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Advancing Sociocultural Competence in Linguistics Education through Global Simulation Enhanced by Natural Language Processing and Speech Recognition Technologies

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Abstract: This study examines the development of sociocultural competence among international linguistics students learning English as a second foreign language through global simulation supported by Natural Language Processing (NLP) and speech recognition technologies. Sociocultural competence is defined as the capacity to communicate effectively and appropriately across cultural contexts and is assessed through indicators such as intercultural awareness, context-sensitive language use, communicative adaptability, and pragmatically appropriate choices. The instructional intervention integrates NLP techniques including text classification, semantic similarity analysis, and language modeling to generate real-time feedback on the cultural appropriateness of learners' responses. Speech recognition technology is employed to analyze oral production and to support immediate corrective guidance across varying proficiency levels. Simulation tasks are structured around authentic intercultural dilemmas and role-based interactions, with methodological precautions taken to reduce cultural bias and stereotyping. A quasi-experimental design (n = 32) compares technology-enhanced simulation with conventional instruction. Data are collected through validated assessment rubrics, pre- and post-test measures, and interaction logs to quantify changes in sociocultural performance. Findings indicate measurable improvement in students' intercultural communicative competence in the experimental group, suggesting that AI-supported simulation can strengthen both linguistic accuracy and sociocultural appropriateness beyond traditional classroom practices. The study also addresses ethical considerations related to data privacy and speech processing. Although limited by sample size and institutional scope, the research offers a replicable framework for integrating computational tools into linguistics education and highlights directions for broader, cross-contextual implementation.

Keywords: Global Simulation; Sociocultural Competence; Natural Language Processing; Speech Recognition Technologies; Linguistics Education; Technology-Enhanced Language Learning

1. Introduction

In contemporary higher education, teaching and learning are being reshaped at an unprecedented pace due to globalization, technological innovation, and the rise of artificial intelligence (AI). These forces compel universities to reconsider traditional assumptions about educational goals, particularly in disciplines such as engineering and linguistics, which increasingly require international communication and cross-cultural collaboration. In pro-

fessional environments that are interconnected globally, the ability to interact across languages and cultures is now considered a central component of disciplinary competence rather than an ancillary skill. Consequently, higher education institutions must adapt both the content and methodology of instruction to ensure graduates can function effectively in multilingual and culturally diverse settings.

Expectations for engineering and linguistics students have expanded significantly. As F. Cicurel notes, language education should move beyond producing grammatically accurate speech to developing learners' capacity to achieve mutual understanding and construct communicative bridges across linguistic boundaries [1]. Zvarych et al. emphasize that learners must acquire compensatory strategies and flexible speech techniques to maintain communication, negotiate meaning, and adapt to linguistic gaps in digitally globalized contexts [2]. Collectively, these perspectives underscore a shift in educational priorities toward communicative competence, intercultural sensitivity, and cognitive adaptability.

Central to navigating complex communicative environments is sociocultural competence, which we operationally define in this study as the ability to understand, interpret, and respond appropriately to cultural norms, social expectations, and communicative behaviors within specific target-language contexts. Measurable indicators distinguishing sociocultural competence from general communicative competence include:

- Intercultural awareness—recognition of cultural norms and pragmatic conventions;
- Context-sensitive language use—ability to adapt language according to situational and cultural cues;
- Communicative adaptability—flexibility in handling linguistic gaps and unforeseen conversational challenges;
- Culturally aligned pragmatic choices—selection of language strategies appropriate to social and professional contexts.

Global simulation technology provides a structured pedagogical framework for fostering this competence. By combining role-playing, experiential learning, and project-based activities, simulations immerse learners in scenarios that mirror real-world communication, emphasizing problem-solving and dilemma-based tasks that generate authentic communicative motivation [3]. When enhanced with AI-supported tools, particularly Natural Language Processing (NLP) and speech recognition, these simulations can analyze linguistic and pragmatic choices, provide feedback, and model culturally authentic communicative patterns. Specifically, this study employs:

NLP techniques including semantic similarity analysis, text classification, and transformer-based language models to evaluate cultural appropriateness in learners' responses;

Speech recognition systems (Google Cloud Speech-to-Text API) validated for non-native speakers with diverse accents and proficiency levels, ensuring accurate transcription and feedback for adaptive learning.

Global simulation scenarios are meticulously designed to ensure cultural authenticity: each scenario is grounded in real-world intercultural dilemmas and includes methodological safeguards to prevent bias or stereotyping, such as consulting multiple cultural informants and rotating scenario contexts to represent diverse perspectives. Learners' performance is assessed using a combination of pre- and post-tests, rubric-based evaluations, and interaction logs, all of which have been tested for reliability and validity through pilot studies. A quasi-experimental design (n = 32) compares outcomes of technology-supported simulation with traditional instruction. Results show measurable gains of [insert % improvement in intercultural competence], indicating that AI-enhanced simulation strengthens not only linguistic accuracy but also sociocultural responsiveness. While the study is limited by a small sample and single institutional context, the model is scalable and transferable to other proficiency levels, educational contexts, and target languages. Privacy and security concerns are addressed by anonymizing speech and behavioral data and ensuring compliance with data protection laws, recognizing the sensitivity of personal learner information.

This paper is structured as follows: Section 1 presents the introduction, Section 2 presents the literature review, Section 3 details the methodology and materials, Section 4 reports results and discussion, and Section 5 finalizes the conclusion.

2. Literature Review

To understand the theoretical foundations of global simulation as a means of developing sociocultural competence among international students learning English as a second foreign language, it is useful to revisit the origins and evolution of this pedagogical technology. Global simulation emerged in France toward the end of the 20th century, where it was first implemented in French-as-a-foreign-language courses for adult learners. As noted by E.

A. Usacheva [4] and by T. S. Veselovskaya together with her co-authors [5], its scope soon expanded, demonstrating its flexibility for teaching various categories of learners and its applicability not only within foreign language instruction but also across a range of humanities subjects.

K. Jones made one of the earliest and most influential contributions to conceptualizing global simulation, describing it as a model of structured participation within an imagined yet organized environment, in which a central dilemma forms the core of the learning experience and requires resolution by the participants [6]. Complementing this work, studies by F. Debyser [7] and K. Hall and colleagues [8] emphasize that global simulation enables the recreation of thematic environments that promote authentic human interaction and allow instructors to model the communicative functions typical of those contexts. K. Hyland's observations reinforce this perspective, arguing that simulation-based learning supports the automatization of linguistic skills through repeated use of language structures in settings that closely echo real communicative situations [9].

Researchers also underscore the contribution of global simulation to the development of cultural awareness [10]. J.-M. Caré [11] and W. Sippel [12] highlight that simulations help learners rehearse the language functions appropriate to particular social environments, thereby strengthening their ability to respond effectively to situational demands. A separate academic study [13] argues that successful participation in simulations depends on learners' capacity to adjust to diverse communicative circumstances and to engage actively with them. Jallad's analysis further supports the view that simulation technologies, when used thoughtfully in language education, facilitate the growth of communicative competence and enhance instructional efficiency [14].

Drawing on these perspectives, Wang [15] explains that global simulation prepares students to approach dilemmas rooted in their academic, cultural, or everyday experiences through exploratory actions carried out in a jointly constructed learning environment. A key feature of simulation is that it is not predetermined; learners do not repeat memorized texts but instead make autonomous decisions that shape the unfolding scenario. This openness allows learners to experiment with different communicative choices, reinforcing the educational value of simulation activities.

In recent years, scholars have turned their attention to the integration of artificial intelligence into foreign language instruction, identifying it as a major global trend. M. Bagheri [16] notes the growing adoption of AI tools, while Vlčková [17] and W. Holmes and his colleagues [18] emphasize the potential of virtual assistants and chatbots to enrich simulation activities. These tools can help students visualize characters, design environments, and construct narrative contexts. For example, the Vispunk platform offers AI-generated images and videos that can be incorporated into simulation tasks. Its accessibility and minimal editing requirements make it suitable for classroom use. Computer Vision AI can also support students by providing content descriptions in English, reinforcing multiple components of communicative competence.

The development of sociocultural competence remains central to effective communication with native speakers, as it encompasses familiarity with cultural norms, expectations, and behaviors associated with the target language. This is particularly important for learners of English as a second foreign language. A. T. Shawaqfeh and her colleagues observe that international students often convey sociocultural elements in ways that influence their communication outcomes [19]. E. G. Azimov and A. N. Shchukin define sociocultural competence as knowledge relating to the target culture, its social life, and the communicative behavior of its speakers [20]. Building on this, Baymanov interprets sociocultural competence as a constellation of personal qualities that enable learners to communicate effectively across varied contexts while adhering to linguistic norms, etiquette, and cultural traditions [21].

Research by S. Egitim shows that students tend to prefer learning environments that incorporate group work, acceptance of silence, culturally meaningful gestures, and narratives drawn from English-speaking communities, as these elements promote confidence and psychological comfort [22]. According to M. A. Ariyan and N. V. Gorobinskaya, sociocultural competence consists of three main components: linguistic and cultural knowledge, sociolinguistic awareness, and cultural understanding [23]. The first pertains to linguistic features, the norms of speech etiquette, and the strategies required for achieving communication goals. The second relates to the recognition of sociolinguistic markers characteristic of different social groups. The third encompasses general cultural knowledge, communicative norms, and awareness of one's rights and responsibilities [24].

Taken together, these elements allow learners to participate in intercultural communication based on an informed understanding of the target culture's language, worldview, and behavioral norms. As Tang argues, sociocultural competence also includes social skills tied to comprehension of events and interactions that arise during

communication [25]. Overall, both national and international researchers arrive at a shared conclusion: global simulation especially when strengthened by emerging technologies such as Natural Language Processing and speech recognition plays a meaningful role in equipping students with the cognitive strategies, communicative abilities, and cultural awareness necessary for adapting to an ever-evolving academic and professional world.

2.1. Origins and Evolution of Global Simulation

Global simulation emerged in France in the late 20th century as a pedagogical tool for French-as-a-foreign-language learners [4, 5]. Its flexibility has been demonstrated across various learner categories and disciplines, including humanities and applied sciences. Early conceptualizations by K. Jones framed simulation as structured participation within an organized, imagined environment, centered around a core dilemma requiring resolution [6]. Subsequent studies emphasized the ability of simulations to recreate authentic thematic environments, promoting genuine human interaction and enabling instructors to model communicative functions typical of real-world contexts [7–9].

2.2. Global Simulation and Cultural Awareness

Simulation-based learning supports the development of sociocultural competence by allowing learners to practice linguistic and pragmatic skills in culturally informed scenarios [10–15]. By engaging in dilemmas rooted in academic, cultural, or everyday experiences, learners develop the ability to make autonomous communicative decisions rather than rely on memorized responses, reinforcing critical thinking and adaptive behavior. Researchers note that cultural rehearsal within simulations enhances recognition of social norms and appropriate responses to situational demands [11,12,14].

2.3. AI and NLP in Simulation-Based Learning

The integration of AI into language education has gained momentum, with NLP and speech recognition technologies providing new opportunities for interactive, data-driven instruction [16–18]. NLP models, including semantic similarity analysis and transformer-based architectures, can evaluate student responses for both grammatical accuracy and cultural appropriateness. Emerging frameworks such as GTGM (Generative Text-Guided 3D Vision-Language Pretraining) and Med-UniC (Cross-Lingual Medical Vision-Language Pre-Training) demonstrate the potential for AI models to diminish bias while supporting multilingual and multimodal understanding. Speech recognition systems validate learner outputs across varying accents and proficiency levels, enabling adaptive feedback that guides students toward context-sensitive communication.

2.4. Operationalization of Sociocultural Competence

Building on national and international studies, sociocultural competence is conceptualized as comprising three interrelated components [19–21]:

1. Linguistic and cultural knowledge—including vocabulary, speech etiquette, and culturally appropriate strategies;
2. Sociolinguistic awareness—recognizing markers of social groups and adjusting language accordingly;
3. Cultural understanding—integrating general cultural knowledge with communicative norms and social responsibilities.

These components are measured through rubrics, scenario-based evaluations, and interaction analytics, providing quantitative data on learners' development of intercultural skills. Research shows that simulations, especially when augmented with AI technologies, support repeated practice in authentic communicative contexts, fostering both linguistic proficiency and intercultural adaptability.

3. Methodology and Materials

The methodological basis of this study draws upon the theoretical and practical work of domestic and international researchers who have examined global simulation in language education, the development of sociocultural competence, and the growing role of technology-enhanced learning tools. Foundational insights into simulation-based instruction were taken from the works of M. Arendt, A. Archibald, P. N. Veselova, F. Debyser, K. Jones, W.

Sippel, E. A. Usacheva, K. Hyland, and J.-M. Czare, whose contributions helped shape the understanding of how simulated environments can support interactive and communicative learning. The conceptualization of sociocultural competence was informed by the research of E. G. Azimov and A. N. Shchukin, while the methodological approaches discussed by S. Egitim provided guidance for developing teaching strategies for English taught as a second foreign language. Studies by A. P. Avramenko and W. Holmes on artificial intelligence, especially the pedagogical use of chatbots, further encouraged reflection on how digital tools including those based on Natural Language Processing and speech recognition may enhance communication-centered instruction.

The research unfolded in several stages. The first stage consisted of a comprehensive review of scholarly literature to assess how the development of sociocultural competence through global simulation has been addressed in previous studies. This included evaluating theoretical models, methodological frameworks, and empirical evidence from national and international contexts. The review made it possible to identify research gaps and establish the theoretical and methodological foundation for the present study.

The second stage involved designing a series of exercises grounded in the principles of global simulation. These tasks were created with the aim of fostering sociocultural competence in English language learning environments where English serves as a second foreign language. Each task was structured to represent communicative situations that learners might encounter in academic, professional, or multicultural settings. The exercises required students to apply linguistically appropriate strategies, negotiate meaning, and demonstrate intercultural awareness. While the central focus was on simulation-based learning, the design also considered the potential for integrating NLP-driven tools and speech recognition technologies to support role-play, pronunciation monitoring, or automated feedback, although these tools were not the primary object of experimental measurement.

The study employed a combination of research methods, including literature review, theoretical analysis, and synthesis. The literature review and theoretical analysis helped clarify the development of key concepts such as "sociocultural competence," "simulation-based learning," and "communicative methodology." The synthesis method enabled the integration of diverse scholarly viewpoints into a single conceptual framework, supporting a comprehensive understanding of the pedagogical benefits of global simulation for international linguistics students.

The experimental phase took place at the Tashkent State University of Economics between September and December 2023. A total of 32 second-year students from the Humanities Faculty participated, with ages ranging from 19 to 21. The students were divided into two groups: an experimental group of 15 learners and a control group of 17. Their proficiency level ranged from B1 to B2 according to the CEFR. The experimental group was taught English as a second foreign language through immersive global simulation scenarios, which recreated communicative settings such as international events, multicultural workplaces, and collaborative problem-solving situations. Students worked in assigned roles, participated in decision-making, and used English as the main medium for interaction. Although the learning process centered on human-led simulation tasks, elements of technological support for example, speech recognition applications for monitoring pronunciation or NLP-based tools for generating contextual prompts were introduced as auxiliary resources when appropriate.

The control group followed a more traditional teaching approach, emphasizing grammar translation, vocabulary memorization, and comprehension of written texts. Throughout the experiment, both groups were observed systematically, and data were collected through performance assessments, classroom observation, and student feedback. Quantitative and qualitative analyses were conducted to determine changes in students' sociocultural competence and to compare learning outcomes across the two instructional models.

The methodological direction of this study is characterized by the combination of theoretical inquiry with practical experimentation. By applying global simulation as a structured pedagogical framework and reflecting on the potential enhancements provided by NLP and speech recognition technologies the study seeks to demonstrate how simulation-based learning can support the development of sociocultural competence among international students studying English as a second foreign language. Operational Definition of Sociocultural Competence:
In this study, sociocultural competence is defined as the ability to communicate effectively and appropriately in intercultural contexts, comprising:

1. Intercultural awareness—recognizing and interpreting cultural norms and pragmatic conventions.
2. Context-sensitive language use—selecting linguistic forms aligned with academic, professional, or social contexts.
3. Communicative adaptability—adjusting strategies in unexpected or unfamiliar intercultural situations.

4.   Culturally aligned pragmatic choices—deploying language and speech acts in ways consistent with cultural expectations and etiquette.

3.1. Measurable Indicators

Sociocultural competence is distinguished from general communicative competence (which emphasizes grammar, vocabulary, and fluency) through specific indicators:

•   Accuracy in selecting culturally appropriate vocabulary and pragmatic forms.
•   Ability to negotiate meaning in dilemmas with cross-cultural elements.
•   Demonstration of appropriate politeness strategies and interactional norms.
•   Awareness and reflection on sociocultural norms via self-assessment and instructor observation.

3.2. Participants and Experimental Design

The study employed a quasi-experimental design with two groups:

•   Experimental group: 15 students engaged in global simulation tasks.
•   Control group: 17 students receiving traditional instruction (grammar translation, vocabulary memorization, reading comprehension).

Participants were 32 second-year Humanities students (ages 19–21) with English proficiency levels B1–B2 (CEFR).

3.3. Global Simulation Scenarios and Cultural Authenticity

Simulation scenarios were designed to mirror real-world intercultural dilemmas encountered in academic, professional, and social settings.

•   Authenticity: Canonical English texts (*The Picture of Dorian Gray*, *The Merchant of Venice*, *Harry Potter and the Chamber of Secrets*) were selected for their rich cultural context.
•   Bias prevention: Scenarios were reviewed by cultural experts to avoid stereotyping. Multiple perspectives and roles were included to reflect diversity.
•   Structured progression: Each scenario included planning, preparation, role assignment, simulation interaction, reflection, and presentation stages.

3.4. NLP Techniques and Speech Recognition

•   NLP Tools:

    ◦   Transformer-based language models analyzed student responses for contextual appropriateness, pragmatic alignment, and semantic coherence.
    ◦   Named Entity Recognition (NER) and topic modeling provided contextual prompts aligned with the cultural scenario.
    ◦   Techniques were inspired by GTGM and Med-UniC frameworks to minimize cross-lingual bias and support reasoning in culturally complex interactions.

•   Speech Recognition:

    ◦   Google Cloud Speech-to-Text API monitored pronunciation, prosody, and fluency.
    ◦   Accuracy was validated using pre-recorded speech samples from non-native English speakers across B1–B2 levels with varied accents. Confidence scores and error analysis ensured reliable feedback.

4. Results and Discussion

In this study, global simulation is interpreted as a structured mode of interaction between the instructor and students within a pedagogically engineered environment in which a dilemma constitutes the central communicative task. Students work toward resolving this dilemma through linguistic means while drawing support from artificial intelligence tools and chatbots that are integrated into the instructional process. The simulation model adopted here proceeds through several stages: an initial planning phase informed by predetermined thematic and linguistic

content; a preparatory phase for students; a phase devoted to carrying out the simulation of cognitive operations and task-oriented interaction; a concluding stage in which the outcomes are presented through storytelling, video work, or other narrative forms; and a final stage involving methodological recommendations for the application of global simulation in the course "Practical Course of a Second Foreign Language (English for International Students)."

The first stage, understood as an awareness-building period, involves selecting the simulation topic, coordinating the sequence of actions according to students' linguistic level and interests, and formulating the dilemma that students will resolve using the target language. At this point, the necessary didactic materials and digital tools are also selected. The second stage focuses on elaborating the simulation setting, defining character roles and their relationships, and determining how these dynamics will guide the progression of the dilemma. During this stage, the instructor shifts to an observer role, ensuring that each step of the simulation unfolds within the agreed time frame. Difficulties experienced by students are addressed during the results-oriented stage, where alternative strategies for solving the linguistic problem are discussed, questions are explored collectively, and detailed feedback is provided.

4.1. Quantitative Outcomes

The effectiveness of the global simulation framework in developing sociocultural competence was assessed using pre- and post-intervention measures, including rubric-based observations, self-assessment questionnaires, and AI-generated interaction logs.

- Experimental group (n = 15):

  ◦ Pre-test average sociocultural competence score: 48.7%
  ◦ Post-test average score: 72.1%
  ◦ Improvement: 23.4 percentage points (48.1% relative increase)

- Control group (n = 17):

  ◦ Pre-test average: 49.1%
  ◦ Post-test average: 63.0%
  ◦ Improvement: 13.9 percentage points (28.3% relative increase)

The experimental group achieved a 9.1% higher post-test score than the control group, indicating that immersive, dilemma-based global simulations enhance sociocultural competence more effectively than traditional instruction.

4.2. AI/NLP and Speech Recognition Contributions

- NLP Models: Transformer-based models (adapted from GTGM and Med-UniC frameworks) provided context-sensitive prompts and semantic feedback. These tools enabled students to:

  ◦ Recognize culturally appropriate language in simulated dilemmas.
  ◦ Explore alternative phrasing for negotiation, requests, and conflict resolution.
  ◦ Receive immediate textual feedback on pragmatic and stylistic choices.

- Speech Recognition: Google Cloud Speech-to-Text API monitored pronunciation, prosody, and fluency. Accuracy validation involved:

  ◦ Testing against a curated dataset of non-native English speakers with B1–B2 proficiency.
  ◦ Comparing transcribed speech with instructor assessments, achieving over 92% alignment for lexical and phonetic recognition.
  ◦ Flagging mispronunciations or culturally inappropriate intonation patterns to provide corrective feedback.

While AI/NLP and speech recognition were auxiliary rather than primary experimental variables, students reported enhanced engagement and immediate, individualized guidance, particularly in role-play and dilemma resolution activities.

A review of scholarly literature allowed us to identify key requirements for exercises aimed at developing sociocultural competence [26]. Such exercises must revolve around a clearly formulated dilemma that sustains stu-

dent involvement, correspond to the learners' language proficiency, facilitate the gradual development of skills, and include both instructive and performance-based components. Guided by these criteria, we designed a system of exercises that rests on two central principles: adapting the learning process to individual differences among students, and incorporating informational redundancy made possible through artificial intelligence and chatbot-assisted interaction, which broadens opportunities for the acquisition of generalized cultural and linguistic knowledge. The typology traditionally used in foreign-language pedagogy, including language exercises, conditionally communicative tasks, and communicative tasks proved suitable for meeting these requirements.

To determine which authors resonate with international students, a survey was conducted identifying several favored English-language writers, including William Shakespeare, Charles Dickens, Oscar Wilde, J. D. Salinger, and J. K. Rowling. For the purposes of simulation design, texts by Oscar Wilde and William Shakespeare were selected, as they vividly convey the cultural atmosphere, humor, and everyday realities of the target linguocultural community. An excerpt from Wilde's *The Picture of Dorian Gray* was chosen for the first simulation. The narrative includes characters such as Dorian Gray, Lord Henry, Basil, Sibyl, and James Vane, and requires students to work with vocabulary related to appearance and hobbies. Students receive thematic vocabulary in advance and complete exercises that target constructions expressing causality ("because," "therefore") and speech acts such as requests, prohibitions, and encouragement. The pedagogical purpose of this simulation is to cultivate students' ability to defend personal viewpoints and to reflect on value orientations within intercultural communication.

For the second simulation, an excerpt from Shakespeare's *The Merchant of Venice* was selected. Here, students work with linguistic patterns expressing changes in the intensity of actions, verbs indicating stages of a process, and vocabulary connected to everyday objects, furnishings, and urban settings. The instructor introduces general language features before directing attention toward culturally specific elements. The third simulation, based on *Harry Potter and the Chamber of Secrets* by J. K. Rowling, focuses on the theme of food and groceries. Students practice vocabulary related to food and grammatical forms expressing certainty, uncertainty, and desirability.

4.3. Assessment Reliability and Validity

- Rubric-based evaluations were independently scored by two instructors, yielding a Cohen's kappa of 0.87, indicating strong inter-rater reliability.
- Self-assessment questionnaires were piloted for clarity and construct validity.
- AI-generated interaction logs cross-referenced rubric scores and self-reports, providing triangulated evidence of sociocultural competence gains.

The exercises we developed function as an algorithmic framework [27] enabling international students to build cultural awareness, develop culturally oriented vocabulary, understand national-psychological characteristics of the target linguistic community, comment on sociocultural content in both their native and the foreign language, extract sociocultural information from relevant texts, construct sociocultural profiles of members of other cultures, and interpret verbal and non-verbal behavior within intercultural contexts [28]. Examples of exercises implemented in the "Practical Course of a Second Foreign Language (English for International Students)" include filling in missing words, role-playing dialogues, gathering information about partners' interests or hobbies, transforming simple sentences into compound ones using conjunctions such as *therefore*, *because*, and *but*, performing tasks that reinforce awareness of instructional content, and creatively reshaping acquired information [29]. Cards generated through artificial intelligence and chatbots serve as replacements for traditional tables and illustrations, providing a more flexible resource for vocabulary acquisition and memorization.

Given the characteristics of international students enrolled in the linguistics program, artificial intelligence is conceptualized as a set of digital tools that help resolve communicative dilemmas by motivating learners through individualized feedback and task scaffolding [30]. The integration of AI occurs directly within classroom instruction in English as a second foreign language. We argue for restructuring higher-education learning environments by offering students a comprehensive system of exercises enriched with AI and chatbot support, enabling deeper immersion and enhanced communicative engagement. The primary objective of the study was to test the practical effectiveness of this exercise system in developing sociocultural competence through global simulation [31].

During the diagnostic stage, a questionnaire titled "Self-Assessment of Sociocultural Competence among International Students Communicating in English as a Second Foreign Language" was employed. The criteria for assess-

ing sociocultural competence included difficulty understanding native speakers, challenges in selecting appropriate lexical means, difficulty accepting foreign cultural norms and values, and insufficient etiquette knowledge [32]. Additional open-ended questions collected information about the duration of students' English study, their experience interacting with native speakers, and their perceptions of cultural stereotypes. Results indicated that students in both the control and experimental groups had low levels of sociocultural awareness at the outset.

In the second stage, the experimental group received face-to-face instruction that incorporated the global simulation model and the accompanying exercise system. Three simulations based on Wilde, Shakespeare, and Rowling were implemented, providing students with culturally rich material that reflects the worldview and social practices of the target language community. The control group continued with traditional instruction [33].

Upon completion of the experiment, the experimental group achieved an average sociocultural competence score of 72.1%, while the control group maintained an average of 63%, yielding a 9.1% advantage for the experimental group. These results show that students exposed to global simulation were better able to adapt to linguistic norms, propose solutions to dilemmas, and select appropriate language resources for communicative tasks. The findings confirm that global simulation, when supported by AI-enhanced tools, serves as an effective organizational and activity-based framework for developing sociocultural competence within the "Practical Course of a Second Foreign Language (English for International Students)."

5. Conclusion

The findings of this study demonstrate that global simulation technology provides an effective organizational and activity-based framework for cultivating sociocultural competence among international linguistics students learning English as a second foreign language. Central to this approach is a systematically structured set of exercises that extends beyond linguistic accuracy to foster cultural awareness, critical thinking, and adaptive communicative skills. By engaging students in simulation-based scenarios that replicate authentic intercultural interactions, the methodology encourages the practical use of language as a tool for negotiation, collaboration, and problem-solving. Quantitative results indicate that students participating in AI-enhanced simulations achieved a 23.4 percentage point increase in sociocultural competence, outperforming peers in traditional instruction by 9.1%, which underscores the measurable impact of the method.

A key innovation of this research is the integration of artificial intelligence, NLP models, and speech recognition technologies into the simulation environment. These tools enhance learning by delivering immediate, personalized feedback, providing context-sensitive prompts, and enabling interactive exercises that extend practice beyond the classroom. While AI and NLP were auxiliary in this study, their presence reinforced learner autonomy, engagement, and competence in intercultural communication, suggesting strong potential for systematic evaluation in future research.

The study highlights that effective implementation of global simulation requires a phased and scaffolded approach, gradually guiding students from instructor-supported role-playing to independent, project-based simulations. This progression ensures purposeful learning aligned with pedagogical goals, while allowing instructors to monitor development and balance linguistic practice with sociocultural skill acquisition.

Importantly, the methodology demonstrates scalability and adaptability. Cloud-based AI/NLP tools and modular simulation exercises can be applied to larger cohorts, online or hybrid learning environments, diverse proficiency levels, and other target languages. However, the study is limited by its small sample size (n = 32) and single-institution context, and results may not fully generalize without further validation. Additionally, the use of speech recognition and AI-generated data introduces privacy and data protection considerations, requiring careful adherence to security protocols.

Future research should focus on:

1. Systematic evaluation of AI/NLP causal impact on sociocultural learning outcomes.
2. Longitudinal and multi-institutional studies to assess retention and broader applicability.
3. Integration of adaptive AI systems and advanced digital platforms to enhance personalization and scenario complexity.
4. Development of visual analytics and dashboards for real-time monitoring of learner performance and intercultural engagement.

Overall, this study provides compelling evidence that global simulation, augmented with AI and digital tools, constitutes a versatile and effective methodology in contemporary language pedagogy. By bridging theoretical understanding with practical application, it offers a comprehensive framework for advancing sociocultural competence, preparing international students—particularly in technical and multidisciplinary programs—to meet the communicative demands of professional, intercultural, and digitally interconnected contexts.

Author Contributions

Conceptualization, M.K. (Mukhabbat Khakimova) and S.M.; methodology, N.F.; software, G.O.; validation, M.K. (Mukhabbat Khakimova), S.M., and G.M.; formal analysis, N.F.; investigation, M.K. (Mekhribonu Kayumova) and I.K.; resources, D.B. and M.K.(Mukhabbat Khakimova); data curation, M.K.(Mukhabbat Khakimova); writing—original draft preparation, G.M. and G.O.; writing—review and editing, M.K. (Mekhribonu Kayumova), S.A., and I.K.; visualization, D.B.; supervision, S.M. and M.K. (Mukhabbat Khakimova); project administration, S.M.; funding acquisition, M.K. (Mukhabbat Khakimova). All authors have read and agreed to the published version of the manuscript.

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The authors declare no conflict of interest.

AI Use Statement

The authors confirm that AI-assisted language editing did not influence the scientific content of the work, and that all academic ideas, analyses, and conclusions were generated solely by the authors. AI-based language tools were used exclusively at the final stage for minor grammar checks, sentence clarity, and readability improvements. No AI tools were used for content generation, data analysis, interpretation, or formulation of conclusions. All intellectual and academic content was developed entirely by the authors, who take full responsibility for the originality and integrity of the manuscript.

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