APPLICATION OF ARTIFICIAL INTELLIGENCE IN LANGUAGE SKILLS TESTING

Lazar Stošić	Faculty of Management, Sremski Karlovci, University UNION Nikola Tesla, Belgrade, Serbia. Don State Technical University, Rostov-on-Don, Russian Federation
Elena N. Malyuga	Head of Foreign Languages Department at the Faculty of Economics, Peoples' Friendship University of Russia named after Patrice Lumumba (RUDN University), Moscow, Russian Federation

Abstract

The integration of artificial intelligence (AI) into language testing marks a transformative shift in how we evaluate linguistic capabilities. AI-driven tools offer unparalleled precision, personalization, and innovative assessment methods, revolutionizing language assessment's accuracy and adaptability. Through advanced algorithms and tailored approaches, AI ensures precise skill evaluation, customized testing, and individualized improvement strategies, promising a more effective language learning experience. However, alongside these advancements, ethical considerations arise concerning data privacy, algorithmic biases, and operational transparency in AI-based language testing. Striking a balance between technological innovation and ethical implications becomes paramount for harnessing AI's potential in enhancing language skills while addressing ethical concerns. Despite these challenges, the future of language testing with AI appears promising. As AI continues to evolve, its role in language assessment is poised to revolutionize educational practices and evaluation methodologies. With a conscientious approach to ethical considerations and continuous technological development, AI holds the promise of significantly enhancing language proficiency and learning processes in the foreseeable future.

1. Introduction to Artificial Intelligence and Linguistic Skills

The concept of artificial intelligence isn't a recent one. It's seen as a disruptive technology with a looming impact on both the economy and society. This potential is highlighted by its capacity to take over perilous or monotonous tasks, leading to a lifestyle that's not just more convenient but also more efficient (Li & Zhang, 2017). Even back in 1950, the British mathematician Alan Turing published a paper titled "Computing Machinery and Intelligence," raising the following fundamental question: can machines think? (Turing, 1950). The term "artificial intelligence" traces its origins to as far back as 1956, where numerous researchers convened at Dartmouth College for a conference. Disciplines spanning mathematics, electrical engineering, psychology, and more were represented, all converging on the powerful tool of computer utilization to simulate human intelligence. During these nascent stages, research in artificial intelligence predominantly focused on diverse applications aimed at fostering intelligence and reasoning, often revolving around playing video games and theorem proving.

By the 1960s, researchers began developing applications focused on perception, language comprehension, and general problem solving. One of the initial applications, somewhat reminiscent of today's ChatGPT, was ELIZA. It allowed humans to communicate with computers via keyboards, giving patients the feeling of conversing with a person rather than a machine (Weizenbaum, 1966). ELIZA, a computer program created at MIT, facilitated natural language exchanges between humans and computers. Running with the MAC time-sharing system it used

---

[1] This study is presented as a paper at 6th International Multidisciplinary Scientific Conference (IMSC-2023), which is held online by The Association-Institute for English Language and American Studies, Tetovo, North Macedonia on December 23, 2023. https://aielasconference.com

rules of decomposition and reassembly to analyze and generate responses to input sentences. The program emphasized identifying keywords, understanding minimal context, selecting appropriate transformations, generating responses even without keywords, and offering an editing capability for ELIZA "scripts". ELIZA operated on the principles of substitution, pattern matching, and random selection. According to Weizenbaum (1966), ELIZA wasn't an embodiment of English language comprehension; it highlighted how easily one could create and sustain the illusion of understanding.

By the early 1970s, an important system emerged: SHRDLU developed by Terry Winograd (Winograd, 1972). SHRDLU could understand and follow fairly complex sentences, yet it had a limitations—it was confined to the domain of simulated blocks. Nonetheless, at that time, SHRDLU surpassed any other system of its era.

The further development of artificial intelligence (AI) marked one of the most significant technological breakthroughs in recent decades. Moving beyond classic applications for gaming and proving theorems, AI advancement has focused on creating systems and algorithms enabling machines to perform tasks requiring human intelligence. When it comes to to language skills, AI plays a pivotal role in transforming how we assess, test, and comprehend language. For instance, one study delved into pronunciation errors in English-speaking skills using the ELSA application, employing qualitative content analysis as a research method (Indari, 2023).

Among various research domains, AI significantly impacts and advances the development of tools and techniques for testing individuals' language abilities. This primarily involves creating traditional grammar tests to assessing vocabulary and speaking skills (Lukácsi, 2020). Today, with the evolution of AI's sophisticated systems capable of analyzing and evaluating language competencies have emerged, surpassing previous traditional methods in terms of efficiency. Contemporary language skill assessment tools are increasingly precise in measuring grammatical accuracy, vocabulary, pronunciation, and linguistic fluency (Malyuga, 2019). These systems not only provide skill evaluations but also identify specific areas where individuals can improve their language abilities.

2. The Development of Technology for Testing Language Skills

The development of technology for testing language skills represents a crucial segment in researching how artificial intelligence affects the way we assess individuals' language competencies (Grünhage-Monetti, 2020). There's a lack of innovation in the domain of high-stakes assessment in education, where traditional methods like paper-based exams still prevail. Richardson and Clesham (2021) suggested the use of new technologies, particularly artificial intelligence (AI), to enhance theory and practice in assessment testing. Technological advancements in language skills testing are experiencing a significant breakthrough due to the application of artificial intelligence. Traditional tests have become increasingly tedious and limiting individuals' complex language skills. However, with the development of advanced technologies such as Natural Language Processing (NLP), deep learning, and computer vision, new avenues have opened for more precise, interactive, and multidimensional language tests.

Pokrivcakova (2019) discusses the integration of Information and Communication Technology (ICT) tools in Teaching English as a Foreign Language (TEFL) at Egyptian universities, focusing on teachers' attitudes toward ICT and its integration. With the aid of new technology, there's been an explosion in learning and receiving new information, particularly on mobile devices (Stošić, 2015). AI-EFL applications have become integrated into daily life, especially in education, aiding in improving English-speaking skills for EFL learners. However, there are limitations in adapting AI-EFLs to specific language learning purposes, such as university English for Specific Purposes (ESP) and Content and Language Integrated Learning (CLIL) approaches (Zou et al., 2021).

From language learning apps to online testing platforms, AI has facilitated the creation of tools offering personalized tests tailored to the individual needs and proficiency levels of each user. Moreover, technological advancements enable the development of realistic language situation simulations, allowing for better assessment of actual language abilities. Godwin-Jones (2001) discussed the expansion of computerized testing in scale and range, encompassing major national and international standardized tests, along with the controversies surrounding them. Several AI tools assist in crafting personalized foreign language tests, including the *Duolingo Test Center*, *Rosetta Stone*, *Babbel*, and *LingQ*. Additionally, specific tools like WebPractest and Hot Potatoes are used for designing language tests, offering features like question-by-question feedback, multiple-choice, fill-in-the-gap, short-answer, jumbled-sentence, and crossword-type quizzes (Godwin-Jones, 2001).

In terms of the above, the integration of AI in foreign language teaching, as discussed by Malyuga (2023) and Akopova (2023), marks a significant advancement, especially in business and professional communication. AI's ability to adapt to the ever-changing linguistic and educational needs is crucial in a globalized business world. This technology continuously learns and evolves, ensuring that learners are exposed to the current language usage, including the latest jargon and colloquialisms, which are crucial in professional settings.

Moreover, AI-driven platforms offer personalized learning experiences, tailoring content to meet the individual needs of each student. By analyzing a learner's progress, strengths, and weaknesses, AI can customize lessons, making them particularly effective for mastering business-specific vocabulary and communication styles. This personalized approach is further backed by AI's capability to provide interactive and practical learning experiences. Through simulated business environments and role-playing scenarios, learners can practice their language skills in realistic settings, preparing them for various professional interactions, from formal meetings to casual networking events.

One of the most notable benefits of AI in language learning is the provision of immediate feedback and correction. As students practice, AI tools can offer instant critiques on language use, pronunciation, and grammar, allowing for quick identification and correction of mistakes (Malyuga et al., 2016). This feature is invaluable in business communication, where accuracy and clarity are essential.

The flexibility and accessibility of AI-powered language learning platforms also stand out. Often available online, these platforms enable learners to study at their own pace and according to

their schedules, catering especially to professionals and business students with demanding commitments. Additionally, AI systems can incorporate the cultural dimension into the learning process. Understanding cultural nuances and etiquette is as important as language skills in international business communication, and AI can illuminate these aspects, scaling up the learner's ability to communicate effectively across diverse cultural scenarios.

In essence, AI's role in foreign language education and testing, particularly in the context of business and professional communication, is transformative. It offers a comprehensive, adaptive, and culturally informed approach to language learning and testing, ensuring that students are not only linguistically proficient but also culturally competent and ready for the global business environment.

All these tools leverage AI to personalize the learning and testing experience of foreign languages, while technological progress enables multidimensional analysis of language skills. This includes measuring various language aspects, such as grammatical accuracy, vocabulary richness, pronunciation, and response speed, providing a more comprehensive insight into an individual's language abilities.

3. The Application of Artificial Intelligence in Evaluating Language Grammar

Language grammar evaluation stands as a pivotal area in testing language skills and the role of artificial intelligence in this domain is profoundly significant. Through the application of advanced Natural Language Processing (NLP) algorithms, AI enables the analysis of complex language structures in text or speech. These tools not only identify grammatical errors but also discern contextual variations and subtleties in language, providing a deeper insight into grammatical accuracy (Gorozhanov & Guseynova, 2020). Additionally, AI allows for a personalized approach to evaluating language grammar. The system can adapt to an individual's proficiency level, offering exercises and tests tailored to specific user needs, thereby focusing on areas of grammar that require improvement. The capabilities of artificial intelligence, such as NLP, speech recognition, machine translation, and adaptive learning, empower applications to provide customized lessons, feedback, and exercises tailored to the strengths and weaknesses of individual learners (Bakhodirov & Rahmanova, 2023).

Assessing vocabulary and word usage is a crucial component in testing language skills, and the role of artificial intelligence in this context is of paramount importance. Through advanced Natural Language Processing (NLP) techniques and machine learning, AI enables the analysis of vocabulary breadth, precision in word usage, and diversity in vocabulary. Algorithms can identify and analyze word usage in context, facilitating a deeper understanding of the breadth and depth of language knowledge. Beyond quantitative vocabulary analysis, AI also enables a personalized approach to vocabulary assessment. Systems can adjust tests and exercises to match an individual's proficiency level, identifying weaknesses and providing specific exercises for vocabulary enhancement.

There are numerous tools offering detailed analysis of vocabulary, emphasizing the advantages in precision, individualization, and adaptability in measuring language skills. Tools for analyzing vocabulary can be highly beneficial for language learning.

Some of the tools offering detailed analysis of vocabulary and word usage include the following:

1. *Vocabulary trainers*. Programs like Anki, Quizlet, or Memrise allow users to input words and phrases they wish to learn, track their learning progress, and customize exercises based on the user's knowledge.

2. *LingQ*. The tool tracks words and phrases encountered by users during language learning, enabling them to monitor and analyze their vocabulary.

3. *Vocabulary analyzers*. Some specialized tools, such as online dictionaries or language learning applications, offer in-depth analysis of user vocabulary, and tracking progress and providing insights into which words or concepts need further learning.

These tools provide a detailed analysis of user vocabulary, allowing individuals to better understand their strengths and weaknesses concerning their knowledge of words and vocabulary in learning a foreign language.

The analysis of the implementation of digital services in foreign language teaching shows that the most popular tools are chatbots, which are used in several cases as dialogue trainers. Significant is the fact that, chatbots are used both for practicing formulaic constructions and for training communicative skills. In addition, there are isolated examples of using chatbots in professionally oriented training. At the same time, we have noticed that the presented experience of working with chatbots does not reflect the latest trends in the development of AI technology.

4. Speech Analysis and Artificial Intelligence in Pronunciation Testing

Considering speech analysis using artificial intelligence in pronunciation testing is an essential part of language skills research. Speech analysis has become a pivotal area in assessing language skills, with artificial intelligence playing a significant role in evaluating and enhancing individuals' pronunciation. Through the use of advanced technologies such as speech recognition and Natural Language Processing (NLP), AI enables the analysis of words, phrases, and sentence pronunciation. Algorithms can detect pronunciation accuracy, accent, intonation, and speech rhythm, providing a detailed assessment of individual pronunciation skills. The use of AI-based pronunciation checks can effectively improve students' pronunciation skills and promote independent learning of English pronunciation. Studies have found that spelling check applications have a positive impact on enhancing students' pronunciation skills and can be effective in fostering independent learning of English word pronunciation (Noviyanti, 2020).

Several Algorithms for speech analysis can detect pronunciation accuracy, accent, intonation, and speech rhythm using several techniques:

1. *Spectrograms and sound analysis*. Algorithms can convert sounds into visual representations (spectrograms) to analyze different frequencies and their temporal patterns. This enables them to identify nuances in pronunciation, accent, and intonation.

2. *Machine learning*. Algorithms are trained using pronunciation data. Through machine learning, they can learn to distinguish correct from incorrect pronunciation based on vast amounts of pronunciation data.

3. *Phonetic analysis.* Algorithms can analyze individual sounds and phonemes, identifying how these sounds are pronounced and whether they align with standard linguistic models.

4. *Contextual understanding.* Some algorithms can analyze speech patterns in the context of sentences or phrases to comprehend intonation, rhythm, and accent as a whole.

These algorithms can provide a detailed assessment of individual pronunciation skills using advanced speech analysis and machine learning technologies.

In addition to assessing pronunciation accuracy, artificial intelligence also enables a personalized approach in pronunciation testing. Systems can tailor exercises and tasks according to an individual's skill level, offering specific guidance for pronunciation improvement. Artificial intelligence facilitates this personalized approach in pronunciation testing through several methods:

1. *Customizing exercises.* AI can adjust pronunciation exercises based on an individual's specific needs. For instance, it can focus on particular sounds or phonemes that pose challenges to the user.

2. *Real-time feedback.* During pronunciation practice, AI can provide instant feedback to the user. By analyzing their speech, it can identify errors and offer advice for enhancement.

3. *Individual progress tracking.* Artificial intelligence can track each user's progress over time. Using these data, it can adapt the level of challenge or exercises to match individual needs and capabilities.

4. *Adaptability.* AI can modify exercise complexity as the user progresses. For example, it can automatically increase the difficulty of exercises as the user makes better progress.

These personalized approaches enable artificial intelligence to effectively assist individuals in improving their pronunciation skills by adjusting to their specific needs and learning pace.

Assessing language fluency is a crucial aspect of testing language skills, and the use of artificial intelligence-based tools significantly impacts the evaluation of this element. Artificial intelligence transforms the assessment and understanding of language fluency in individuals in several ways:

1. *Objective assessment.* Instead of subjective human evaluations, artificial intelligence employs objective metrics to assess language fluency. This eliminates bias and enables more consistent evaluations.

2. *Analysis of large datasets.* AI can analyze vast amounts of speech samples and language data to identify patterns and trends in language fluency. Based on this data, it can tailor assessments and provide recommendations for improvement.

3. *Real-time evaluation.* Tools utilizing AI enable real-time assessment of language fluency. For instance, during conversations or practice sessions, AI can analyze and evaluate speech speed, expressiveness, and grammatical accuracy.

4. *Personalized feedback.* AI can offer personalized recommendations for enhancing language fluency. Through the analysis of speech patterns, it can identify areas requiring additional attention and provide specific advice for improvement.

This combination of objectivity, data analysis, and real-time evaluation allows AI to transform the way language fluency is assessed and understood, offering users more precise feedback and personalized strategies for improving their speaking skills.

Through the use of advanced technologies like natural language processing (NLP) and machine learning, AI tools can meticulously analyze language fluency. They not only measure speech or writing speed but also assess rhythm, coherence of expression, and continuity of communication.

AI tools can comprehensively analyze language fluency using several techniques:

1. *Speech analysis*. Artificial intelligence can examine speech patterns to identify speech rate, pauses between words, speech flow, and rhythm. These parameters aid in evaluating fluency and naturalness of speech.

2. *Grammar analysis*. Tools can pinpoint grammatical errors, word usage, phrases, or sentence constructions that might impact language fluency. By assessing the correctness of grammatical structures, tools evaluate the level of speech fluency.

3. *Intonation analysis*. AI can analyze intonation, stress, and tonality in speech to identify a natural and fluent flow of expression.

4. *Comparison with reference material*. Tools can compare speech samples with reference materials or language standards to assess compliance with fluent speech norms.

The combination of these techniques allows AI-powered tools to thoroughly analyze language fluency, identifying aspects such as speed, grammatical correctness, intonation, and adherence to language standards. This enables more precise assessments and the provision of specific recommendations for improving speaking skills.

One of the key advantages of AI-driven tools is their ability to tailor tests and exercises to match an individual's skill level. This enables precise measurement and identification of areas where improvement in language fluency is needed.

AI-based tools offer several advantages when it comes to adapting tests and exercises to an individual's skill level:

1. *Personalization*. AI enables the customization of tests and exercises according to each individual's skill level. Based on the analysis of their responses or speech, tools can adjust the difficulty level, add challenges, or simplify exercises to suit individual needs.

2. *Dynamic adaptation*. Tools utilizing AI can dynamically adjust exercises over time in line with an individual's progress. As skills improve, the difficulty of exercises can increase, providing an appropriate level of challenge.

3. *Progress tracking*. AI allows for tracking the progress of each individual based on their responses, speech, or exercise completion. This tracking provides a better understanding of individual strengths and weaknesses and offers guidance for further improvement.

4. *Learning efficiency*. Tailoring exercises to an individual's skill level can enhance learning efficiency. Individuals are challenged at a precisely determined level, which can contribute to faster progress.

These advantages enable AI-driven tools to provide a more personalized and efficient learning or testing experience, customized to each individual and their specific needs.

5. Advantages and Challenges of Applying Artificial Intelligence in Language Testing

The application of artificial intelligence in language testing brings forth a range of advantages but also comes with challenges within this context.

Advantages:
1. *Precision in assessment*. Artificial intelligence enables detailed and objective analysis of language skills, providing more accurate results compared to traditional assessment methods.
2. *Test personalization*. AI allows the customization of tests and exercises based on an individual's level of knowledge, offering a personalized approach to assessing language skills.
3. *Efficiency and speed*. AI-driven tools enable quick and efficient testing of skills, saving time for both individuals and evaluators.

According to Fryer and Carpenter (2006), the advantages of using chatbot can help language learners through six ways: (1) students tend to feel more relaxed talking to a computer than to a person; (2) chatbots are willing to repeat the same material with students endlessly; (3) many bots provide both text and synthesized speech, allowing students to practice both listening and reading skills; (4) Bots are new and interesting to students; (5) students have an opportunity to use a variety of language structures and vocabulary that they ordinarily would not have a chance to use; and (6) chatbots could potentially provide quick and effective feedback for students' spelling and grammar (Fryer & Carpenter, 2006).

Challenges:
1. *Need for extensive data*. The quality of AI-driven tools often relies on vast databases, which can be challenging, especially for smaller languages or specific dialects.
2. *Context sensitivity*. Artificial intelligence may struggle with understanding context, leading to inaccurate assessments of language skills in certain situations.
3. *Ethics and privacy concerns*. The use of AI in language testing raises questions about data privacy, the ethics of algorithms, and the potential for discrimination.

Artificial intelligence is also employed in language testing, highlighting advantages in precision and personalization, but it also presents challenges in terms of the need for extensive data, context sensitivity, and ethical and privacy considerations.

Artificial intelligence plays a pivotal role in language testing, offering precision and personalization in several ways:

1. *Accurate response analysis*. Through advanced algorithms, AI can precisely analyze responses in language tests. This analysis covers grammatical accuracy, spelling, vocabulary, intonation, and text comprehension, providing a high level of precision in assessment.

2. *Adaptation of tests to skill levels*. AI enables the adaptation of tests to each individual's level of proficiency. Tools dynamically adjust based on responses during testing, offering assessments that match the individual's skill and knowledge level.

3. *Personalization of experience*. By analyzing test results, AI can offer personalized recommendations for further learning or improvement. This involves identifying specific areas for improvement and suggesting additional resources or exercises to enhance language skills.

4. *Real-time feedback*. During testing, artificial intelligence can provide immediate feedback on answer accuracy or comprehension levels. This allows participants to see their results instantly and receive guidance for improvement.

These AI features in language testing ensure high precision in assessing knowledge while providing a personalized experience to each user, resulting in more efficient learning and skill enhancement. Assessing socially and culturally significant units also remain a challenge (Wang, 2022; Malyuga & Akopova, 2021; Sibul et al., 2019). Necessity in constant testing is growing as the methodology becomes widespread in software development (Grishechko, 2023).

6. Ethics and Privacy Issues in the Use of Artificial Intelligence

Ethics and privacy are gaining increasing significance in the context of using artificial intelligence in language testing. Artificial intelligence's impact on privacy, security, and ethical considerations necessitates the proactively identification and prevention of associated risks. Because of these potential drawbacks, transparency challenges and ethical considerations need to be carefully weighed (Stošić & Janković, 2023, p. 68). The utilization of personal data from diverse sources in AI applications raises concerns about privacy, particularly regarding potential privacy infringements when companies access personal information (Li & Zhang, 2017).

The ethical dimensions of AI have emerged as a crucial area of interest across academia, industry, government, society, and individual spheres. Extensive studies have focused on exploring ethical concerns within AI (Huang et al., 2023). Zhang and colleagues delve into ethical and privacy issues concerning AI and their implications for everyday human life. Their work identified key contributors—such as research institutions, countries/regions, research journals, and communities—involved in AI ethics research via co-occurrence analysis (Zhang et al., 2021). By aligning AI techniques with critical ethical concerns, their study pinpoints emerging ethical issues derived from recent articles in prestigious journals. The insights gleaned from their research hold relevance not only for the AI community but also for audiences in science policy, technology management, and public administration. While the extensive use of artificial intelligence offers advantages, it also poses risks and threats, particularly concerning security, privacy, and ethics. Implementing research, regulatory measures, and oversight mechanisms is recommended to address these multifaceted issues (Li & Zhang, 2017).

When discussing ethics, the focus primarily revolves around the following:

1. *Data privacy*. The use of AI in language testing involves collecting and processing data related to individuals' language skills. This raises questions about how these data are stored and utilized and who has access to them.

2. *Discrimination and bias*. AI-based tools might be susceptible to biases that reflect upon different linguistic communities, dialects, or specific groups of people. This raises concerns about fairness and equality in evaluating language skills.

3. *Algorithm transparency*. Transparency in the functioning of algorithms assessing language skills is crucial. Lack of transparency can lead to insufficient understanding of how decisions regarding language proficiency assessments are made.

4. *Responsibility in technology use*. Questions arise regarding who is responsible for the accuracy and ethical use of AI-based tools in language testing and who is accountable for any errors or biases.

7. The Future of Language Skills Testing with the Advancement of Artificial Intelligence

The future of language skills testing promises comprehensive changes and advancements with the continuous development of artificial intelligence. This primarily includes:

1. *Personalized approach*. Advancements in artificial intelligence will further enable highly personalized approaches to language testing. Tools will more precisely adapt to individual needs and the knowledge level of each person.

2. *Innovative evaluation methods*. Expectations lean towards the development of even more sophisticated methods for assessing language skills. This involves integrating multiple modalities, such as speech, text, real-time interaction, and the ability to tailor tasks to real-life situations.

3. *Enhanced objectivity and reliability*. Further advancements in artificial intelligence for language testing will increase objectivity and reliability in assessing language abilities, reducing the subjectivity associated with traditional assessment methods.

4. *Evolution of educational processes*. The use of AI in language testing can influence the evolution of educational processes, adapting them to the needs of learners and providing better feedback for improving language skills.

8. Conclusion

Artificial intelligence represents an immensely valuable tool in advancing language skills. Through its advanced algorithms, analytical capabilities, and personalized approaches, AI transforms how we assess, understand, and improve language. Its contribution lies in the precision of language skill assessment, tailoring tests to individual needs, efficiency in evaluation, and providing personalized guidance for improvement. Moreover, AI drives innovation in language testing, promising evolution in evaluation methods and educational processes. However, alongside these advantages, it's essential to consider the ethical aspects of using AI in language testing, particularly regarding data privacy, potential algorithmic biases, and transparency in operations.

AI can be efficiently used in foreign language teaching. The role of artificial intelligence in foreign language learning is becoming more and more prominent, digital services developed through AI technology are used in teaching methods, and in the future, AI can become an assistant to the teacher in his/her pedagogical activities, taking over some of the functions.

Overall, the role of artificial intelligence in enhancing language skills is significant and promising. With an appropriate balance between innovation, ethical considerations, and continuous technological development, AI has the potential to significantly enhance our language abilities and language learning processes in the future.

References

Akopova, A. S. (2023). English for Specific Purposes: Tailoring English language instruction for history majors. *Training, Language and Culture, 7*(3), 31-40. https://doi.org/10.22363/2521-442X-2023-7-3-31-40

Bakhodirov, O., & Rahmanova, G. (2023, October). The role of AI in language learning apps. In *International Conference on Higher Education Teaching* (Vol. 1, No. 11, pp. 9-12). https://aidlix.org/index.php/de/article/view/201/198

Fryer, L. & Carpenter, R. (2006). Bots as language learning tools. *Language Learning & Technology, 10*(3), 8-14. https://scholarspace.manoa.hawaii.edu/server/api/core/bitstreams/5a011229-a52a-4909-b487-1546df0bb1a2/content

Godwin-Jones, R. (2001). Language testing tools and technologies. *Language Learning & Technology, 5*(2), 8-13. https://scholarspace.manoa.hawaii.edu/server/api/core/bitstreams/2f0935c2-5f5f-41a3-b104-b40ef0d92eae/content

Gorozhanov, A. I., & Guseynova, I. A. (2020). Programming for specific purposes in linguistics: A new challenge for the humanitarian curricula. *Training, Language and Culture, 4*(4), 23-38. https://doi.org/10.22363/2521-442X-2020-4-4-23-38

Grishechko, E. G. (2023). Language and cognition behind simile construction: A Python-powered corpus research. *Training, Language and Culture, 7*(2), 80-92. https://doi.org/10.22363/2521-442X-2023-7-2-80-92

Grünhage-Monetti, M. (2020). Which competences for whom? Supporting the supporters of work-related L2 development by migrants and ethnic minorities. *Training, Language and Culture, 4*(4), 62-77. https://doi.org/10.22363/2521-442X-2020-4-4-62-77

Huang, C., Zhang, Z., Mao, B., & Yao, X. (2023). An overview of artificial intelligence ethics. *IEEE Transactions on Artificial Intelligence, 4*(4), 799-819. https://doi.org/10.1109/TAI.2022.3194503

Indari, A. (2023). The detection of pronunciation errors in English speaking skills based on artificial intelligence (AI): Pronunciation, English speaking skills, AI, ELSA application. *Jurnal Serunai Bahasa Inggris*, *15*(2). https://www.ejournal.stkipbudidaya.ac.id/index.php/jd/article/view/1007

Li, X., & Zhang, T. (2017, April). An exploration on artificial intelligence application: From security, privacy and ethic perspective. In *2017 IEEE 2nd International Conference on Cloud Computing and Big Data Analysis (ICCCBDA)* (pp. 416-420). IEEE. https://doi.org/10.1109/ICCCBDA.2017.7951949

Lukácsi, Z. (2020). Standard setting and internal validation of a novel approach adopted for assessing speaking. *Training, Language and Culture, 4*(4), 9-22. https://doi.org/10.22363/2521-442X-2020-4-4-9-22

Malyuga, E. N. (2019). *Functional approach to professional discourse exploration in linguistics.* Springer. https://doi.org/10.1007/978-981-32-9103-4

Malyuga, E. N. (2023). A corpus-based approach to corporate communication research. *Russian Journal of Linguistics, 27*(1), 152-172. https://doi.org/10.22363/2687-0088-33561

Malyuga, E. N. & Akopova, A. S. (2021). Precedence-setting tokens: Issues of classification and functional attribution. *Training, Language and Culture, 5*(4), 65-76. https://doi.org/10.22363/2521-442X-2021-5-4-65-76

Malyuga, E. N., Shvets, A., & Tikhomirov, I. (2016). Computer-based analysis of business communication language. In *Proceedings of 2016 SAI Computing Conference SAI 2016* (pp. 229-232). IEEE. https://doi.org/10.1109/SAI.2016.7555987

Noviyanti, S. D. (2020). Artificial intelligence (AI)-based pronunciation checker: An alternative for independent learning in pandemic situation. *ELT Echo: The Journal of English Language Teaching in Foreign Language Context, 5*(2), 162-169. https://doi.org/10.24235/eltecho.v5i2.7246

Pokrivcakova, S. (2019). Preparing teachers for the application of AI-powered technologies in foreign language education. *Journal of Language and Cultural Education*, *7*(3), 135-153. https://doi.org/10.2478/jolace-2019-0025

Richardson, M., & Clesham, R. (2021). Rise of the machines? The evolving role of Artificial Intelligence (AI) technologies in high stakes assessment. *London Review of Education*, *19*(1), 1-13. https://doi.org/10.14324/LRE.19.1.10

Sibul, V. V., Vetrinskaya, V. V., & Grishechko, E. G. (2019). Study of precedent text pragmatic function in modern economic discourse. In E. N. Malyuga (Ed.), *Functional approach to professional discourse exploration in linguistics* (pp. 131-163). Springer. https://doi.org/10.1007/978-981-32-9103-4_5

Stošić, L. (2015). The importance of educational technology in teaching. *International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE)*, *3*(1), 111-114. https://doi.org/10.23947/2334-8496-2015-3-1-111-114

Stošić, L., & Janković, A. (2023). The impact of artificial intelligence (AI) on education – balancing advancements and ethical considerations on human rights. *Pravo - Teorija i Praksa*, *40*(4), 58–72. https://doi.org/10.5937/ptp2304058S

Turing, A. M. (1950). Computing machinery and intelligence. *Mind, 59*(236), 433-460. https://doi.org/10.1093/mind/LIX.236.433

Wang, Z. (2022). Assessing intercultural competence using videotapes: A comparison study of home students' performance. *Training, Language and Culture, 6*(2), 9-19. https://doi.org/10.22363/2521-442X-2022-6-2-9-19

Weizenbaum, J. (1966). ELIZA: A computer program for the study of natural language communication between man and machine. *Communications of the ACM*, *9*(1), 36-45. https://dl.acm.org/doi/pdf/10.1145/365153.365168

Winograd, T. (1972). *Understanding natural language.* Addison Wesley.

Zhang, Y., Wu, M., Tian, G. Y., Zhang, G., & Lu, J. (2021). Ethics and privacy of artificial intelligence: Understandings from bibliometrics. *Knowledge-Based Systems*, *222*, Article 106994. https://doi.org/10.1016/j.knosys.2021.106994

Zou, B., Liviero, S., Wei, K., Sun, L., Qi, Y., Yang, X., & Fu, J. (2021). Case study 11, Mainland China: The impact of pronunciation and accents in artificial intelligence speech evaluation systems. *Language Learning with Technology: Perspectives from Asia*, 223-235. https://doi.org/10.1007/978-981-16-2697-5_18