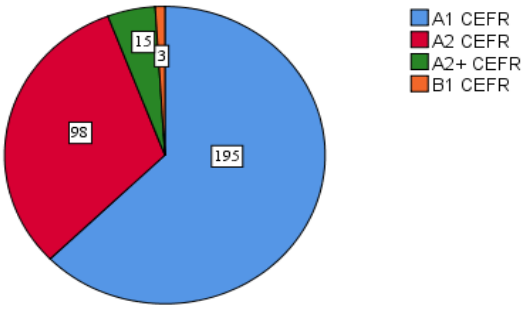


Table4. *Distribution of language proficiency levels as determined by the CEFR*

		Frequency	Percent	Valid Percent	Cumulative Percent
EFL Learners from ExpG	A1 CEFR	286	66.4	66.7	66.7
	A2 CEFR	111	25.8	25.9	92.5
	A2+CEFR	26	6.0	6.1	98.6
	B1 CEFR	6	1.4	1.4	100.0
	Total	429	99.5	100.0	
Missing	System	2	.5		
Total		431	100.0		
ExpG= Experimental Group					

Table 4 and Figure 1 display the distribution of CEFR levels (A1, A2, A2+, and B1) among two groups of EFL learners, comprising 431 participants in the Experimental Group and 311 participants in the Control Group. These participants were sampled from the English Department and CE.BE.LA.E institutions of the University of Abomey-Calavi in Benin. The data indicate that most participants (66.4% in the Experimental Group and 62.7% in the Control Group) achieved the A1 CEFR level. In contrast, only a small percentage (1.4% in the Experimental Group and 1% in the Control Group) managed to attain the B1 CEFR level. Overall, the findings suggest that the participants have a lower level of English proficiency.

Based on these results, it can be inferred that the respondents lack confidence in their language abilities, except for grammar and personal communication, where they exhibit moderate confidence. These findings imply that the respondents would benefit from additional training and support to enhance their language skills.

2.4.1.2. Results of the post-test

The Kolmogorov-Smirnov test yielded typical distribution results for the post-test data. The experimental and control groups were found to have significant levels of 0.510 and 0.302, respectively, according to the test. These values exceed the widely accepted p-value of 0.05. As shown in Graph 3 and Table 5, these findings indicate that the EFL learners' data from both groups likely originated from a normal distribution. Additionally, the homogeneity of variance test results for the post-test, presented in Table 6, suggest that the scores' dispersion in the two groups is similar, indicating that there is homogeneity in the variance between the scores of the experimental and control groups.

Graph 3. *Illustration of the* ***Kolmogorov-Smirnov*** *Tests of Normality (From the* ***Post-Test*** *Data)*

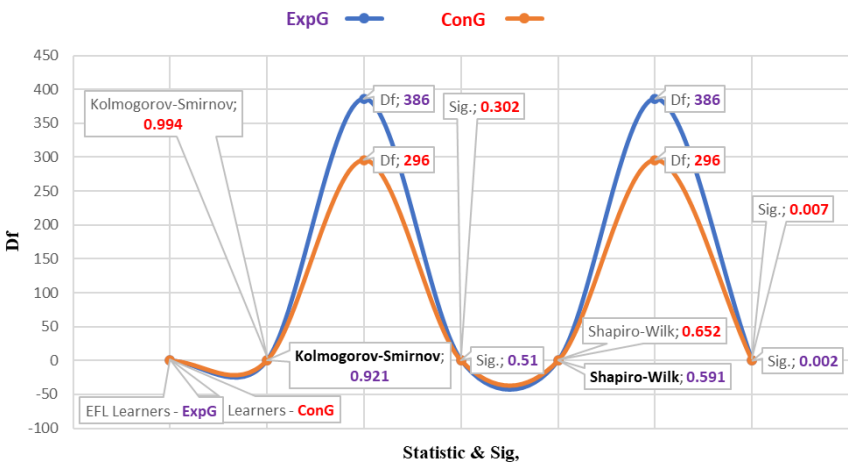


Table 5. ***Kolmogorov-Smirnov***[a] *Tests of Normality*

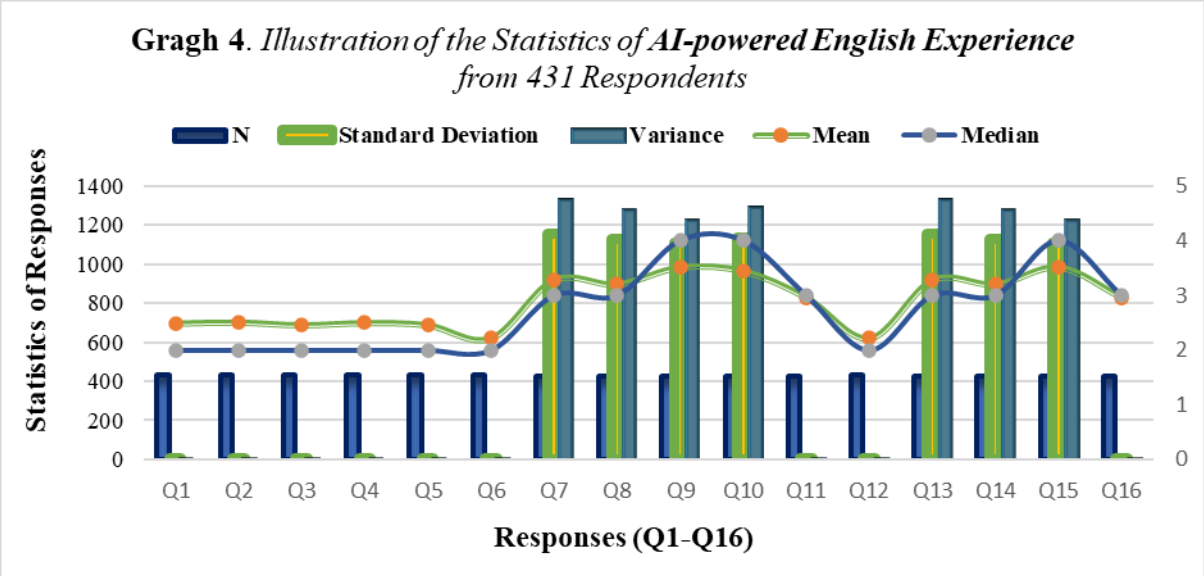
Post-TEST	ID : EFL Learners	Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistic	**Df**	**Sig.**	Statistic	df	Sig.
	Experimental Group	**.921**	**386**	**.510**	.591	386	.002
	Control Group	**.994**	**296**	**.302**	.652	296	.007
a. Lilliefors Significance Correction							
b. Calculated from data							

Table 6. *Results of the test of Homogeneity of Variance*						
		Levene Statistic	df1	df2	Sig.	The findings indicate that the p-values obtained from all four approaches exceed the significance level of 0.05. They imply that there is no substantial difference in the variances of the pre-test scores between the two groups.
Post-TEST	Based on Mean	2.047	1	707	.612	
	Based on Median	1.001	1	707	1.08	
	Based on Median and with adjusted df	1.001	1	767.478	1.08	
	Based on trimmed mean	1.329	1	707	.636	

The outcomes of three distinct Chi-Square Tests, employed to examine the degree of independence between two categorical variables, are summarised in Table 7.

Table 7. *Results of three different Chi-Square Tests*				
	Value	df	Asymptotic significance (2-sided)	Insufficient evidence exists to corroborate the notion that a correlation exists between the variables of the experimental and control groups.
Pearson Chi-Square	8.741[a]	4	.519	
Likelihood Ratio	8.728	4	.069	
Linear-by-Linear Association	2.593	1	.358	
N of Valid Cases	707			
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.89.				

The findings suggest that there is no significant statistical correlation between the variables of the experimental and control groups, as can be inferred from the analysis.



Graph 4. *Illustration of the Statistics of* ***AI-powered English Experience*** *from 431 Respondents*

Table 8. ***Data Table of AI-powered English Experience Statistics*** **from 431 Respondents**

Question	N	Mean	Median	Standard Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Maximum	Sum
Q1	431	2.49	2	0.553	0.306	0.354	0.118	-0.822	0.235	4	1075
Q2	431	2.51	2	0.574	0.33	0.45	0.118	-0.618	0.235	4	1081
Q3	431	2.46	2	0.508	0.258	0.066	0.118	-1.734	0.235	3	1059
Q4	431	2.5	2	0.562	0.316	0.391	0.118	-0.731	0.235	4	1078
Q5	431	2.46	2	0.508	0.258	0.066	0.118	-1.734	0.235	3	1059
Q6	431	2.22	2	0.84	0.706	0.303	0.118	-0.232	0.235	5	956
Q7	428	3.28	3	1.153	1.330	-0.107	0.118	-0.936	0.235	5	1403
Q8	429	3.2	3	1.131	1.279	-0.084	0.118	-0.896	0.235	5	1374
Q9	428	3.51	4	1.107	1.225	-0.415	0.118	-0.631	0.235	5	1503
Q10	428	3.44	4	1.137	1.292	-0.269	0.118	-0.85	0.235	5	1474
Q11	429	2.96	3	0.891	0.795	0.544	0.118	0.108	0.235	5	1268
Q12	431	2.22	2	0.84	0.706	0.303	0.118	-0.232	0.235	5	956
Q13	428	3.28	3	1.153	1.330	-0.107	0.118	-0.936	0.235	5	1403
Q14	429	3.2	3	1.131	1.279	-0.084	0.118	-0.896	0.235	5	1374
Q15	428	3.51	4	1.107	1.225	-0.415	0.118	-0.631	0.235	5	1503
Q16	429	2.96	3	0.891	0.795	0.544	0.118	0.108	0.235	5	1268

The research survey included 16 semi-structured questions on language learning and the influence of AI-powered tools like Google Classroom and IBM Watson on EFL learners' language skills. Statistical analysis was conducted on the data collected, including mean, median, standard deviation, variance, skewness, kurtosis, and standard error of skewness and kurtosis (Cf. Graph 4 and Table 8). The mean and median values of each question were calculated to determine the central tendency of the responses. The standard deviation and variance values were used to measure the spread of the data and the distance of individual responses from the mean. Skewness and kurtosis values were computed to assess the symmetry and peakedness of the data distribution, while the standard error of skewness and kurtosis provided an estimate of their accuracy.

The survey's mean score was 2.49 out of 5, with a standard deviation of 0.55 and a median of 2 out of 5. The results showed mixed feelings among the respondents on the effectiveness of AI-powered tools in improving English language learning. Scores in writing (3.28) and speaking (3.20) skills were higher than in reading (2.22) and listening (2.96) skills, suggesting improvement in the former and not the latter. However, it should be noted that some respondents found the tools helpful while others did not, with a maximum score of 5 and a minimum of 1.

To better understand the participants' language proficiency levels and the effectiveness of the AI-powered tools, it would be useful to compare the survey results with the results of the CEFR-based Cambridge proficiency test that the respondents took after 12 weeks of using the tools. This comparison could provide insight into whether the tools have helped improve language proficiency and if the improvements align with the CEFR levels. Such an analysis would provide a more nuanced understanding of the benefits and limitations of AI-powered tools in language learning and inform future research in this field.

Table 9. *Distribution of language proficiency levels as determined by the CEFR*

		Frequency	Percent	Valid Percent	Cumulative Percent
EFL Learners from ExpG	A1 CEFR	3	.7	.7	.7
	A2 CEFR	226	52.4	52.4	53.1
	A2+CEFR	145	33.6	33.6	86.8
	B1 CEFR	57	13.2	13.2	100.0
Total		431	100.0	100.0	

ExpG= Experimental Group

The table displays the CEFR (Common European Framework of Reference for Languages) proficiency levels of EFL learners in the experimental group (ExpG). The four CEFR levels are A1, A2, A2+, and B1. The table shows the number of participants at each level, with the largest group comprising 226 participants at the A2 CEFR level. Participants' percentage at each level is presented based on the total number and valid responses. Additionally, the table includes the cumulative percentage of participants at each level and all levels below it. These findings provide insight into the distribution of CEFR levels among EFL learners in the experimental group.

Based on the data presented in Table 9 and Figure 2, the A2 CEFR level was found to be the most common among the experimental group participants, comprising 52.4% of the group. The second most frequent CEFR level was A2+ at 33.6%, while only a small number of participants were at the A1 (7%) and B1 (13.2%) CEFR levels. These results suggest that most participants in the experimental group had a proficiency level at the A2 CEFR level or higher, indicating a relatively high level of language proficiency. The findings also indicate a diverse range of language proficiency within the experimental group, as participants were evenly distributed across various CEFR levels.

Figure2. Experimental Group's EFL Learners CEFR-based English Language Proficiency Level

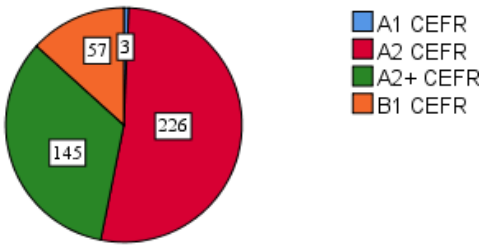
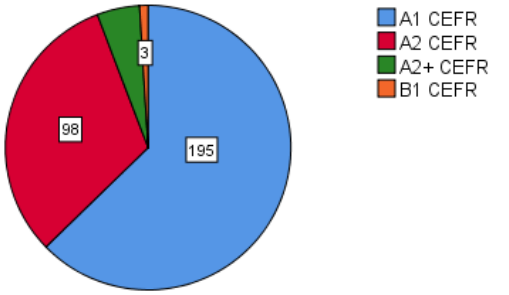


Figure3. Control Group's EFL Learners CEFR-based English Language Proficiency Level



On a scale of 1-5, with 1 being "not effective at all" and 5 being "very effective," how would you rate the effectiveness of Google Classroom AI compared to IBM Watson Natural Language Understanding in helping EFL learners improve their language skills

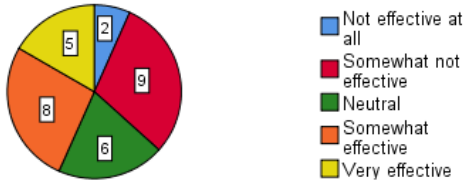


Figure 4. Statistics of EFL teachers answers to the impact of AI-powered tools on EFL learners

Upon comparing the results of both groups, it can be observed that the experimental group had a higher percentage of participants at the A2+ and B1 levels (33.6% and 13.2%, respectively) compared to the control group, which had a higher percentage of participants at the A1 level (66.7%). The control group had fewer participants at the A2+ and B1 levels (6.1% and 1.4%, respectively) than the experimental group (Cf. figure 3). This discrepancy in the distribution of CEFR levels suggests that the use of AI-powered tools positively impacted the English language proficiency of the Beninese EFL learners in the experimental group. This observation implies that the AI-powered tools may have facilitated improvement in the English language proficiency of the experimental group. Although the opinions of the 30 teachers involved in the study align with previous findings, some of them consider drawing a definite conclusion regarding the impact of AI-powered tools without additional data and analysis inconclusive.

The analysis of qualitative data provided by the respondents (Cf. figure 4) suggests that it is currently impossible to conclude which of the two AI-powered tools, Google Classroom AI or IBM Watson Natural Language Understanding, is superior. To make a definitive determination, additional data collection, analysis, and observation over a more extended period are required to comprehensively evaluate the effectiveness of each tool and determine which one is superior.

2.4.2. Discussion

The COVID-19 pandemic has brought about unprecedented challenges to the field of education, especially in teaching English as a foreign language (EFL). The conventional classroom-based approach to language learning has been disrupted, resulting in a rapid shift toward online learning. AI-powered collaborative and interactive language learning is becoming increasingly relevant in this context to enhance EFL teaching in the post-COVID-19 era. This section presents the study's results, which examined the impact of AI-powered tools such as Google Classroom AI and IBM Watson Natural Language Understanding on Beninese EFL teaching in the post-pandemic era.

The study results indicate that AI-powered collaborative and interactive language learning can enhance EFL teaching in the post-pandemic online environment. The respondents provided mixed feedback on the efficiency of AI tools in English language learning, averaging a score of 2.49 out of 5, with a standard deviation of 0.55 and a median score of 2. Nevertheless, the study demonstrates that implementing AI-assisted collaborative online learning can improve engagement in EFL instruction, enhance learning outcomes for EFL students, and increase teacher satisfaction.

The AI-powered Google Classroom and IBM Watson tools were found to have helped improve writing and speaking skills to some extent. Still, according to the respondents, they did not significantly impact reading and listening skills. However, this study found that the Cambridge Proficiency post-test results showed high scores at the A2 CEFR level (52.4%), A2+ CEFR level (33.6%), and minimal scores at the A1 CEFR level (7%), and B1 CEFR level (13.2%). This observation contrasts with the results of the pre-test, where the majority of participants were at the A1 CEFR level (66.4%), and a lower percentage were at the A2 CEFR level (25.8%) and A2+ CEFR level (6.0%), with only a small number at the B1 CEFR level (1.4%). Overall, the results indicate that most participants who used the two AI-powered collaborative and interactive language learning tools had a relatively high level of proficiency, with most of them at or above the A2 CEFR level. AI-powered tools are believed to impact Beninese EFL learners' English proficiency positively. Previous research supports the notion that collaborative and interactive AI-powered language learning can enhance EFL instruction in the post-pandemic online setting (Chen, Chen, & Lin, 2020). Therefore, the study confirms the validity of the first research assumption.

Moreover, the study's findings are further supported by the results of online class observations, which indicate that the use of AI-powered collaborative e-learning can increase student engagement, improve learning outcomes, and enhance teacher satisfaction in EFL teaching. These results are consistent with Huang, Lu, and Yang's (2023) findings and support the study's second hypothesis.

Additionally, the qualitative data collected from 30 EFL instructors highlight the importance of improving teachers' Information and Communication Technology (ICT) proficiency to integrate AI-assisted collaborative e-learning into EFL teaching effectively. The study's results suggest that providing professional development opportunities for teachers to acquire the necessary skills for using AI-enabled tools can enhance the effectiveness of EFL teaching. This finding is consistent with the third research hypothesis (Hennessy et al., 2021).

This study provides valuable insights into the impact of AI-enabled collaborative and interactive language learning on EFL education in the post-pandemic era and its implications for EFL teachers and students. These findings can potentially inform and guide future EFL teaching and learning practices.

In sum, the effectiveness of AI-powered tools in EFL learning is still being researched and debated. However, substantial evidence suggests that AI-powered tools can offer several benefits to EFL learners, including tailored feedback, real-time error correction, and gamification features that can enhance engagement and enjoyment in language learning. Additionally, AI-powered tools are highly adaptable and convenient, offering learners access to a wide range of learning materials and resources.

It is important to note that AI-powered tools are not meant to replace traditional language teaching methods but to supplement them. The most effective EFL learning programs are likely to involve a combination of human interaction and technology-based tools. Furthermore, regular evaluation and independent research are necessary to ensure the continued effectiveness of AI-powered tools and their use in promoting optimal learning outcomes for language learners.

3. CONCLUSIONS

The COVID-19 pandemic has brought about significant changes in traditional language learning, resulting in the need for online teaching and exploring innovative language education approaches. This research, conducted at the University of Abomey-Calavi in Benin, sought to evaluate the effectiveness of incorporating AI-based collaborative and interactive methods in teaching English as a foreign language (EFL) within a post-pandemic online learning context. Specifically, the study employed AI-based Google Classroom and IBM Watson Natural Language Understanding tools. This mixed-methods approach study used surveys, semi-structured interviews, and observation of online language classes to provide a comprehensive understanding of the opportunities and challenges presented by AI in EFL teaching. The study's outcomes provided insights into the most effective teaching methods, evaluation techniques, and the role of technology in EFL instruction.

Additionally, the research discusses the benefits and drawbacks of AI-based tools, specifically Google Classroom and IBM Watson Natural Language Understanding, in the context of the study. Although AI algorithms have the potential to personalize learning, automate grading and feedback, and enhance accessibility in education, they also have potential limitations. These include biases related to gender, race, or culture, reliance on human input, technical issues, slow response times, and limited customization options.

The study emphasised the importance of human interaction and personalised instruction in language learning to ensure the best possible EFL education. While AI-powered tools can enhance the learning process, they should not be seen as a substitute for human interaction and feedback. Instead, AI-powered tools should be used as a complement to human interaction and feedback, leveraging the strengths of both to achieve the best results in language education. Therefore, the study recommends that EFL teachers undergo professional development to successfully integrate AI-assisted collaborative e-learning into their teaching practice, ensuring the best outcomes for EFL students.

This research provides a fascinating look into the future of language teaching, demonstrating the vast potential of AI-assisted interactive and collaborative learning for EFL instruction. The results provide light on important questions for EFL learners and educators, equipping them to make informed decisions in the rapidly developing field of online language instruction. Moreover, this study demonstrates how the use of AI may dramatically improve language instruction, which is very timely given the current epidemic.

Future researchers should broaden the scope of their studies by including a wide variety of AI-powered tools and language learners from different cultural and competence backgrounds to continue pushing the frontiers of EFL learning and AI. Moreover, they need to investigate the effects of AI-powered tools on factors including motivation, engagement, language acquisition, and competence in EFL learning. The impact of AI on English as a foreign language (EFL) education may be better understood by doing research that combines qualitative and quantitative approaches of data collecting and analysis.

Ethical concerns with using AI in language instruction include data privacy, security, and algorithmic prejudice. Researchers can ensure AI's ethical and productive use by adopting preventative measures to lessen the impact of the dangers mentioned above. Finding the best methods to incorporate AI-powered tools into EFL instruction and maximize their effectiveness requires close collaboration between teachers, academics, and producers of educational technology. Finally, the future of language teaching may be influenced by analyzing the lasting impacts of AI on EFL learning and its potential to revolutionize language education.

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APPENDIX

Questions in the 5-Point Likert Scale Semi-Structured Questionnaire – (**Q11 to Q16 were intended for EFL teachers and Learners**)

- **Q1** How effective do you feel Google Classroom AI is in assisting with your English language learning?
- **Q2** To what extent do you feel IBM Watson's Natural Language Understanding capabilities improve your understanding of English texts and writing?
- **Q3** How helpful is Google Classroom AI in helping you practice speaking English?
- **Q4** How effective do you believe IBM Watson's Natural Language Understanding is in improving your writing skills in English?
- **Q5** To what extent have the Google Classroom AI and IBM Watson helped you become more confident in using English in everyday communication?
- **Q6** To what extent have your listening skills improved since using the AI-powered Google Classroom and IBM Watson tools?
- **Q7** To what extent have your writing skills improved since using the AI-powered Google Classroom and IBM Watson tools?
- **Q8** How much have your speaking skills improved due to using the AI-powered Google Classroom and IBM Watson tools?
- **Q9** How effective do you feel the AI-powered Google Classroom and IBM Watson tools have improved your reading skills in English?
- **Q10** To what extent have the AI-powered Google Classroom, and IBM Watson tools helped you better understand English grammar and vocabulary?
- **Q11** How effectively do you believe the Google Classroom AI and IBM Watson Natural Language Understanding tools assist EFL learners with their language skills development?
- **Q12** In your experience, to what extent have the AI-powered Google Classroom and IBM Watson tools helped EFL learners improve their listening skills?
- **Q13** How helpful are the Google Classroom AI and IBM Watson tools in improving EFL learners' speaking skills? (
- **Q14** To what extent do AI-powered Google Classroom and IBM Watson tools help EFL learners improve their reading and writing skills?
- **Q15** How would you rate the overall impact of the AI-powered Google Classroom and IBM Watson tools on the language development of EFL learners?
- **Q16** On a scale of 1-5, how effective do you rate Google Classroom AI compared to IBM Watson Natural Language Understanding in helping EFL learners improve their language skills? (**Please note that this question was optional for EFL learners but essential for EFL teachers to consider**).
- **Q17** Using a rating scale ranging from 1 to 5, where 1 denotes "not at all" and 5 being "significantly," how much do you feel your English language level has improved in the last twelve weeks?