



## Artificial Intelligence tools for enhancing English communication skills

Subir Tapaswi

Future Institute of Engineering and Management, Narendrapur, Kolkata, West Bengal, India

### Abstract

Recent developments in Artificial Intelligence (AI) have brought significant changes to the field of English language education. AI-driven tools such as automated writing assistants, conversational chatbots, speech recognition systems, and adaptive learning platforms are increasingly used to support the development of English communication skills. This paper examines the effectiveness of AI tools in enhancing listening, speaking, reading, and writing abilities among undergraduate learners. It highlights how AI facilitates personalized instruction, continuous feedback, and learner engagement. The study also discusses the educational benefits, pedagogical implications, and limitations of AI-assisted language learning. The paper concludes that AI, when integrated thoughtfully with conventional teaching practices, can substantially improve communicative competence in English.

**Keywords:** Artificial Intelligence, English communication skills, language learning technology, ELT, undergraduate education

### Introduction

In the contemporary academic and professional environment, effective English communication has become a critical skill. English functions as a global medium for education, research, technology, and employment. However, many learners struggle to achieve communicative competence due to limited exposure, a lack of individualized attention, and insufficient opportunities for practice in traditional classrooms.

The emergence of Artificial Intelligence has opened up new possibilities in English language teaching and learning. AI-based tools offer interactive environments, personalized learning paths, and immediate corrective feedback, addressing many shortcomings of conventional methods. This paper explores the role of AI tools in improving English communication skills, with particular reference to undergraduate learners in higher education.

### Observation

Based on an analytical review of existing literature, classroom experiences, and the growing use of AI-enabled language learning platforms in higher education, the following observations have been made regarding the use of AI tools for improving English communication skills among undergraduate learners:

- **Improved Learner Engagement:** It has been observed that AI-based tools significantly increase student engagement due to their interactive and user-friendly interfaces. Learners show greater willingness to practice speaking and writing when feedback is provided instantly and non-judgmentally.
- **Enhanced Speaking Confidence:** Undergraduate learners demonstrate noticeable improvement in speaking confidence when using AI-powered conversational agents and pronunciation tools. The absence of peer pressure and fear of correction encourages repeated practice.
- **Immediate and Consistent Feedback:** AI tools provide real-time feedback on grammar, pronunciation, and sentence structure, which helps learners identify

and correct errors more effectively than delayed classroom feedback.

- **Personalized Learning Experience:** AI-driven platforms adapt content according to learners' proficiency levels, learning pace, and performance. This personalization addresses individual learner needs that are often difficult to meet in traditional classroom settings.
- **Improvement in Writing Accuracy:** Regular use of AI writing assistants leads to observable improvement in grammatical accuracy, vocabulary usage, and coherence in students' written communication, particularly in academic and professional writing tasks.
- **Increased Learner Autonomy:** Students using AI tools tend to become more independent learners. They rely less on teacher intervention for minor corrections and actively engage in self-directed learning.
- **Limitations in Contextual and Emotional Understanding:** Despite their technical efficiency, AI tools are limited in their understanding of emotional nuance, cultural context, and pragmatic language use. Human guidance remains essential for developing sociolinguistic competence.
- **Need for Guided Integration:** It has been observed that the effectiveness of AI tools increases significantly when their use is guided by teachers. Unguided or excessive reliance on AI may reduce critical thinking and original language production.

### Artificial Intelligence in the Educational Context

Artificial Intelligence refers to the capability of machines to perform cognitive functions such as learning, reasoning, language processing, and decision-making. In education, AI systems are designed to analyze learner data, adapt instructional content, and simulate intelligent interaction.

In the domain of English language learning, AI applications rely on technologies such as Natural Language Processing (NLP), machine learning algorithms, speech recognition, and intelligent tutoring systems. These technologies enable computers to interpret human language and provide meaningful responses, making AI a valuable resource for developing communication skills.

**AI Tools for Enhancing English Communication Skills**

Artificial Intelligence has introduced innovative methodologies in the teaching and learning of English communication skills. AI-driven tools support the development of the four fundamental language skills—speaking, listening, reading, and writing—through adaptive learning systems, instant feedback mechanisms, and interactive practice environments. This section examines how AI tools contribute to each of these skills in undergraduate English language education.

**AI Tools for Enhancing Speaking Skills**

Artificial Intelligence (AI) has significantly transformed the landscape of language learning, especially in the development of speaking skills. Traditional speaking practice in English language classrooms often faces limitations such as a lack of individual attention, hesitation among learners, limited feedback time, and the absence of real-time correction. AI-powered tools address these gaps by offering personalized, interactive, and data-driven speaking practice environments that simulate real-life communication contexts.

**1. Role of AI in Speaking Skill Development**

- AI tools utilize technologies such as Automatic Speech Recognition (ASR), Natural Language Processing (NLP), Machine Learning (ML), and Speech Analytics to evaluate and enhance learners’ oral communication. These technologies analyze pronunciation, fluency, stress, intonation, grammar, vocabulary usage, and coherence of speech, providing immediate corrective feedback that is often not possible in conventional classrooms.
- AI systems can:
  - Detect pronunciation errors at the phoneme level
  - Analyze speaking speed and pause patterns

- Evaluate sentence structure and vocabulary richness
- Provide model pronunciation and replay options
- Simulate conversational scenarios for practice

**2. Prominent AI Tools for Speaking Practice**

**a. ELSA Speak (English Language Speech Assistant)**

- ELSA uses advanced speech recognition to identify pronunciation errors and provides instant phonetic-level feedback. It offers customized lesson plans based on learner weaknesses and tracks improvement over time.
- **Pedagogical Value:** Enhances pronunciation accuracy, stress, and intonation patterns.

**b. Google Speech-to-Text / Voice Typing**

- This tool converts spoken words into text in real time. Learners can assess how accurately their speech is recognized, which indirectly reflects clarity of pronunciation and fluency.
- **Pedagogical Value:** Self-evaluation of clarity and fluency.

**c. ChatGPT / AI Conversational Bots**

- AI chatbots simulate human-like conversations, allowing learners to practice spontaneous speaking in various contexts such as interviews, presentations, group discussions, and daily communication.
- **Pedagogical Value:** Improves confidence, coherence, and conversational ability.

**d. Microsoft Azure Speech Services**

- Provides pronunciation assessment, fluency scoring, and speech analytics through AI-driven dashboards.
- **Pedagogical Value:** Data-driven feedback for structured improvement.

**e. Orai and Speech Coach Apps**

- These apps analyze filler words, pace, clarity, and confidence in speech delivery, especially useful for presentations and public speaking.
- **Pedagogical Value:** Develops professional speaking and presentation skills.

**3. AI-Based Features That Enhance Speaking**

AI Feature	Function	Speaking Skill Improved
Speech Recognition	Converts speech to analyzable data	Pronunciation & clarity
Pronunciation Scoring	Phoneme-level accuracy check	Accent & articulation
Fluency Analysis	Measures speed, pauses, fillers	Fluency & confidence
Intonation Detection	Identifies pitch variation	Expressiveness
Conversational Simulation	Real-life dialogue practice	Communication competence
Performance Tracking	Progress reports & analytics	Self-improvement

**4. Advantages Over Traditional Speaking Practice**

- **Immediate Feedback:** Learners correct mistakes instantly.
- **Personalized Learning:** AI adapts to individual proficiency levels.
- **24/7 Practice Environment:** Removes time constraints of classroom.
- **Reduced Anxiety:** Practice without fear of judgment.
- **Objective Assessment:** Data-driven evaluation rather than subjective judgment.

- **Scalable for Large Classrooms:** Ideal for engineering colleges and language labs.

**5. Classroom and Language Lab Integration**

- AI speaking tools can be effectively integrated into language labs and communication courses through:
  - Guided pronunciation sessions
  - AI-assisted role plays
  - Mock interviews using chatbots
  - AI-evaluated presentations
  - Weekly progress tracking reports

- Teachers can use AI analytics to identify common speaking problems among students and design remedial sessions accordingly.

**6. Limitations and Considerations**

- Despite their advantages, AI tools have certain limitations:
  - Dependence on internet connectivity
  - Accent bias in some speech recognition systems
  - Lack of emotional and cultural understanding
  - Over-reliance may reduce human interaction
  - Therefore, AI should be used as a supplementary tool, not a replacement for teacher-guided speaking practice.

**AI Tools for Enhancing Listening Skills**

Listening is a foundational component of language acquisition and communicative competence. In English language learning, especially in technical and professional education contexts, learners often struggle with understanding varied accents, speech speeds, authentic dialogues, and contextual meanings. Traditional listening practice—limited to recorded audios and teacher-led activities—often lacks personalization, repetition control, and performance analytics. Artificial Intelligence (AI) addresses these limitations by offering adaptive, interactive, and analytics-driven listening environments that significantly enhance learners’ listening comprehension.

**1. Role of AI in Listening Skill Development**

- AI-powered listening tools employ Automatic Speech Recognition (ASR), Natural Language Processing (NLP), Machine Learning (ML), and audio analytics to create intelligent listening platforms. These systems can:
  - Convert speech to text for verification
  - Adjust playback speed without distortion
  - Provide accent-varied audio inputs
  - Generate comprehension questions automatically
  - Track learner responses and improvement patterns

- AI thus transforms passive listening into an active, measurable, and personalized learning process.

**2. Prominent AI Tools for Listening Practice**

**a. Google Live Transcribe / Speech-to-Text**

- These tools transcribe spoken language into text in real time. Learners can compare what they hear with the transcript, improving the accuracy of comprehension.
- Pedagogical Value:** Enhances word recognition and understanding of connected speech.

**b. YouTube Auto-Captions with AI Subtitles**

- AI-generated subtitles allow learners to listen and read simultaneously. Playback speed control helps learners process fast speech.
- Pedagogical Value:** Improves comprehension of natural speech and varied accents.

**c. TED-Ed and Podcast Platforms with AI Features**

- AI-enabled transcripts and interactive captions allow learners to follow complex talks and verify understanding.
- Pedagogical Value:** Exposure to authentic academic and professional speech.

**d. Language Learning Apps (Duolingo, Elsa, Cake)**

- These apps use AI to create listening exercises based on learner level and provide instant feedback on comprehension tasks.
- Pedagogical Value:** Adaptive listening exercises with graded difficulty.

**e. AI Chatbots with Voice Mode (e.g., conversational AI assistants)**

- Learners listen to AI-generated speech and respond, simulating real conversational listening.
- Pedagogical Value:** Develops interactive listening and response ability.

**3. AI-Based Features That Enhance Listening**

AI Feature	Function	Listening Skill Improved
Real-time Transcription	Speech-to-text comparison	Word recognition
Adjustable Playback	Control speed & replay	Processing fast speech
Accent Variation	Multiple speaker models	Accent adaptability
Interactive Subtitles	Synchronized text support	Contextual understanding
Comprehension Analytics	Performance tracking	Listening accuracy
Adaptive Difficulty	Level-based content	Progressive learning

**4. Advantages Over Traditional Listening Practice**

- Repeatability:** Unlimited replay without teacher dependency
- Personalized Pace:** Learners control speed and repetition
- Exposure to Global Accents:** AI voice databases offer varied pronunciations
- Immediate Verification:** Transcript comparison ensures correct understanding
- Data-Driven Progress Tracking:** Measures listening growth over time
- Engaging and Interactive:** Turns listening into an active task

- Caption-based listening exercises
- Transcript verification tasks
- AI-generated listening quizzes
- Accent identification practice
- Listening-to-respond activities using voice bots
- Teachers can use AI analytics to identify common comprehension issues and plan targeted interventions.

**5. Integration into Classroom and Language Lab**

- AI listening tools can be incorporated through:

**6. Limitations and Considerations**

- While effective, AI listening tools may have:
  - Occasional transcription inaccuracies
  - Over-reliance on subtitles reduces pure listening effort
  - Need for internet-enabled devices
  - Limited cultural and contextual interpretation
  - Hence, AI should complement teacher-designed listening activities.

**AI Tools for Enhancing Reading Skills**

Reading is a critical receptive skill that enables learners to decode meaning, build vocabulary, interpret context, and develop analytical thinking. In English language learning—particularly for technical and professional students—reading often involves complex texts, unfamiliar vocabulary, dense information, and varied genres. Traditional reading practice typically relies on static texts and post-reading questions, offering limited personalization and delayed feedback. Artificial Intelligence (AI) enhances reading instruction by creating interactive, adaptive, and analytics-driven reading environments that support comprehension, vocabulary growth, and critical engagement with texts.

**1. Role of AI in Reading Skill Development**

- AI-powered reading tools use Natural Language Processing (NLP), Machine Learning (ML), text analytics, and semantic processing to analyze texts and learner interactions. These systems can:
  - Simplify complex passages automatically
  - Provide instant word meanings and contextual explanations
  - Generate summaries and key points
  - Create comprehension questions dynamically
  - Track reading speed, attention, and understanding
- AI thus transforms reading from a passive decoding activity into an active, guided, and measurable learning process.

**2. Prominent AI Tools for Reading Practice**

**a. Rewordify**

- This tool simplifies difficult English texts into easier versions while

preserving meaning. Learners can compare original and simplified texts.

- **Pedagogical Value:** Supports comprehension of complex academic texts.

**b. Grammarly and AI Writing Assistants**

- While primarily writing tools, they help learners understand sentence structures, vocabulary usage, and grammatical patterns while reading.
- **Pedagogical Value:** Enhances awareness of language patterns in texts.

**c. Google Dictionary / AI-powered Reading Extensions**

- Instant definitions, synonyms, pronunciation, and usage examples while reading digital content.
- **Pedagogical Value:** Builds vocabulary and contextual understanding.

**d. ChatGPT and AI Summarizers**

- These tools generate summaries, explain paragraphs, and clarify difficult concepts from reading passages.
- **Pedagogical Value:** Aids comprehension and analytical reading.

**e. Newsela / CommonLit (AI-adaptive reading platforms)**

- Provide texts at multiple reading levels with quizzes and progress tracking.
- **Pedagogical Value:** Adaptive reading based on learner proficiency.

**3. AI-Based Features That Enhance Reading**

AI Feature	Function	Reading Skill Improved
Text Simplification	Converts complex text to a readable form	Comprehension
Instant Vocabulary Support	Word meanings in context	Vocabulary growth
AI Summarization	Extracts key ideas	Analytical reading
Adaptive Text Levels	Difficulty adjustment	Progressive learning
Auto-generated Questions	Checks understanding	Critical thinking
Reading Analytics	Tracks speed and accuracy	Reading efficiency

**4. Advantages Over Traditional Reading Practice**

- **Personalized Difficulty Level:** AI adjusts text complexity
- **Immediate Support:** No need to consult dictionaries separately
- **Interactive Engagement:** Questions and summaries during reading
- **Time Efficiency:** Faster comprehension through guided tools
- **Progress Monitoring:** Data on reading habits and improvement
- **Access to Diverse Texts:** News, academic, technical, and literary materials

**5. Integration into Classroom and Language Lab**

- AI reading tools can be integrated through:
  - Simplified versions of technical articles for beginners
  - Vocabulary enrichment exercises using AI dictionaries
  - AI-generated summaries for comprehension checks
  - Reading-to-analyze tasks using AI explanation tools
  - Timed reading exercises with analytics
- Teachers can use AI insights to identify students' reading challenges and provide targeted guidance.

**6. Limitations and Considerations**

- Despite their usefulness, AI reading tools may:
  - Encourage over-dependence on simplification
  - Reduce deep reading if summaries are overused
  - Provide contextually limited explanations
  - Require digital access and familiarity
- Hence, AI should be used to support, not replace, critical reading practices.

**AI Tools for Enhancing Writing Skills**

Writing is a productive language skill that demands control over grammar, vocabulary, coherence, cohesion, organization, and style. In English language learning—particularly in technical and professional education—students often struggle with structuring ideas, avoiding grammatical errors, maintaining academic tone, and developing clarity. Traditional writing instruction, constrained by time and delayed feedback, cannot always provide individualized guidance. Artificial Intelligence (AI) addresses these gaps through real-time feedback, linguistic analysis, and adaptive support, turning writing into an iterative, data-informed learning process.

**1. Role of AI in Writing Skill Development**

AI writing tools rely on Natural Language Processing (NLP), Machine Learning (ML), grammar engines, and semantic analysis to evaluate and improve learner writing. These systems can:

- Detect grammatical, punctuation, and spelling errors instantly
- Suggest vocabulary enhancements and collocations
- Evaluate sentence structure and readability
- Assess tone, clarity, and coherence
- Provide paraphrasing and summarization support
- Offer genre-specific writing guidance (emails, reports, essays, abstracts)

AI thus enables continuous drafting, revising, and refining—core processes in effective writing pedagogy.

**2. Prominent AI Tools for Writing Practice**

**a. Grammarly**

Provides real-time grammar correction, style suggestions, tone detection, and clarity improvements.

**Pedagogical Value:** Enhances grammatical accuracy and stylistic appropriateness.

**b. QuillBot**

Offers paraphrasing, summarizing, grammar checking, and vocabulary enhancement.

**Pedagogical Value:** Develops paraphrasing skills and lexical variety.

**c. ChatGPT and AI Writing Assistants**

Assist in idea generation, outlining, drafting, and revising across genres such as essays, reports, and research abstracts.

**Pedagogical Value:** Supports organization of ideas and coherence in writing.

**d. Hemingway Editor**

Analyzes readability, sentence complexity, and passive voice usage.

**Pedagogical Value:** Improves clarity, conciseness, and readability.

**e. Google Docs Smart Compose / Microsoft Editor**

AI-powered predictive writing and error detection are integrated into word processors.

**Pedagogical Value:** Encourages correct writing habits during drafting.

**3. AI-Based Features That Enhance Writing**

AI Feature	Function	Writing Skill Improved
Grammar & Spell Check	Error identification	Accuracy
Style & Tone Detection	Formality and clarity suggestions	Academic writing
Paraphrasing Tool	Rewriting sentences	Lexical flexibility
Readability Analysis	Sentence simplification	Clarity
Predictive Text	Writing assistance	Fluency
Coherence Suggestions	Logical flow improvement	Organization

**4. Advantages Over Traditional Writing Practice**

- **Immediate Feedback:** Instant correction during writing
- **Personalized Suggestions:** Based on individual writing patterns
- **Multiple Draft Support:** Encourages revision and editing
- **Time Efficiency for Teachers:** Reduces basic correction workload
- **Genre-Specific Guidance:** Emails, reports, essays, research writing
- **Confidence Building:** Learners write without fear of making mistakes

- Limited understanding of creative or cultural nuances

Therefore, AI should be used as a guided support system alongside teacher feedback and critical thinking practices.

**5. Integration into Classroom and Language Lab**

AI writing tools can be integrated through:

- AI-assisted essay drafting sessions
- Paraphrasing and summarization exercises
- Error-identification tasks using Grammarly reports
- Report writing practice with readability analysis
- Research abstract writing with AI feedback

**AI and Communicative Competence**

Communicative competence refers to the ability to use language effectively and appropriately in real-life contexts. It extends beyond grammatical accuracy to include sociolinguistic appropriateness, discourse management, strategic use of language, and pragmatic understanding. Rooted in the models proposed by Dell Hymes (1972) and later refined by Canale and Swain (1980), communicative competence comprises four major components: grammatical competence, sociolinguistic competence, discourse competence, and strategic competence.

Artificial Intelligence (AI), with its capabilities in Natural Language Processing (NLP), Automatic Speech Recognition (ASR), Machine Learning (ML), and conversational modeling, offers powerful tools to develop these components in an integrated and measurable way. AI-driven platforms simulate authentic communication scenarios, provide real-time feedback, and create adaptive learning environments that were previously difficult to achieve in traditional classrooms.

**6. Limitations and Considerations**

AI writing tools may present challenges such as:

- Over-reliance reduces independent thinking
- Incorrect contextual suggestions
- Risk of plagiarism if misused

**1. AI and Grammatical Competence**

Grammatical competence involves mastery of vocabulary, syntax, pronunciation, and sentence formation. AI writing and speaking tools such as Grammarly, ELSA Speak, and

AI speech analyzers detect errors at micro level and provide instant corrective feedback.

**AI Contribution**

- Grammar and pronunciation correction
- Vocabulary enhancement suggestions
- Sentence structure analysis
- Pronunciation scoring at the phoneme level

This continuous feedback loop strengthens learners’ control over linguistic forms.

**2. AI and Sociolinguistic Competence**

Sociolinguistic competence refers to the ability to use language appropriately according to social context, culture, and situation. AI chatbots and conversational assistants simulate diverse real-life scenarios such as interviews, meetings, presentations, and informal conversations.

**AI Contribution**

- Context-based conversation practice
- Exposure to formal and informal language use
- Cultural and situational language modelling
- Role-play simulations

Learners practice choosing suitable expressions depending on the situation.

**3. AI and Discourse Competence**

Discourse competence is the ability to connect sentences logically and maintain coherence and cohesion in spoken or

written communication. AI writing assistants and summarization tools help learners organize ideas effectively.

**AI Contribution**

- Coherence and cohesion suggestions
- Paragraph organization feedback
- Summarization and idea structuring
- Logical flow analysis in speech and writing

This enables learners to produce well-structured communication rather than isolated sentences.

**4. AI and Strategic Competence**

Strategic competence involves the use of communication strategies to overcome breakdowns in communication, such as paraphrasing, asking for clarification, or using alternative expressions. AI conversational tools provide opportunities for learners to practice such strategies in simulated dialogues.

**AI Contribution**

- Paraphrasing assistance
- Interactive dialogue practice
- Immediate response to communication attempts
- Encouragement of repair strategies

Learners gain confidence in managing real-life communication challenges.

**5. AI Features Supporting Communicative Competence**

Component of Communicative Competence	AI Feature	Learning Outcome
Grammatical Competence	Grammar & pronunciation checkers	Linguistic accuracy
Sociolinguistic Competence	AI chatbots & scenario simulation	Contextual appropriateness
Discourse Competence	Summarizers & coherence analyzers	Logical organization
Strategic Competence	Conversational AI & paraphrasing tools	Communication repair skills

**6. Pedagogical Integration in English Classrooms**

AI tools can be integrated into communicative language teaching through:

- AI-assisted role plays and group discussions
- Mock interviews and presentation practice
- AI-evaluated speaking and writing tasks
- Context-based conversation exercises
- Continuous performance tracking and feedback

Teachers can use AI analytics to monitor communicative growth across multiple dimensions.

**7. Advantages Over Traditional Approaches**

- Real-time corrective feedback
- Personalized communication practice
- Authentic scenario simulation
- Reduction of speaking anxiety
- Objective assessment of communicative performance
- Scalability in large classrooms and language labs

**8. Limitations and Ethical Considerations**

Despite its strengths, AI may:

- Lack deep cultural sensitivity
- Provide contextually limited responses
- Encourage over-dependence

- Raise concerns regarding data privacy and academic integrity

Hence, AI should complement human interaction and teacher facilitation.

**Benefits of AI-Based Communication Tools**

The integration of AI in English communication learning offers several advantages:

- Customized learning experiences based on individual needs
- Instant and consistent feedback
- Increased learner engagement and motivation
- Flexible access to learning resources
- Reduced hesitation and anxiety in speaking practice
- Continuous monitoring of learner progress

These benefits make AI tools effective supplements to classroom instruction.

**Limitations and Challenges**

Despite their advantages, AI tools have certain limitations. They lack human emotional understanding and cannot fully replace teacher guidance. Dependence on technology may also widen the digital divide among learners. Additionally, issues related to data security, ethical use, and cultural

appropriateness remain concerns. Overuse of AI correction tools may also reduce learners' critical language awareness.

### **Pedagogical Implications**

For effective implementation, AI tools should be integrated into English communication courses through a blended learning approach. Teachers play a crucial role in guiding learners, contextualizing AI feedback, and promoting critical thinking. Proper training and ethical awareness are essential to ensure responsible and meaningful use of AI in language education.

### **Future Prospects of AI in English Communication**

The future of AI in English communication appears promising with advancements in emotional intelligence, immersive technologies, and multilingual processing. Innovations such as virtual reality-based language practice and AI-driven assessment systems are expected to further enhance communicative competence and learner engagement in higher education.

### **Conclusion**

Artificial Intelligence has introduced innovative approaches to improving English communication skills among undergraduate learners. By offering personalized instruction, interactive practice, and immediate feedback, AI tools support the development of comprehensive communicative competence. However, AI should function as an educational aid rather than a substitute for teachers. A balanced integration of AI and human instruction can significantly enrich English language education.

### **References**

1. Chapelle CA. *Computer-Assisted Language Learning*. Cambridge University Press, 2020.
2. Crystal D. *English as a Global Language*. Cambridge University Press, 2019.
3. Luckin R, Holmes W, Griffiths M, Forcier LB. *Intelligence Unleashed: An Argument for AI in Education*. Pearson, 2016.
4. Warschauer M. Technology in second language learning. *Language Learning & Technology*, 2018;22(1):1–15.
5. UNESCO. *Artificial Intelligence and Education: Guidance for Policymakers*, 2021.