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DESIGN OF THE FRAMEWORK FOR STEM LANGUAGE TRAINING IN ENGINEERING EDUCATION

Abstract: In the era of digital transformation and globalization of science, the development of scientific and professional language training technical specialists has a particular importance. The present study was carried out in the of implementation of the project "Enhancing scientific and professional language learning for engineering students in Kazakhstan through Digital Technologies" financed by the Science Committee of the Republic of Kazakhstan (Grant No. AP19678460). The research in the article is devoted to the analysis of modern approaches to the formation of scientific language literacy of STEM (Science, Technology, Engineering, Mathematics) students by means of digital technologies. In the research there has been presented the framework of STEM language training aimed at developing scientific literacy, academic writing skills, and effective professional communication among STEM students in the context of digital transformation. Key principles and approaches of STEM language training such as interdisciplinarity, digitization, practical orientation and research-based learning are considered. The study highlights the positive impact of language literacy in the STEM communication on research skills development of future engineers and effectiveness of the digital tools on the development of research language skills and suggests future research directions, including the integration of artificial intelligence into the educational process.

Keywords: STEM language training, research language skills, framework, scientific communication, engineering education, digital transformation.

Introduction

Contemporary advancements in science and technology require technical specialists to combine in-depth professional knowledge with competence in scientific communication. In the context of digital transformation and globalization, the ability to communicate effectively in scientific and professional settings becomes increasingly vital. Under the conditions of digital transformation and globalization, scientific and professional communication takes on a special significance. Modern technical and scientific developments take place in an international context, which makes the mastery of scientific style and terminology an integral part of professional training. This problem is particularly relevant in the light of the introduction of scientific researches and digital technologies into the educational process. The use of electronic learning platforms, automated text analysis systems, data visualization tools and scientific databases opens up new possibilities for the development of scientific and professional language skills. However, along with the benefits of digitization, there are also new challenges associated with the need to adapt research methods to new conditions and to develop approaches that combine technological innovations with scientific principles of professional communication.

Nowadays there is a growing interest in the development of language skills of students of technical universities. Researchers consider various aspects of this problem, including the integration of interdisciplinary learning, the use of digital tools in the development of academic writing, the formation of research skills, and academic ethics. Despite the abundance of studies,

the issues of an integrated approach to academic language training in the conditions of digital transformation, as well as the evaluation of the effectiveness of different techniques and tools, remain unresolved.

The present article is devoted to the development and analysis of the framework of STEM language training of future engineers. The aim of the study is to identify the most effective approaches and methods aimed at the formation of research, academic and communicative skills in STEM disciplines. In order to achieve this goal, we analyzed modern approaches to the formation of scientific literacy of students of STEM disciplines taking into account the use of digital technologies, considered key principles of training such as interdisciplinarity, digitalization, practical orientation and research approach, and analyzed the world best practices and researches in the field of scientific communication. The proposed framework of STEM language training includes conceptual, content, technological and evaluation-result blocks, which provides an integrated approach to the development of scientific and professional language competence for engineering education. The results of the study can be used to improve the educational programs at technical universities and the quality of graduates' preparation for professional communication in the digital economy. Thus, the article examines the theoretical foundations of this problem, analyses domestic and foreign experience, presents methods for assessing the effectiveness of language training, and offers recommendations for its improvement.

Methodology

The methodology of this study is based on an integrated approach to the development of scientific and professional STEM language training for technical specialists in engineering education. It combines several interrelated methods aimed at creating a comprehensive, practice-oriented, and digitally adaptable framework.

The study begins with a literature review focused on the comparative analysis of the best practices and solutions in the field of language training for STEM students. The goal of this review is to identify theoretical foundations and practical strategies for enhancing scientific language literacy and academic communication skills, particularly in the context of digital transformation. There has been identified effective methodologies, tools, and educational models that support the development of research language skills for interdisciplinary communication among future engineers.

The classification method was applied to systematize linguo-didactic techniques used in scientific and professional STEM language training. This classification enables the structuring of key teaching principles and ensures their integration into the proposed training framework. It supports the alignment of instructional strategies with modern requirements of STEM education, including the use of digital technologies and the promotion of academic integrity.

The modeling method was used to design a pedagogical framework of STEM language training engineers. The framework was developed based on the classified linguo-didactic techniques and includes four interconnected blocks: conceptual, content, technological, and evaluation-result. The modeling process ensured the coherence of the framework’s components and their alignment with the objectives of developing linguistic, research, and digital competencies for engineering students.

Literature review

In recent academic literature, there is a growing interest in the development of the language skills of students at technical universities. Researchers consider various aspects of this problem, including critical thinking development, the application of digital technologies in developing academic writing and scholarly communication, and others. The analysis of

scientific sources allowed us to identify the main trends and approaches to the formation of scientific and professional language training of technical specialists.

The authors pay a lot of attention to the integration of digital technologies in the language training of students of STEM disciplines. L. M. Hrynevych, N. V. Morze and V. P. Vember consider the development of critical thinking through digital educational platforms (Hrynevych et al., 2023), and G. Siemens analyses the impact of digital transformation on academic writing and scholarly communication (Siemens,2020). T. Asten emphasizes the need for a structured approach to integrating digital skills in education, where the incorporation of digital tools may enhance students' communicative and collaborative abilities in both technical and academic settings (Asten, 2022).

The growing interdependence between digital competence and academic literacy, particularly within the context of engineering education plays a pivotal role in preparing engineering students to engage with the complex linguistic and communicative demands of their discipline. In the context of language training, academic literacy encompasses a set of core competencies, including the ability to read and interpret technical texts, produce structured and coherent written work, understand disciplinary discourse conventions, and critically evaluate sources of information. For engineering students, this means not only acquiring subject-specific terminology, but also mastering the language functions used to describe processes, interpret data, argue claims, and report research findings. An important place is occupied by the study W. Ye, which studies the methods of improving academic literacy using interactive platforms and artificial intelligence (Ye 2024). A. Y. Bagiyan, T. A. Shiryaeva and E. V. Tikhonova offer a model of pedagogical design aimed at improving the quality of language teaching in technical universities (Bagiyan et al., 2021).

A valuable contribution to the discourse on digital language education is provided by A. Mentsiev, M. Z. Ashakhanova and P. H. Almurzaeva. They emphasize the effective use of digital technologies, which facilitates the development of language skills and enhances students' ability to communicate professionally, collaborate in digital spaces, and access specialized information in multiple formats (Mentsiev et al., 2019).

Understanding, interpreting, and producing complex technical texts in digital formats is becoming essential as engineering curricula depend increasingly on digital platforms, simulation tools, and remote collaboration technologies. This means, teachers need to teach students how to navigate digital communication environments, write collaboratively, and adjust to the changing needs of online academic and professional discourse in addition to linguistic accuracy. The main opportunities and challenges presented by digitalization in the academic setting of engineering are outlined by C. Dell'Era, S. Magistretti, and M. Candi. C. Dell'Era, S. Magistretti, M. Candi highlight that a rethinking of educational models is necessary for the successful integration of digital tools in engineering education, where interdisciplinary integration becomes crucial including language and communication training (Dell'Era et al., 2025).

I. I. Trubina considers the development of soft skills through the integration of terminology in educational programs (Trubina, 2023). V. Tarasova stresses the need to develop students' academic writing and reading skills for successful scientific activity and professional growth (Tarasova,2020).

K.A. Maspul emphasizes the crucial role of scientific and technical language proficiency for prosperous engineering and technology careers. The author stresses that poor language proficiency can cause problems with data interpretation, scientific communication, and results presentation (Maspul, 2023).

Through the use of interactive simulations, collaborative platforms, and multimedia content, students can practice academic writing in digital formats, interact with peers in real-time problem-solving, and be exposed to technical terminology in context. These methods are

in line with contemporary language education objectives, which integrate professional communication, digital fluency, and academic literacy to help develop skilled, future-ready engineering professionals. The research of H.Hubal, A. Siasiev identifies key challenges such as the need for digital infrastructure, teacher readiness, and the adaptation of didactic models, as well as the significant prospects that digital environments offer for enhancing student engagement and interdisciplinary learning (Hubal et al., 2024).

The review thus demonstrates the increasing significance of language proficiency development in STEM education through digital technologies. It draws attention to important topics like encouraging critical thinking through digital platforms, incorporating digital skills into academic literacy, and the necessity of methodical approaches in language instruction. The emphasis is on using AI and interactive tools to improve student collaboration and communication. Along with the need for proficient language skills to support scientific communication and professional success, issues like teacher preparedness and digital infrastructure are mentioned. All things considered, incorporating digital resources into STEM language instruction is crucial to producing qualified engineering professionals.

The Framework for STEM Language Training engineers

The framework has been developed in the context of integrating academic language instruction into engineering education by aligning linguistic competencies with the cognitive and communicative demands of STEM disciplines. The framework seeks to bridge the gap between technical content and language acquisition by promoting disciplinary literacy, digital communication skills, and academic discourse practices. It is intended to improve engineering students' comprehension, interpretation, and production of scientific texts, their ability to work with others to solve problems, and their capacity to express themselves clearly both orally and in writing in both academic and professional contexts. The framework intends to support the development of linguistically competent, communicatively skilled, and globally competitive engineering professionals through the integration of digital technologies, interactive methodologies, and interdisciplinary collaboration. The framework is based on linguo-didactic strategies that assist STEM professionals in developing their scientific and linguistic literacy in order to guarantee both theoretical coherence and practical applicability. Language training has been able to be systematized thanks to this classification, guaranteeing alignment with the changing demands of digital transformation and integration within the suggested framework.

At the core of the proposed framework there are the linguo-didactic techniques, which constitute its theoretical foundation and are strategically integrated into the conceptual and content blocks. These techniques perform several critical functions. Firstly, they provide a set of scientifically grounded principles aimed at the formation and advancement of STEM-specific language competence. Secondly, they inform the pedagogical framework by guiding the selection of teaching methodologies, the incorporation of digital resources, and the reinforcement of academic integrity. Thirdly, they contribute to the systematic organization of language instruction by aligning it with the evolving demands of digital transformation and the internationally recognized norms of scientific discourse. The integration of linguo-didactic techniques thus ensures the internal coherence, contextual relevance, and pedagogical robustness of the framework, supporting its applicability in the training of future technical specialists.

Table 1
Linguo-didactic techniques

No.	Name of linguo-didactic techniques	Features of linguo-didactic techniques
1	Adaptation training materials for teaching scientific and technical terminology to international standards (ISO 704, ISO 1087)	1. Adaptation of terminology training materials with the creation of scientific and technical content in line with international scientific and technical standards. 2. Application of terminology teaching strategies through an interdisciplinary approach through harmonization, standardization and definition of terms. 3. Development of terms in new areas of scientific knowledge, taking into account the seven principles of terminology according to ISO 704. 4. Training in the application of terminological rules and standards of professional scientific and technical communication using modern digital technologies.
2	Focused training in science and technology communication using digital technologies: online dictionaries, electronic glossaries and databases.	1. Focused teaching of scientific and technical terminology through the use of specialized digital technologies: online dictionaries, electronic glossaries and databases. 2. Making scientific language learning accessible and effective through the creation of interactive educational materials using modern digital technologies. 3. Using online tools to check grammar and style when writing scientific and technical texts. 4. 4. Applying AI to analyze and create scientific text to meet the requirements of scientific style.
3	Comprehensive analysis of terms used in science and technology communication training, including identification, definition and comparison of concepts.	1.Introducing integrated term analysis in science and technology communication education, including identification, definition and description of concepts. 2.Teaching integrated analysis of scientific and technical text using critical thinking techniques. 3. Applying rigid syntactic norms for logical presentation of the content of scientific and technical text. 4. Comprehensively analyze terms to identify similarities and differences at all linguistic levels.
4	Interactive learning technologies (case studies, project-based learning) for use in real-life situations of scientific and technical communication	1. Contextualize terms to understand and apply them to specific science and technology communication situations through interactive learning technologies. 2. Use associations and analogies in teaching terminology through comparisons and association maps to facilitate understanding and memorization of new terms. 3. Develop new technologies for the visualization of scientific data to improve the quality of professional communication. 4. Integrating online educational resources in the development of visual-graphic data of linguistic information for better learning and memorization of complex linguistic terms and concepts.
5	Interdisciplinary approach to scientific language teaching through harmonization and standardization of terms	1. Practical teaching of scientific language with the setting of language tasks in real situations of professional-technical communication. 2. Teaching the key features of scientific and technical text: informativeness, logicality, structure and clarity.

		3. Unification of linguistic means for clear understanding and interaction of concepts. 4. Introducing methods of processing large amounts of information to ensure data security, identifying patterns, trends and relationships between data.
6	Using modern technologies to teach a scientific language - the language of inquiry	1. Using of AI to analyze and produce scientific text to improve the quality of writing and meet academic standards of scientific style. 2. Applying standardized data analysis techniques to ensure the reliability and validity of scientific and technical information and to provide accurate conclusions and recommendations. 3. Learning to use modern methods of analyzing scientific and technical information, AI and data mining technologies to analyze data effectively, developing their analytical skills and critical thinking in the context of scientific research. 4. Using virtual laboratories to optimize technological processes for experimentation and research, creating a safer and more effective environment for practical mastery of scientific language and methods of scientific presentation.
7	Scientific language in the promotion and accessibility of scientific research	1. Teaching students' effective methods of collecting and analyzing data in scientific language ensures correct interpretation of results and high standards of scientific enquiry. 2. Developing critical thinking and data analysis skills using scientific language promotes sound conclusions and strengthens scientific argumentation. 3. Interacting with colleagues from different disciplines using scientific language enables cross-disciplinary solutions to modern engineering problems and promotes innovation. 4. Knowledge of scientific language facilitates the writing of reports and publications, which increases the visibility and citation of students' work and contributes to their integration into the scientific community.

Linguo-didactic techniques with its features form the methodological foundation of the framework, guiding teaching approaches, defining language skills to be developed, and establishing evaluation criteria for effective learning (Table 1).

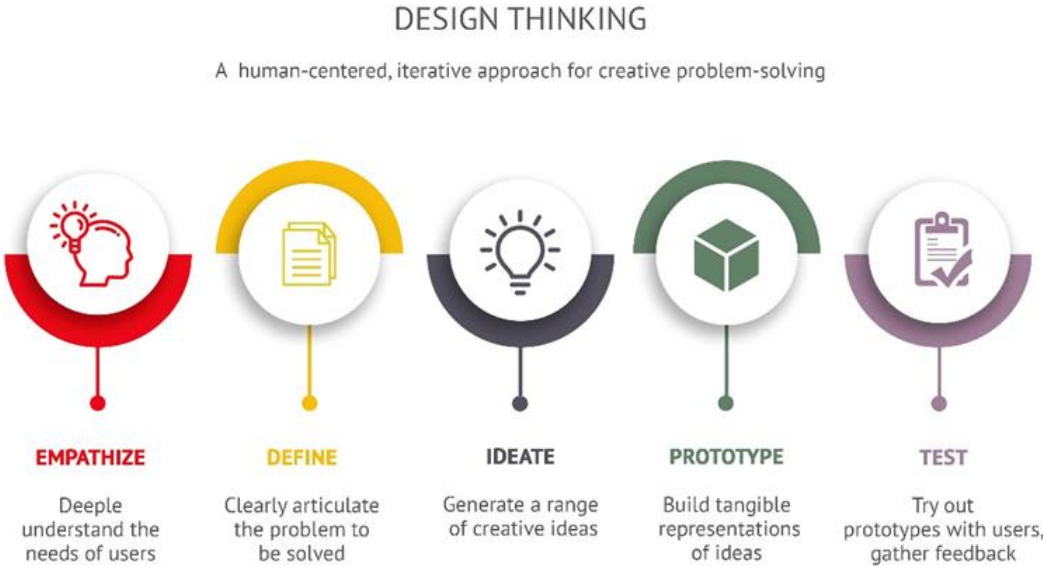
Results and discussion

This study aims to create an innovative framework that integrates interdisciplinary, digital and communicative approaches to enhance students' scientific literacy and research skills. The objectives include usage of contemporary approaches to scientific and professional language training, classifying linguo-didactic techniques that contribute to STEM education, developing a structured framework that includes conceptual, content, technological and evaluation blocks. Important stage is assessing the effectiveness of the proposed framework in improving students' language and research competences, and investigating the role of digital tools in promoting academic writing, terminology acquisition and scientific communication.

To put these theoretical frameworks into practice, the study uses five key methodological approaches, each chosen for their relevance to current educational challenges and their validation in current research and empirical work. These approaches were chosen for their capacity to address the multifaceted nature of language training in STEM education and for their proven effectiveness in fostering interdisciplinary competence, digital literacy, and communicative proficiency.

1. Design Thinking approach fosters critical thinking, creativity, collaboration, and the ability to solve complex engineering problems by mastering scientific concepts through hands-on experience and project activities (Guaman-Quintanilla et al., 2023). In the contemporary landscape of innovation and education, design thinking is emerging not just as a method, but as a fundamental way of thinking that is changing the way problems are framed and solutions are developed. Its collaborative, iterative and human-centered approach helps practitioners to deal with complex, ambiguous and rapidly changing challenges. Design thinking's integrity and efficacy ultimately derive from other approaches, such as interdisciplinary integration, digital and technological methodologies, communication strategies, and socio-cultural models, which provide useful additions. Design thinking ensures that innovation is not only possible and viable, but also appealing and successful, by balancing user needs with technological capabilities and business realities (Figure 1).

Figure 1
Design thinking approach



2. The interdisciplinary approach combines linguistic training with technical disciplines to guarantee contextual relevance, which promotes the use of language skills in practical engineering and scientific scenarios and improves problem-solving skills by fusing domain-specific knowledge with effective communication (Kreps, 2019). The interdisciplinary approach in this framework aims to combine language instruction with STEM subjects, guaranteeing that language learning is firmly rooted in the engineering and scientific fields. By encouraging contextual relevance and problem-solving skills, this alignment helps students apply their language proficiency to authentic academic and professional situations.

3. The digital and technological approach makes use of AI-based tools, digital platforms, and online research databases for academic writing and analysis (Le et al. 2023. It also ensures continuous access to scientific literature, citation management, and plagiarism detection tools, while encouraging self-directed learning through adaptive and interactive digital learning environments. This method is a key part of the suggested framework, which focusses on integrating contemporary digital tools and platforms to support scientific language learning, academic writing, and research communication. The frame aims to provide engineering students with the language and research competencies they will need in a digitalized academic

and professional environment. It illustrates how language instruction must be modified to meet the demands of digital transformation in STEM education.

4. The communicative approach emphasizes the practical application of scientific language in academic and professional settings, fostering peer review, collaborative learning, and structured academic writing exercises while improving students' capacity to engage in research discussions, conferences, and professional communication (Cezzar,2020). The communicative approach is essential for preparing engineering students for academic and professional communication in the real world. It emphasizes the use of scientific language in practice and focusses on building the students' capacity to communicate effectively in a variety of communicative contexts.

5. The sociocultural approach promotes adherence to international academic and publication standards while highlighting linguistic and cultural diversity in scientific communication. It prepares students for successful engagement in global scientific discourse by strengthening their capacity to manage interdisciplinary collaborations in a globalized research environment (Al Siyabi et al. 2022). This method in STEM education responds to the increasing demand for engineers to function well in cross-disciplinary and global settings.

By incorporating these approaches, the study establishes a comprehensive framework that enhances scientific and professional language training within this framework STEM specialists acquire linguistic proficiency, academic integrity, and digital competencies necessary for effective communication in technical and research domains.

The development of an effective pedagogical framework for STEM language training requires a systematic and theoretically grounded approach. In this context, the modeling method has proven to be a durable tool for the conceptualization and design of educational systems. Guided by the principles of pedagogical modeling theory, the selection of components within the proposed framework was carried out with careful attention to coherence, functional integration, and alignment with the target competencies of modern engineering education.

The framework is structured around four fundamental components: the conceptual block, the content block, the technological block, and the evaluation-result block. Each of these components performs a distinct yet interrelated function, collectively ensuring the theoretical coherence, practical applicability, technological integration, and systematic assessment of the framework’s effectiveness.

In contemporary scientific and educational models, particularly within STEM language education, the framework consistently structures around these four foundational components.

The Conceptual Block defines the fundamental principles of the framework, encompassing interdisciplinarity, digitalization, practical orientation, and a research-based approach. It establishes the theoretical foundation of scientific literacy and professional communication in STEM, ensuring that language training objectives align with contemporary challenges in STEM education (Newton et al. 2025). The Conceptual Block serves as the foundational element of the entire pedagogical model. It defines the guiding principles and theoretical underpinnings that shape the structure, content, and objectives of STEM language training for engineering students.

The Content Block focuses on the core components of language training, including academic writing, research skills, professional terminology, and data visualization. It incorporates interdisciplinary teaching methods that integrate linguistic training into STEM subjects, enhancing students' ability to interpret, analyze, and produce scientific texts in accordance with academic standards (Varianytsia et al 2022). The Content Block of the framework outlines the core educational components necessary for developing scientific and professional language competencies among engineering students, which emphasizes the essential linguistic and cognitive skills required in STEM language training, ensuring that

students are equipped to read, write, interpret, and communicate technical and scientific information effectively.

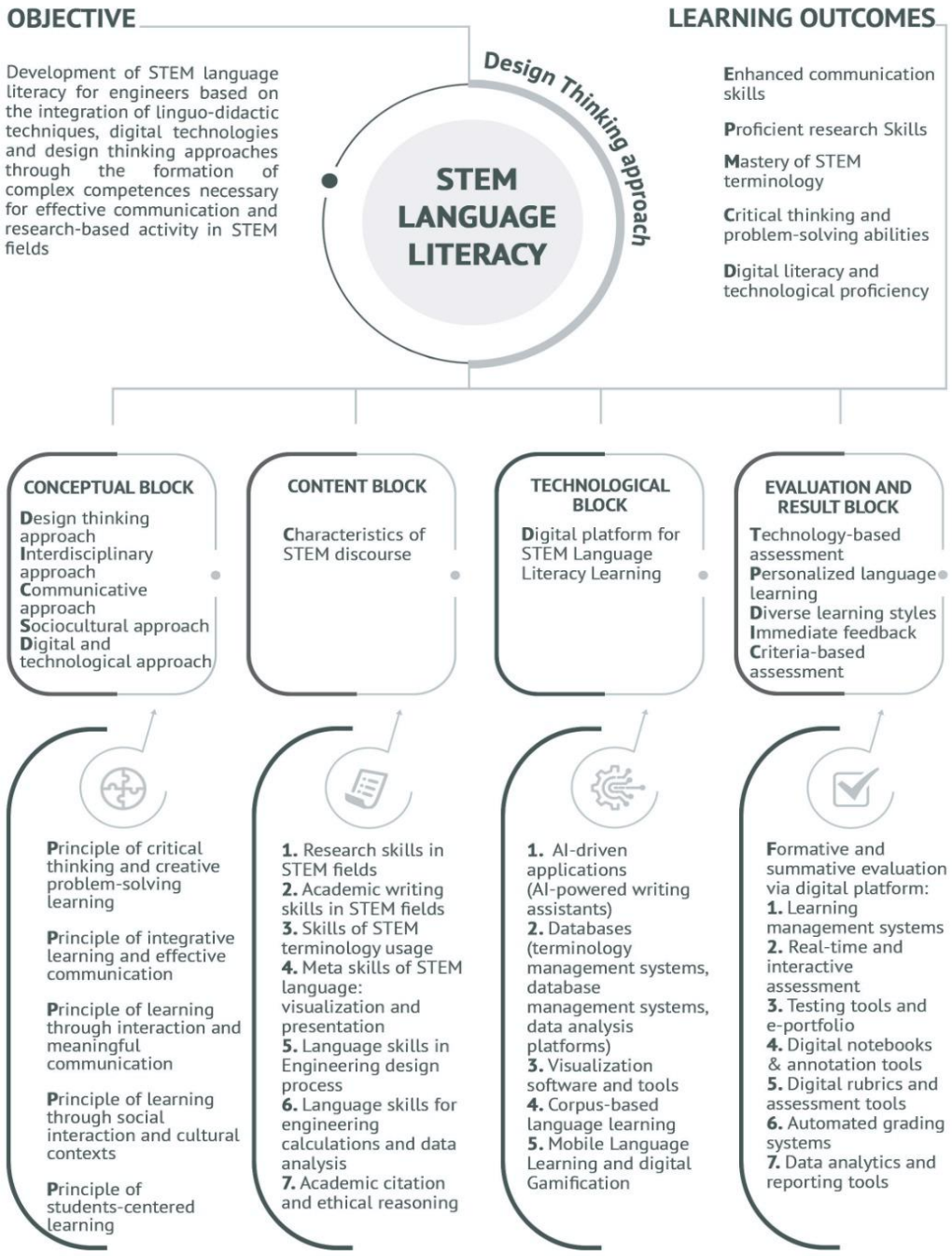
The Technological Block implements digital tools like Grammarly, Mendeley for academic writing and citation management, integrates research platforms such as Google Scholar, Web of Science, and Scopus for information retrieval and analysis, and utilizes data visualization software like Tableau, Python, and R to support the representation of research findings (Pérez et al., 2025). Within the framework, this block integrates modern educational technologies, digital tools, and AI-powered resources into the teaching and learning process and its purpose is to enhance the efficiency, accessibility, and interactivity of scientific and professional language training in STEM fields.

The Evaluation and Result Block assesses the effectiveness of language training by evaluating students' academic writing, research competencies, and use of digital tools, implements formative and summative assessment strategies to track progress in language proficiency, and ensures compliance with academic integrity standards through plagiarism detection and citation accuracy analysis (Ullrich et al.,2023). This block is a crucial component that ensures the systematic assessment and continuous improvement of language training outcomes, which provides a structured approach to evaluate the effectiveness, quality, and impact of scientific and professional language education within STEM.

These components were obtained as a result of an analytical classification of linguo-didactic techniques and methodological approaches, which makes it possible to verify that each element contributes to the holistic development of learners' linguistic, research and digital competences within the framework for STEM language training engineers.

This framework will be piloted in Abylkas Saginov Karaganda Technical university, where its effectiveness will be assessed based on academic writing proficiency, research skills, the ability to utilize scientific databases, engagement with digital tools for citation management, text analysis, and visualization, and adherence to academic integrity standards, with preliminary results indicating that integrating these approaches enhances students' ability to communicate research findings effectively, improves the quality of academic writing, and fosters a deeper understanding of STEM terminology and scientific ethics (Figure 2).

Figure 2
STEM Language Literacy model



Conclusion

The development of a comprehensive framework for STEM language training in engineering education represents a significant advancement in addressing the multifaceted challenges posed by digital transformation and globalization. By integrating linguo-didactic techniques, digital technologies, and interdisciplinary approaches, this framework not only enhances the scientific literacy and communication skills of engineering students but also

equips them with essential competencies for effective participation in a rapidly evolving global landscape.

The research conducted highlights the importance of fostering academic writing skills, research competencies, and professional communication abilities within STEM disciplines, ensuring that future engineers are well-prepared to navigate the complex demands of their profession. Moreover, the incorporation of digital tools and interactive methodologies facilitates a more engaging and effective learning experience, promoting self-directed learning and critical thinking.

The proposed framework, structured around the conceptual, content, technological, and evaluation-result blocks, provides a systematic approach to language training that aligns with contemporary educational requirements. By emphasizing the integration of digital resources and collaborative learning, the framework not only enhances the educational experience but also supports the development of a workforce that is adept at addressing real-world engineering challenges.

Future research directions will focus on the empirical evaluation of the framework's effectiveness in various educational settings, as well as the exploration of innovative digital tools, including artificial intelligence, to further enrich the learning experience. Ultimately, the framework aims to contribute to the preparation of globally competitive engineering professionals who can effectively communicate their ideas, engage in interdisciplinary collaboration, and contribute to advancements in science and technology. Through continuous refinement and adaptation, this approach has the potential to significantly elevate the standards of STEM language training and ensure the success of engineering graduates in a dynamic and interconnected world.

Conflict of Interest Statement

The authors declare no potential conflicts of interest regarding the research, authorship, or publication of this article.

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Author Contributions

Damira Jantassova: Conceptualization, Methodology, Validation, Writing-Original Draft, Supervision, Project Administration. Daniyel Damiyev: Formal Analysis, Investigation, Resources, Visualization, Writing -Review And Editing.

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RELIABILITY OF AI IN FOREIGN LANGUAGE SPEAKING ASSESSMENT: COMPARING AUTOMATED AND HUMAN SCORING AMONG UNDERGRADUATE IT STUDENTS IN KAZAKHSTAN

Abstract: The integration of Artificial Intelligence (AI) in language assessment, particularly in evaluating speaking skills, has introduced opportunities for greater consistency, efficiency, and scalability in educational contexts. This paper studies the reliability of AI-assisted speaking assessment compared to human-mediated evaluation, with a focus on inter-rater and intra-rater reliability in English as a Foreign Language (EFL) learning. This paper explores the strengths and limitations of AI in automated scoring, such as its capacity for standardization, alongside challenges related to validity, bias, and interpretability of results. This study reviews discrepancies between human and AI scoring due to subjective judgment and training limitations. The study emphasizes the need for standardized rubrics, rater training, and AI model calibration to enhance reliability. This paper concludes by proposing a hybrid assessment framework in which AI complements human raters, supported by methodological and technical improvements in speech recognition and natural language processing. This approach aims to optimize speaking proficiency evaluations while maintaining fairness and educational integrity.

Key words: AI in speaking evaluation, human-mediated assessments, inter-rater reliability, intra-rater reliability, AI-assisted assessment, rater severity.

Introduction

The use of artificial intelligence (AI) in foreign language speaking assessment has brought significant changes to education, particularly in the assessment of speaking skills. Since traditional language assessment methods often rely on human rater, AI-assisted assessment, on the other hand, offers greater standardization and scalability. However, reliability and validity of AI-generated ratings or scores continue to be the subject of debate compared to human assessments, particularly in the context of English as a Foreign Language (EFL) learners.

Artificial intelligence can improve the automated scoring process. Automated scoring involves three processes: feature extraction, feature evaluation and feature accumulation (Ercikan & McCafrey, 2022), i.e. the sum of growth by all additions. The first process presents the separation of specific elements of a response like words and sentences. The second analyses these elements and converts them into numeric values such as frequency and word length. The third feature combines these values to a single overall score. Artificial intelligence can enhance each of these steps by ensuring standardized and consistent evaluation. In contrast, individualized human raters assess responses by understanding the content and context and applying rubrics to assign a suitable score with some subjective judgment.

Automated assessment at large-scale language examinations can perform the teachers' role in grading and is termed as Computer-Assisted Language Learning (CALL) systems. The benefits of these systems are their accuracy in grading, these systems save human resources and improve efficiency (Wang, 2021). This is mostly relevant to the written forms of

examinations. However, oral examinations and speaking assignments are not yet automated or automated partly.

The present study is significant in that it attempts to research the opportunities of speaking assessment automation to enhance the reliability of the evaluation process. Here, this paper focuses on exploring the reliability of human-mediated speaking assessments compared to AI-assisted scoring, with a focus on inter-rater and intra-rater consistency. Additionally, our paper will examine key factors that influence rating reliability, such as rubric calibration, rater severity, grading and familiarity biases. Understanding these elements will contribute to improving the consistency and fairness of speaking assessments. Moreover, this research seeks to evaluate the opportunities and challenges that AI presents in human assessment of speaking skills. While AI has the potential to enhance efficiency and reduce grading time, concerns remain regarding bias, validity, and the ability of AI to provide meaningful feedback for language learners. By analyzing the role of AI in speaking proficiency evaluation, this study will offer insights into how AI can complement human raters and propose best practices for integrating AI into language assessment frameworks.

The current study targeted the following three research questions:

To what extent does human-mediated speaking assessment demonstrate inter-rater and intra-rater reliability compared to AI-assisted scoring in language proficiency evaluations?

What factors influence the inter-rater and intra-rater reliability of speaking proficiency evaluations?

What are the practical considerations for incorporating AI into human-led speaking assessment?

Literature Review

AI-assisted speaking assessment in TEFL

Artificial Intelligence (AI) is revolutionizing various educational environments by enabling personalized and interactive learning experiences. AI's use in language learning, specifically EFL contexts, is increasingly gaining attention. AI tools, such as Automatic Speech Recognition (ASR), allow students to practice speaking and receive feedback even when a native speaker is not present. AI-based systems can mimic human speech recognition, which has been shown to be beneficial for language learners in overcoming challenges related to fluency, pronunciation, and comprehension (Junaidi et al., 2020). Traditionally, EFL education emphasizes grammar, syntax, and written skills. However, studies have shown that this grammar-based approach has not been successful in improving fluency in spoken language. Over time, the focus in foreign language education has shifted towards achieving fluency and effective communication. Research points out that students often struggle with flow, fluency, pronunciation, and vocabulary in spoken English. Technologies like AI aim to bridge this gap by offering tools that replicate native speech environments. In the EAP context, AI tools such as Chivox, iFlytek, and Liulishuo assist university students in practicing speaking tasks necessary for academic success. These tasks often include presentations, group discussions, and answering questions related to subject-specific content (Zou et al., 2020).

The study by Junaidi et al. (2020) on the use of Lyra Virtual Assistant (LVA) demonstrates how AI can help secondary school students improve their speaking skills. Lyra, chosen for its affordability and functionality, allowed students to practice pronunciation and receive immediate feedback. The study compared students using LVA with a control group using traditional methods, showing significant improvement in pronunciation, grammar, flow, fluency, and vocabulary in the experimental group. Another study by Abdulhussein Dakhil (2025) investigated the impact of AI-mediated speaking assessment on the speaking performance and willingness to communicate (WTC) of intermediate Iraqi EFL learners. Forty participants were randomly divided into experimental and control groups, with the

experimental group receiving ten 60-minute sessions using the ELSA Speech Analyzer. Pre- and post-tests assessed speaking performance (grammar, vocabulary, pronunciation, intonation, fluency and flow), and the WTC scale measured communication willingness. Results showed significant improvements in grammar, vocabulary, intonation, and fluency for the experimental group, but no difference in pronunciation. Additionally, AI-mediated assessment enhanced WTC with both native and non-native speakers and in school contexts. Overall, AI-assisted speaking assessment proved effective in improving learners' speaking skills and communication willingness. In the same vein, the research by Zheng (2024) examined the use of an AI-assisted formative assessment platform in an English public speaking course. The platform utilized deep learning, automatic speech recognition, and writing evaluation to provide immediate feedback on speaking anxiety and competence. Fifty-two learners were randomly assigned to two groups: the control group (G1) used self-, peer, and teacher assessment, while the experimental group (G2) used self-, automated, and teacher assessment. Results showed that G1 reported higher social engagement, highlighting the importance of peer interaction in assessment. While G1 students were concerned about peer feedback quality, G2 students desired more detailed automated feedback. No significant differences were found in self-efficacy, engagement, or competence, suggesting that AI-assisted assessment can effectively supplement formative assessment and serve as a reliable learning aid.

Another study shows that students are generally receptive to the AI-powered presentation platform designed to provide students with more chances to practice their presentation skills without requiring faculty involvement. However, there are clear differences in the scoring abilities of AI and human raters. The results highlight limitations in both AI and human evaluation, suggesting that a collaborative approach combining AI and human intelligence could be beneficial (Chen et al., 2022). Furthermore, EAP Talk is the AI-powered platform aimed at improving the speaking abilities of English for Academic Purposes (EAP) learners. EAP Talk's impact on various speaking competencies, including fluency, grammar, vocabulary, pronunciation, and organization of ideas is found effective. EAP Talk is effective in enhancing EAP learners' speaking skills, with significant improvements observed in all evaluated areas. It can provide personalized feedback and the ability to tailor exercises to individual needs, which were highly valued by participants. However, some limitations were also identified, including the accuracy of speech recognition and automated scoring. Therefore, AI-assisted platforms like EAP Talk have the potential to complement traditional learning methods in EAP contexts, offering learners more personalized and adaptive learning opportunities (He et al., 2024).

Speaking assessment criteria

Educators argue that form and content in assessment are interconnected, requiring a balance between linguistic accuracy and structured arguments depending on the task (Moser, 2020). Speaking assessment commonly focuses on fluency, accuracy, pronunciation, grammar, and vocabulary. Fluency is often linked to speed, confidence, and minimal hesitations, that is described as the ability to use language naturally and effectively (Bailey, 2003; Makhlouf, 2021). While some researchers focus on fluency, others highlight the importance of content in effective communication (Harmer, 2015; Makhlouf, 2021). Webb, Newton, and Chang (2012) suggest that familiarity with words and expressions can help develop fluency. At the same time, accuracy is seen as a key indicator of proficiency, allowing speakers to communicate without errors and effective language control (Ellis, 2005; Makhlouf, 2021). Mispronunciation can lead to misunderstanding without practice, yet phonological training is sometimes overlooked in teaching (Vasbieva et al. 2016; Makhlouf, 2021). In standardized assessments like IELTS, accuracy is assessed through grammar, pronunciation,

and vocabulary (IELTS, 2007). Finally, vocabulary is vital in ensuring clear and meaningful communication (Schmitt, 2008; Zarei & Mahmoodzadeh, 2014; Ramezanali, 2017; Makhlouf, 2021). Each of these elements contributes to the overall learner's ability to communicate effectively, making them important for consideration in the language assessment.

These aspects included in predefined scaled assessment criteria enhance the overall objectivity and reliability of rating procedure. According to Dogan and Uluman (2017), this standardization minimizes subjective interpretation by different raters, leading to more consistent and fair evaluations.

Both traditional and AI assessments have limitations that must be addressed to ensure fair, accurate, and effective evaluation of student learning. The limitations of traditional assessment models mentioned by Yesilyurt (2023) are reliance on summative assessments, the difficulty in providing timely and personalized feedback, and the constraints of manual grading. Therefore, AI-driven innovations like automated scoring, speech recognition, multimodal analytics, and adaptive testing can transform language learning assessment. AI-powered assessments hold promise for improving efficiency and personalization, but they also have significant limitations. AI struggles to understand subtle nuances in language, creativity, and critical thinking that humans can easily grasp. Current AI assessment systems often rely on surface features of text (e.g., word count, sentence structure, grammar) rather than deeper understanding of content and argumentation. Many AI assessment systems are "black boxes," making it difficult to understand how they arrive at a particular score. So, it can be concluded that a responsible, human-centric integration of AI is needed to enhance pedagogy and the learner experience (Greene, Hoffman, & Stark, 2019; Selwyn, 2019; Yesilyurt, 2023).

Score Reliability

Generalizability Theory (GT) built on Classical Test Theory and ANOVA, provides a unique conceptual framework for evaluating score reliability (Brennan, 2001, as cited in Wang & Luo, 2019). It views scores as samples from a broader perspective of testing conditions where higher reliability suggests better generalization to other contexts (Cronbach et al., 1972, as cited in Wang & Luo, 2019). The generalizability of scores depends not only on task-specific factors but also on external contexts that influence result interpretation and decision-making (Bachman, 1990, as cited in Wang & Luo, 2019). The level of inter-rater reliability can be assessed using several methods derived from Generalizability Theory. For determining agreement among raters on a specific item for an individual examinee Cohen's kappa coefficient is used. Additionally, statistical measurements such as Fleiss's kappa, Kendall's W and intra-class correlation coefficient (ICC) are commonly employed (Dogan & Uluman, 2017).

Performance task results can be influenced by various factors such as task design, interviewer, rating scales, and raters (Barkaoui, 2010; Eckes, 2005; McNamara, 1996, as cited in Wang & Luo, 2019), with raters playing a particularly significant role in score variability. Due to individual differences, raters may demonstrate inconsistent severity (Myford & Wolfe, 2003, as cited in Wang & Luo, 2019), interact with other facets (Kondo-Brown, 2002; Schaefer, 2008; Upshur & Turner, 1999, as cited in Wang & Luo, 2019), and deviate from standardized scoring practices (Eckes, 2005; Yan, 2014, as cited in Wang & Luo, 2019), potentially compromising fairness in test interpretation and use.

The consistency of marks given by various raters to the same performance or response is known as inter-rater reliability (IRR) (McHugh, 2012). In assessments where human raters are involved, for instance, grading an essay or rating a speech, it is crucial to analyze how much raters agree beyond mere coincidence. Some real-world assessments involve more than two raters, which necessitates an extended approach to IRR. Fleiss' kappa is an extension of Cohen's kappa that enables assessment of agreement among three or more raters (Zapf et al.,

2016). Conceptually, Fleiss' kappa also corrects for chance agreement, but it aggregates the ratings from multiple judges to produce a single coefficient of reliability. This statistic, like Cohen's, ranges from –1 to +1, where higher values indicate stronger reliability. A key advantage of Fleiss' kappa is its ability to handle any fixed number of raters, making it well-suited for panel evaluations or situations where several instructors or judges independently score the same set of performances (McHugh, 2012; Nichols, 2010). Interpreting Fleiss' kappa values involves categorizing the strength of agreement: values less than 0 indicate poor agreement; value 0.01–0.20 indicates slight agreement; value 0.21–0.40 means fair agreement; value 0.41–0.60 corresponds to moderate agreement; values 0.61–0.80 shows substantial agreement; and value 0.81–1.00 means almost perfect agreement (Nichols, 2010).

Rater effects often discussed in literature include severity, halo effect, central tendency effects, etc., and introduce systematic distortions in assessment outcomes as they come from the rater's judgment. These biases can threaten the validity of ratings by introducing extra factors that distort the evaluation process. The most common rater bias is severity effect when assessors consistently give overly harsh or lenient scores compared to other raters (Eckes, 2005). According to Eckes (2009), rater severity can be influenced by various factors like experience, personality, attitudes, demographics, workload and assessment purpose. While senior raters may be stricter to adhere to standards, less-experienced raters tend to be more lenient, but the author suggests that research on the stability and causes of these biases remains limited. The study by Eckes (2005) found that while women generally received higher scores than men in writing and speaking assessments, aligning with prior research, which is not considered to be a systematic gender bias, though some raters showed varying scoring tendencies. Based on the observed study results in rater severity, he prioritizes rater training and individual consistency rather than between raters, regular raters' monitoring for severity, leniency, consistency, and score adjustment to ensure fairness in examinee evaluation (Eckes, 2005).

According to Hardré (2014), grading bias means assigning different grades to student work of similar quality due to irrelevant factors, undermining the fairness of assessment. Even with the best intentions, teachers can unknowingly let bias influence their grading. The author argues that teachers' personal knowledge and perceptions of students can influence grading: they may grade more generously students who are positive and engaged, even if their performance is like others. When unsure about grading, teachers may rely on mental labels and grades based on perceived potential rather than objective performance.

The study by Park (2020) investigated how rater characteristics, especially familiarity with foreign accent influence oral assessments, focusing on the interrater reliability and rater severity among EFL raters. The findings showed that teachers with little familiarity with Korean accent demonstrated the highest consistency while heritage/native Korean speakers and teachers with some familiarity exhibited slightly lower but still high reliability in ratings. According to Bogorevich (2018), research on native and non-native raters in speaking and writing has shown conflicting results due to variations in rater populations, study designs and assessment conditions with no quantitative differences in scoring approaches while qualitative analyses reveal differences in rating approaches for specific speech features.

Methodology

The current study sample consists of the participants learning English as a Foreign language in their first year of studies at B1 proficiency level from the Computer Science, Cybersecurity, Software Engineering, Media Technologies and Smart Technologies Departments of a higher education institution in Astana (Astana IT University). A systematic random sampling method was employed selecting every third student from a total number of 274 students, resulting in 91 participants. Of these, 70 students agreed to participate and signed

informed consent forms. Random sampling is where every individual has an equal chance of being selected from the population. Simple random sampling guarantees that each person has the same probability of being included. In this approach, the researcher compiles a numeric list of the entire sample size and employs a computer program to generate random numbers (Acharya, 2013). The participants answered predetermined speaking cards. The cards included topics related to the use of technology in the healthcare system. Students' oral responses were audio recorded for further assessment. All the recorded responses were initially assessed in three subgroups by raters, who were instructing these students, using the scaled assessment criteria rubric which included the following sections: content and organization, fluency, vocabulary accuracy, grammar accuracy, pronunciation and clarity, and time management.

The next step included cross-checking of subgroup recordings by independent raters to enhance reliability and consistency in assessment. Following human evaluation, the recordings were graded by the AI model which included two interconnected scripts: speech recognition, designed to convert audio files into text, and the second, which performs the analysis and evaluation of the resulting transcription (Figure 1). Out of 70 results 6 were excluded due to some technical errors. The scores given for fluency, pronunciation and clarity, and time management by human raters were also removed from the analysis due to AI model's constraints or limitations (AI model failed to provide scores for these abovementioned criteria). Hence, excluding these criteria from analysis is made strategically rather than intentionally to balance strengths and constraints of the AI model.

Natural language processing and speech recognition technologies allow for automating the process of audio transcription and text analysis which are relevant for educational and research purposes. The interaction of these components allows not only to automate the process of oral speech processing but also to perform a detailed analysis of speech quality considering the predefined assessment criteria. The application of such methods is especially valuable for evaluating students' oral speech, preparing data for machine learning, and automated analysis of audio files in various professional fields.

A speech recognition system was utilized. A script with the "Whisper AI" performs key tasks in processing audio files: converting them into a unified format, splitting long audio fragments into smaller parts, and then transcribing speech into text. This tool is based on the Whisper library developed by OpenAI (Radford et al., 2022), which uses neural network algorithms for highly accurate speech recognition. In addition, the script applies pydub (Pydub, 2023) to process audio files and ffmpeg (FFmpeg, 2023) to convert files to WAV format with the required parameters.

The script execution process starts with checking the audio file passed in the command line arguments. If the file format is other than WAV, it is automatically converted by ffmpeg to a 16 kHz monaural format. This step is necessary to ensure optimal performance of the Whisper model, since it is trained on data with similar characteristics. Once the audio file has been reduced to the desired format, it is analyzed for length. If the audio is longer than 30 seconds, the file is automatically split into parts of the specified length using the pydub library. This splitting is necessary because transcribing long files can be difficult both in terms of computational resources and model accuracy.

Next, each of the received audio parts is passed to the Whisper neural network model, which performs speech-to-text conversion. The received text is aggregated into a single string and written to a file with the extension _transcription.txt. Additionally, the function of deleting temporary files containing intermediate parts of the audio recording is implemented, which allows for optimizing the use of disk space. As a result of the script operation, the user receives a text transcription of the audio file, which allows for use in further analysis, machine learning, or other areas of natural language processing.

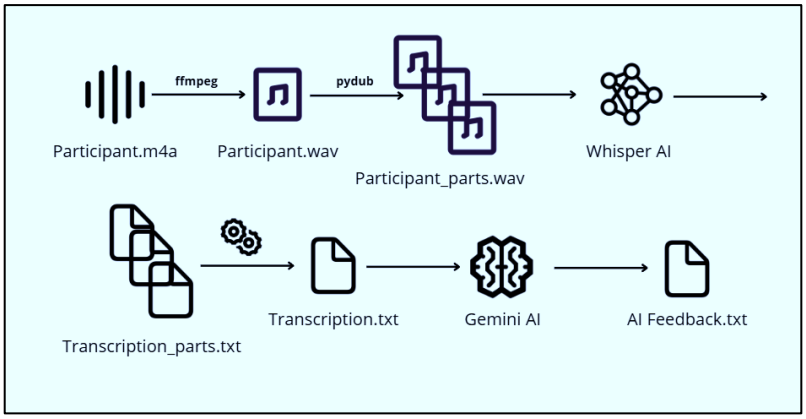
The generative AI script is designed to analyze transcribed text using the capabilities of the Gemini language model provided by Google. The main goal of this script is an automated evaluation of speech quality according to the predefined assessment criteria. For this purpose, the Google Generative AI API (Google AI, 2024) is used, which allows integrating the model into text processing and using it as an expert evaluation tool.

The script starts by loading the transcribed text from the file passed in the command line arguments. Then the evaluation model is applied to the text, working based on a specially prepared prompt. The prompt specifies evaluation criteria that include parameters such as speech organization and content, fluency, adherence to time frames, vocabulary proficiency, grammatical correctness, and pronunciation. To interact with the Gemini model, a chat session is created in which the transcription is sent as input. The model analyzes the text and generates a response containing a numerical score for each of the given criteria.

The assessment results are saved in a file with the _result.txt extension, which allows researchers to analyze the dynamics of students' performance, automatic verification of speech quality in educational and research settings. This tool provides the possibility of automated verification of oral speech, integration with distance learning systems, the assessment of speaking skills, and linguistic analysis.

Figure 1

Model of speaking assessment by AI



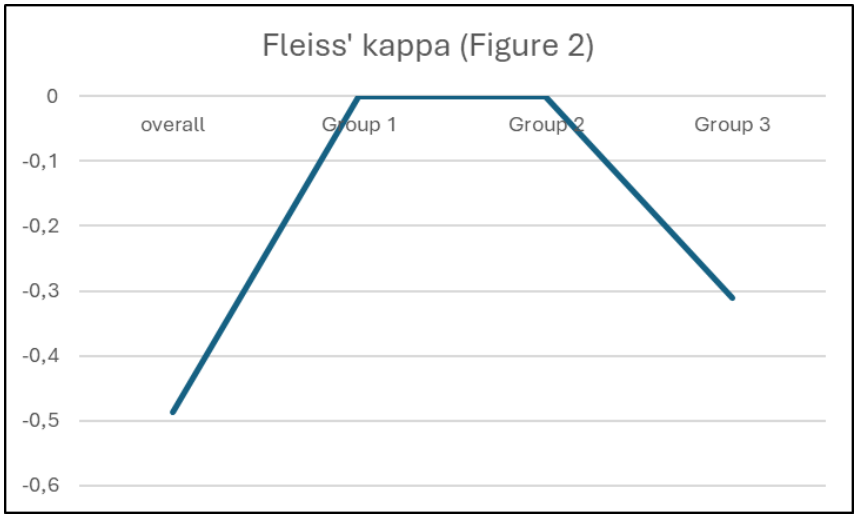
The collected data was processed in the following way: to analyze the reliability of four rater assessments (rater 1, rater 2, rater 3, and AI), Microsoft Excel as a tool for statistical calculations was used. The inter-rater reliability was examined using Fleiss' kappa to measure the level of agreement across four different raters, providing insight into the consistency of their grades. Intra-rater reliability was assessed using descriptive statistics for rater score analysis (mean, standard deviation, and standard error mean) to determine the consistency of a single rater. Additionally, rater severity was calculated to evaluate the extent to which individual raters differed in their scores, identifying the leniency or severity degree.

Findings

To assess inter-rater reliability, Fleiss' kappa was calculated for the entire dataset (all three groups of raters) and separately for each group (group 1, group 2, and group 3). Overall Fleiss' kappa equals to -0.487, indicating poor agreement across all rater assessments. Fleiss' kappa of group 1 (rater 1, rater 3, and AI) is 0.09 which corresponds to slight agreement. Group 2 (rater 2, rater 1, and AI) shows 0.02 which indicates slight agreement. Group 3 (rater 3, rater 2, and AI) has Fleiss' kappa of -0.31 which demonstrates poor agreement among raters (Figure

2). A negative kappa value suggests disagreement beyond chance, meaning that AI and human raters do not follow a consistent scoring pattern.

Figure 2
Fleiss' Kappa Inter-rater Reliability



To evaluate intra-rater reliability, descriptive statistics were computed separately for each group. As shown in Table 1, there are notable inconsistencies in mean scores among different assessors. In Group 1, assessor 1 assigned the highest mean score (39.00), whereas AI provided the lowest (26.05), with assessor 3 falling in between (28.33). In Group 2, assessor 1 and assessor 2 demonstrated a high level of agreement, with mean scores of 38.68 and 38.05, respectively. However, AI's mean score was significantly lower (31.89), suggesting a different evaluation approach. In Group 3, assessor 3 assigned the highest mean score (41.33), while AI once again provided the lowest (24.95), and assessor 2's score (31.58) was closer to AI than to assessor 3.

Table 1 also illustrates the variability of scores through standard deviation (SD) and standard error (SE). A lower SD indicates that the rater gives scores that do not vary much demonstrating high consistency, while a high SD means the raters' scores range widely with lower consistency in assessment. AI exhibits the highest SD in Groups 2 and 3 (10.3 and 10.08, respectively), highlighting greater variability in its scoring patterns compared to rater 1 and rater 2 who have significantly lower SD (4.03 and 6.27 respectively). In Group 1, assessor 1 has the highest SD (9.85), suggesting less consistency in scoring compared to other human assessors. Regarding SE, AI's values range from 1.9 to 2.4 across groups, implying a lower degree of confidence in its mean scores compared to some human assessors. Notably, assessor 1 in Group 2 has the lowest SE (0.9), indicating a high level of scoring precision.

Table 1

Assessment Scores across Three Groups

	Group	Mean Score	Standard Deviation	Standard error
Assessor 1	1	39	9.85	2.15
Assessor 3	1	28.33	8.69	1.9
AI	1	26.05	8.8	1.9
Assessor 2	2	38.05	6.27	1.4
Assessor 1	2	38.68	4.03	0.9
AI	2	31.89	10.3	2.4
Assessor 3	3	41.33	7.03	1.4
Assessor 2	3	31.58	5.24	1.07
AI	3	24.95	10.08	2.06

The analysis of rater severity further confirms these disagreements, as it measures how much each assessor's mean score deviates from the overall mean score (Figure 3). AI consistently displays negative severity values across all groups, indicating that it is systematically stricter in scoring compared to human raters. Conversely, assessor 3 exhibits the highest positive severity, particularly in Group 3, showing a more lenient evaluation approach. Meanwhile, assessors 1 and assessor 2 generally align more closely with the overall mean, showing their relative consistency. Overall, AI scores were systematically lower than human scores across most categories, highlighting the AI's greater severity.

Figure 3

Rater Severity across Three Rater Assessments

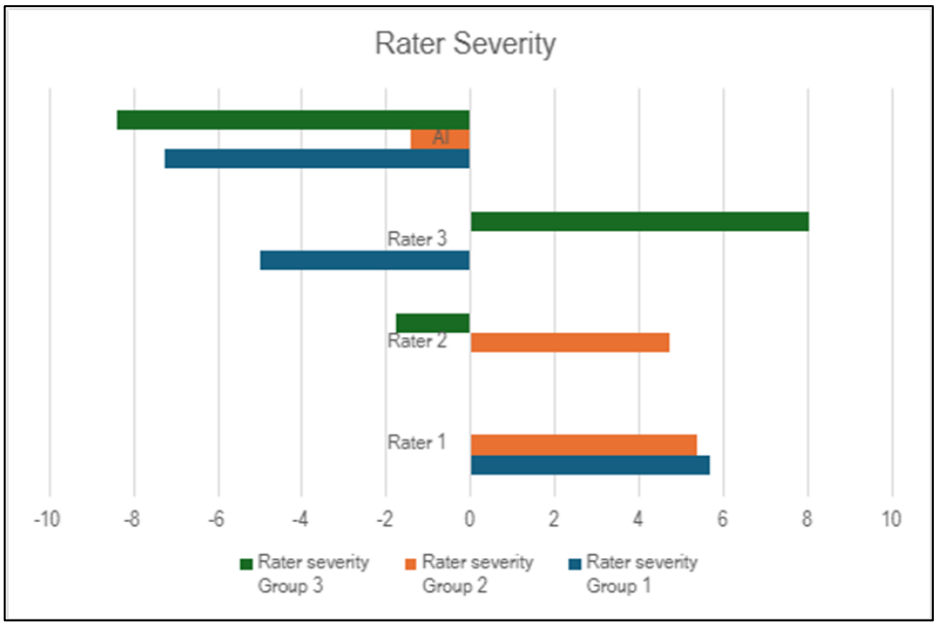


Table 2 demonstrates that AI seems to be tougher than human raters when assessing the content and organization and grammar categories. It shows bigger differences in scoring this category. It means that assessing how ideas are organized and accuracy in grammar can be subjective, and both AI and human raters see it differently in terms of foreign language norms and error detection precision. Vocabulary is the most consistent category among all raters

compared to the content and organization category. As it is agreed well on whether students have sufficient language to express themselves, suggesting that vocabulary is easier to judge objectively.

Table 2

Descriptive Statistics for Human Raters and AI Scores by Assessment Criteria

		Rater 1		Rater 3		AI	
	Criteria	M	SD	M	SD	M	SD
Group 1	Content & Organization	25.9	7.34	16.57	7.42	13.8	7.05
	Vocabulary	6.42	1.5	6.38	1.16	5.57	0.92
	Grammar	6.04	1.24	5.9	1.04	4.66	1.19
	Total	39	9.85	28.33	8.69	26.04	8.8
		Rater 2		Rater 1		AI	
	Criteria	M	SD	M	SD	M	SD
Group 2	Content & Organization	24.73	5.08	26.52	3.65	21.05	7.56
	Vocabulary	6.42	1.07	6.26	0.8	6.31	1.33
	Grammar	6.89	0.65	6.42	0.96	4.57	1.98
	Total	38.05	6.26	38.68	4.02	31.89	10.29
		Rater 3		Rater 2		AI	
	Criteria	M	SD	M	SD	M	SD
Group 3	Content & Organization	27	5.27	19.75	4.52	15	7.51
	Vocabulary	6.95	0.95	5.66	0.76	5.45	1.64
	Grammar	7.08	1.17	6.08	0.71	4.2	1.88
	Total	41.33	7.02	31.58	5.24	24.95	10.08

Discussion

These findings suggest a significant inconsistency in scoring patterns among assessors and AI. Particularly, the negative kappa value in Group 3 implies that raters were inconsistent due to disagreement. Such disagreement may stem from differences in individual assessors' interpretation of the rubric or variability in their scoring criteria. This confirms that inconsistencies remain constant aligning with previous research (Eckes, 2005; Wang & Luo, 2019). AI, in particular, may apply a stricter or fundamentally different evaluation method compared to human raters, leading to persistent discrepancies across all groups. This raises concerns about the alignment of AI-based scoring with human judgment, particularly when used as an objective assessment tool. Moreover, the slight agreement observed in groups 1 and 2 suggests that there is room for improvement in rubric calibration and training to enhance scoring consistency among human raters too.

The variations in mean scores and standard deviations indicate discrepancies in rating patterns, which have implications for intra-rater reliability. It varies notably across assessors and AI, and discrepancies among human assessors, especially in Group 1, highlight potential differences in how they interpret assessment rubric, suggesting the need for further calibration or training to improve scoring consistency. The findings by Limgomolvilas and Sukserm (2025) indicate that while multiple raters can improve reliability, a single well-trained assessor can still provide consistent evaluations in a resource-limited setting. A detailed analytical

rubric, its calibration, and proper rater training can make assessments efficient and reliable, even with just one rater.

Rater severity results indicate that AI systematically assigns lower scores compared to human assessors, particularly in Groups 1 and 3 which suggests that AI may be using a stricter or fundamentally different evaluation method compared to human raters. Variations in severity suggest that strict scoring tendencies of AI may need recalibration to align better with human evaluators, while slight disagreements among human raters indicate the necessity for comprehensive assessment criteria to enhance reliability.

In terms of criterion-based assessment, inter-rater discrepancies are notable in content evaluation, vocabulary assessment seems to show higher inter-rater reliability, and the grammar category shows more alignment with human raters in several groups while AI suggests more disagreement with human raters. These differences suggest that human raters may account for nuances in speech that AI does not, leading to greater variation. The findings propose that slight inconsistencies among human raters can result from familiarity bias or grading bias. Group 1 has moderate disparity where rater 1 (group 1 instructor) appears to be the most lenient and in Group 3, rater 3 (group 3 instructor) appears to have a tendency to give higher scores. This points to a strong leniency or familiarity bias in rater 3 for Group 3 and moderate leniency in rater 1 for group 1. Whereas the trend in Group 2 implies that it has higher agreement in scoring among human raters, suggesting reliable and consistent assessment. This is consistent with study conducted by Hardré (2014) where grading bias can be observed among human raters caused by various factors.

Conclusion

This study emphasizes that differences in assessment are conditioned not only by subjective perception of the assessment process but also by inconsistencies in how assessment criteria are understood and applied both by human raters and the AI model. However, AI ameliorates this process by standardization of variables to be considered. At the same time, we must constantly monitor programs and revise protocols as they need to be. Hence, continuous monitoring of rating quality is essential. It also conforms with Eckes (2005), who recommends regular revision of assessment protocols to raise the rater's consistency in terms of criteria and task design.

Reliability among human raters and AI has not been observed. This might correlate with the fact that the AI model was trained to assess native speakers mainly. Moreover, even though data training was administered (study materials on the content, assessment rubric, and prompts were introduced to the AI model), the results obtained were not complete. Furthermore, the strict requirements can justify the severity of the AI model; it can penalize small mistakes and observe minor inaccuracies in language usage. Human raters may allow nuanced judgment (familiarity bias) and leniency in the language usage being themselves non-native speakers. Addressing inter-rater inconsistencies through standardized training and recalibrating AI models to align more closely with human raters could improve inter-rater reliability in future assessments.

Developing comprehensive analytical rubrics can help reduce differences in rater's evaluations. Regular training sessions and calibration activities should be conducted to minimize inconsistencies among raters and a single rater. Ongoing evaluation of rater's performance can be conducted. Utilizing technology from AI models will ensure efficiency and optimization in large-scale assessments. This aligns with Limgomolvilas and Sukserm (2025) who advocate for detailed rubrics to enhance rating consistency. However, the need to evaluate multiple factors simultaneously within a limited time presents a challenge for raters. To ensure fair grading, educational institutions and instructors should use strategies that identify, reduce, and prevent bias in their assessment practices, including professional

development on recognizing bias, sharing assessment tools, and grading assignments together (Hardré, 2014).

Implementing AI in human-led conversation evaluation requires methodological and technical considerations to ensure objectivity, and consistency with human experts. From a methodological perspective, AI models must be trained to evaluate conversational speech based on the established CEFR frames of reference to maintain consistency with human experts. The AI should complement by acting as a co-assessor depending on the needs of the educational institution. AI-generated assessments and feedback should be clear so that humans can understand and validate the AI's decisions. From a technical perspective, high-quality Automatic Speech Recognition (ASR) models such as Whisper are needed for accurate speech transcription, especially for non-native speakers. AI should also use Natural Language Processing (NLP) to analyze cohesion and lexical diversity, providing detailed feedback on spoken responses. Real-time feedback tools are necessary for assessing pronunciation and grammar while remaining easy for users. By tackling these methodological and technological challenges, AI can substantially increase the effectiveness of human-led spoken language assessments, while preserving the reliability and objectivity of language evaluations.

Conflict of Interest Statement

The authors declare no potential conflicts of interest regarding the research, authorship, or publication of this article.

Author Contributions

Tleshova Zhibek: Editing, Annotation, Administration, Reviewing; Zhanar Tusselbayeva: Literature Review, Data Collection And Preparation, Grading Students' Works, Methodology; Aelita Ichshanova: Literature Review, Data Collection And Preparation, Grading Students' Works, Methodology; Aigerim Urazbekova: Literature Review, Data Collection And Preparation, Grading Students' Works, Methodology; Meruyert Zhenisbayeva: Literature Review, Methodology, Discussion; Ali Orynbayev: Software Development, Tools And Scripts Building And Processing.

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BILINGUAL EDUCATION: ANALYSIS OF SCIENTIFIC PUBLICATIONS IN SCOPUS

Abstract: The article considers bilingualism as one of the main trends in the linguistic development of society. Bilingual education is an important component of the educational process. The purpose of the work is to analyze the dynamics and content of scientific publications in order to identify the main directions of development and trends in the field of bilingual education. The research methodology includes the collection of data on the keywords "bilingualism" and "education", processing and analysis of 7609 publications using the statistical package SPSS and qualitative analysis programs, which allows for a multi-level analysis of thematic, geographical, and temporal aspects. The theoretical significance of the research lies in the systematization of knowledge about bilingual education, deepening understanding of the multidisciplinary nature of this field of research. The practical significance is expressed in the possibilities of using the results to develop strategies for preserving linguistic diversity and promoting intercultural communication. The results of the study showed a significant increase in the number of studies on bilingual education. Geographical and industry analysis of publications show the global and interdisciplinary nature of the research area. The conclusions of the study are that, in the context of globalization and digitalization of public space, it is important to continue research related to bilingual education in order to better understand the relationship between language, society, and culture.

Key words: bilingualism, education, Scopus, scientific publications, multidisciplinary, quantitative analysis, intercultural education.

Introduction

In the modern multicultural world, the issue of bilingualism is becoming particularly relevant, especially in the context of educational processes. Learning two languages can significantly affect students' cognitive development, social adaptation, and academic success. The article is aimed at analyzing scientific papers published in the Scopus database, which allows us to assess the current state of research in this area. The use of VOSviewer and Bibliometrix tools for bibliometric analysis, as noted by Cruz-Lovera et al. (2017), as well as in-depth search for specific keywords in Scopus, highlighted in the works of Pakkan et al. (2022) and Akkaya & Ertekin (2021), has become standard practice in scientific research. This not only provides comprehensive coverage of citations and literary excerpts, but also expands the profile of journals, improving access to scientific publications and contributing to citation analysis. Special attention is paid to how bilingualism affects learning in different educational systems, as well as which methods and approaches are most effective in teaching bilingual students. This research will help scientists and educators better understand the potential of bilingualism and adapt educational strategies to support multilingual students.

The importance of bilingualism in the educational field is continuously confirmed by scientific research that highlights its beneficial effects on cognitive abilities and academic performance. Bialystok (2017) indicates an improvement in executive functions due to proficiency in several languages. Han (2011) focuses on the role of bilingualism in the academic trajectory of children in primary school. Lindholm-Leary (2016) also links

bilingualism with increased cognitive abilities and academic achievement. Chin (2015) emphasizes the importance of bilingual education in ensuring cultural inclusion and diversity, while Cervantes-Soon et al. (2017) draw attention to its importance in promoting equality and equity through bilateral immersive programs. Mendis et al. (2021) propose considering bilingualism as a global public health strategy for maintaining cognitive health in old age. Duncan & Phillips (2016) argue that bilingualism can serve as a cognitive reserve that slows down the processes of deterioration of cognitive functions, and Perquin et al. (2013) provide new data to support the hypothesis of cognitive reserve associated with prolonged multilingualism.

An analysis of publications from the period 2000 to 2023 on the topic of bilingualism and education, based on the keywords "bilingual" and "education," reveals a noticeable increase in scientific interest in this area. The total number of studies found on these parameters was 7,609. The number of publications started at 66 in 2000 and reached its peak at 775 papers in 2023. This upward trend reflects scientists' increased attention to the issues of bilingual education, likely due to globalization processes, migration flows, and the recognition of the importance of multicultural education. This trend confirms the significance of bilingualism in the modern educational discourse, as countries worldwide strive to integrate multilingual strategies into their educational systems to enhance education quality and strengthen intercultural communication.

Our research aims to comprehensively analyze academic papers selected based on the keywords "bilingual" and "education" for the period 2000 to 2023. The study seeks to identify and analyze key trends and methodologies influencing the bilingualism and education debate in linguistic research. The tasks include quantitatively analyzing the pace of publication activity, determining the geographical distribution of research, identifying leading scientists and organizations in the field, and analyzing contributions from significant scientific journals. This study will identify the main research centers focusing on bilingualism in the educational context, uncover existing knowledge gaps and poorly studied aspects of the topic. The gathered information will help steer future research and contribute to a deep understanding of the interaction between bilingualism and educational practice, crucial for developing effective educational strategies in multilingual and multicultural settings.

Literature review

The study of bilingualism in education is inextricably linked to the cognitive processes of students. Studies by Bialystok et al. (2012), Grundy & Timmer (2016), and others emphasize that bilingualism has a significant impact on the cognitive development of children and adults. Special attention is paid to improving executive functions and working memory, where the language used during tasks affects cognitive outcomes (Bialystok & Craik, 2010). The efforts of scientists such as Festman et al. (2010) and Cox et al. (2016) point to the benefits of bilingualism, which manifest themselves in various aspects of cognitive control, including improved phonetic learning and thinking flexibility (Antoniou et al., 2014). These studies allow us to better understand how bilingual education can promote literacy and language achievement by supporting cognitive development in various educational contexts (Sefedini, 2018; Adnyani et al., 2023).

The effectiveness of bilingual education is closely linked to the use of methods and strategies that ensure successful bilingual education for students. Research by Kenner et al. (2008) and Yeh et al. (2002) points to the cognitive and cultural benefits that bilingual educational programs can offer. Pedagogical strategies developed and implemented by teachers contribute to strengthening student learning. Rolstad et al. (2005) demonstrated the effectiveness of an approach in which reading is first taught in the student's native language and then in English. For children of the second generation of immigrants, bilingual education

is vital for preserving the first language and acquiring the language of the country of residence (Schwartz et al., 2012). The importance of specific bilingual learning strategies aimed at reducing the cognitive load of students and improving learning outcomes is emphasized in the works of Ashton-Hay et al. (2021). Guglielmi (2012) also links bilingual education to the enhancement of academic achievement through the preservation and development of native language skills. The use of a variety of teaching strategies promotes the understanding and assimilation of academic content (Martínez et al., 2019), which emphasizes the need for careful planning, effective implementation, and continuous evaluation in the process of teaching two languages simultaneously.

The socio-cultural aspects of bilingualism in education determine the depth and diversity of the educational process, bringing elements of intercultural interaction and personality formation. Studies by AlShamsi & Alsheikh (2020) and Hamman-Ortiz & Palmer (2020) emphasize the importance of sociocultural competence, which influences educational experience and promotes intercultural interactions. Loginova & Gvozdeva (2019) examine the influence of bilingualism on national identity among various ethnic groups, emphasizing the close connection of language with culture and identity. In an educational context, it is important to take into account intercultural and multicultural competencies for effective navigation in diverse social landscapes (Hus & Hegediš, 2018). The work of Chapman et al. (2022) focuses on the importance of socio-cultural factors in bilingual education for the academic and socio-cultural development of students. Kharkhurin's (2010) studies explore the role of bilingualism in stimulating creativity, pointing out that the relationship between bilingualism and creativity depends on the sociocultural context. Bilingual education programs focused on the development of intercultural competence (Khuziahmetov & Valeev, 2018) and the introduction of socio-cultural pedagogies (Teemant et al., 2005) create inclusive educational environments that take into account the diversity of linguistic and cultural backgrounds of students, emphasizing the importance of developing bilingual curricula to prepare students for the role of intercultural citizens (Wang et al., 2017).

In examining the landscape of bilingual education in Kazakhstan, recent studies highlight the diverse approaches and challenges within the context of the country's trilingual policy. Goodman and Tastanbek (2020) discuss the shift from codeswitching to translanguaging, emphasizing the need for nuanced language policies to support multilingual education. Moldabekova et al. (2021) and Imambek (2023) focus on the development of polylingual communication skills and the adaptation of teaching methodologies to new demographic realities. The sociocultural dimensions of Kazakhstan’s bilingual environment are explored by Salimgerey et al. (2023) and Tlemissov et al. (2020), who highlight the implementation of trilingual systems in secondary education. Innovative pedagogical methods, including the integration of linguocultural components and mind-mapping, are addressed by Kalizhanova et al. (2020) and Bakishev and Plumlee (2022). The practical implications of multilingual education in specific contexts, such as agricultural institutions, are discussed by Duisebayeva and Imasheva (2022). Collectively, these studies provide a comprehensive view of the challenges and opportunities in fostering effective bilingual and trilingual education in Kazakhstan (Abdulina, 2022; Danilov et al., 2020; Valieva, 2019).

In conclusion, of the literature review, it can be noted that bilingualism in education covers a wide range of cognitive, methodological, and socio-cultural issues, each of which makes a significant contribution to the general understanding and development of bilingual education. The reviewed studies emphasize not only the academic importance of bilingualism but also its impact on personal development in a multilingual and multicultural world. The interaction of these aspects provides valuable insights for the development of educational strategies that will contribute to the comprehensive development of students and prepare them for active life in a globalized society.

Materials and research methods

Materials

The research on the topic of bilingualism and education was conducted on the basis of a comprehensive analysis of academic papers registered in the Scopus database from 2000 to 2023. Based on the keywords "bilingual" and "education," 7,609 publications were selected, which represents a large volume of research data for analysis. The research material includes scientific articles (5,294), book chapters (1,149), conference reports (443), reviews (338), and other forms of scientific works. Such a variety of source materials makes it possible to cover many perspectives and provide an integrated approach to the topic under study, allowing you to trace the dynamics and development of research interest in the field of bilingualism during this period.

The data for the analysis reflect a wide range of studies conducted in different countries, which allows us to take into account the diversity of educational systems and cultural contexts in which bilingualism operates. The study of publications in reputable journals such as the international Journal Of Bilingual Education And Bilingualism, Bilingual Research Journal, and many others provides an opportunity to delve into the specifics of discourse and identify key topics that occupy the scientific community in the context of bilingual education. The body of scientific papers under consideration also includes publications from a variety of specialized journals and series that represent the main platforms for the exchange of knowledge in the field of linguistics and education. This provides an opportunity to conduct a thorough analysis of current research trends and scientific approaches to bilingualism.

Special attention in the study is paid to the careful selection of publications according to specified criteria to ensure the relevance and significance of the collected data. In addition to quantitative characteristics, such as the year of publication and the type of research, qualitative aspects of the work are also analyzed, including the depth of analytical coverage of the topic, the methodological approach of the researchers, as well as specific conclusions and recommendations presented in the research. All this allows us to create a complete picture of the state of research in the field of bilingualism and education, identify the main directions and gaps in existing knowledge, as well as determine the potential for future scientific work.

Instrument

The selection of appropriate analytical tools plays an important role in the study of bilingualism and education. The SPSS program was chosen as the basis for quantitative analysis because of its ability to process data arrays and perform complex statistical analysis. This tool is designed for deep analysis of textual data, allowing the researcher to encode, classify, and analyze qualitative data while identifying key concepts and topics. It is particularly valuable for research in the field of education and bilingualism, where contextual and cultural aspects must be taken into account. Qualitative analysis programs facilitate the process of identifying common thematic patterns and individual characteristics in large text arrays, which deepens understanding of the topic under study and reveals unique relationships between bilingualism and educational processes.

In addition to SPSS, specialized data visualization programs such as Tableau and Excel were integrated into the study. These tools allow for the creation of interactive charts and graphs to visually demonstrate the results. They not only facilitate the interpretation of complex statistical data but also enhance the effectiveness of presenting analysis results to the scientific community. Visualizing statistically significant relationships and trends in data becomes critically important when presenting conclusions in a scientific article.

Procedure

The analytical data processing began by extracting information from the Scopus database using complex queries for the keywords "bilingual" and "education". This stage identified

relevant studies that met the specified criteria within the specified period. Each selected work underwent a verification process to ensure it met the established research parameters, including thematic relevance and academic value. Spreadsheets were created to catalog the data, including metadata of publications such as the type of research, authors, year of publication, number of citations, and availability of the text. This provided a convenient platform for subsequent data extraction and analysis.

For detailed analysis, the SPSS statistical package was used. Descriptive data analysis was carried out to determine the distribution of publications by year, journal, country, and other key parameters. This allowed for the identification of main trends in the field of bilingualism and education, as well as a comparative analysis between different research groups and approaches. Comprehensive analysis was enhanced by combining data obtained using various methodological approaches to ensure maximum objectivity and reliability of the results.Upon completion of statistical and qualitative processing, the data was visualized for better perception and interpretation of the results. Graphs and diagrams illustrating key findings were created using data visualization programs, significantly enhancing the understanding of complex relationships and facilitating the presentation of results. The final stage involved synthesizing all the obtained data into an exhaustive report, which served as the basis for the development of a subsequent scientific publication.

The conclusion of the "Methodology" section reflects an integrated and multifactorial approach to the analysis of data on bilingualism and education. The applied methods and analysis tools provided depth to the research, accuracy to the results, and the possibility of interpretation within a broad academic context. The findings have the potential to shape further research, enrich academic dialogue, and be applied practically in educational policy and teaching practices.

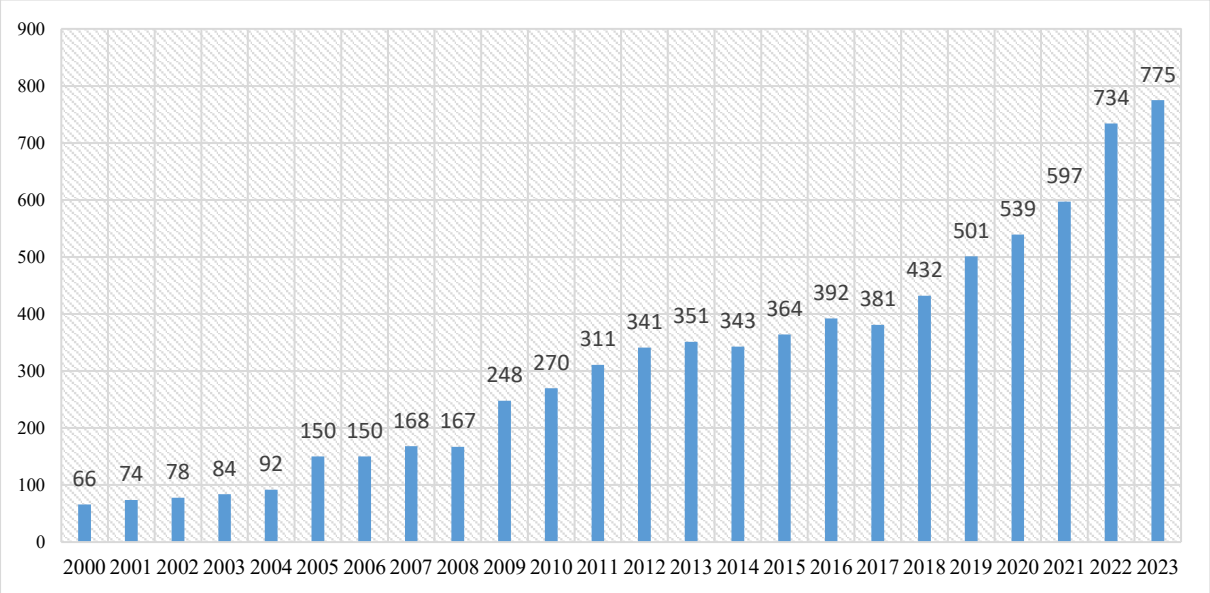
Results and discussion

As part of the study, analytical procedures were carried out to assess the current state and dynamics in the field of bilingualism and education. Temporal analysis revealed a steady increase in the number of publications during the study period, which indicates a growing interest in bilingual education. The geographical analysis highlighted the global nature of research with the active participation of scientists from different cultural and linguistic contexts. The sectoral analysis pointed to the multidisciplinary nature of research involving a wide range of knowledge branches and approaches. The organizational analysis showed a variety of leading scientific centers that make a significant contribution to the development of the topic. The publishing analysis has identified key journals that actively publish scientific works on bilingualism and education. The analysis of keywords in the titles of publications gave an idea of the most discussed aspects in this field, while the evaluation of citations revealed the most influential studies shaping the directions of academic discourse. Taken together, these data illustrate a wide range of interests and priorities in the study of bilingual education and open up new horizons for further scientific research and practical developments in this direction.

A temporal analysis of publications indexed in the Scopus database on the topic of bilingualism in the educational field shows a significant increase in scientific interest since the beginning of the XXI century. From 66 papers registered in 2000, the number of publications has steadily increased, reaching 775 by 2023. This growth reflects not only an increase in the volume of research in the field of bilingual education, but also the expansion of theoretical and methodological approaches to the study of bilingualism, as well as increased interest in this topic in the light of globalization and migration processes (Figure 1).

Figure 1

Trends in publication activity in the context of bilingualism and education: analysis of Scopus data for 2000-2023 (Source: own calculations based on data from publications indexed by Scopus)

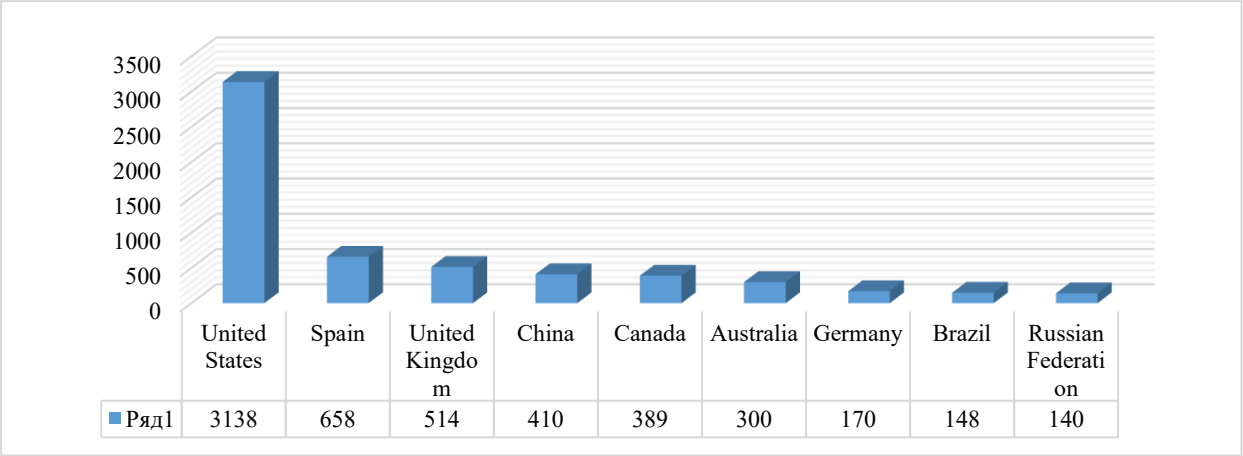


Of particular interest is the period after 2010, when there is a particularly noticeable increase in publication activity, which may be due to increased attention to bilingual education in the context of international educational policy and practice. The peak values in the period from 2021 to 2023, when the number of publications exceeded 500 annually, emphasize the importance of this topic in academic discourse and reflect the relevance of bilingualism as a key aspect in educational research.

An analysis of the number of publications by country on bilingualism and education shows significant differences in academic activity. The United States of America holds a leading position with 3,138 publications, highlighting its dominant role in scientific research in this area (Figure 2). Leading European countries, such as Spain and the United Kingdom, also demonstrate significant interest in the topic of bilingualism, with 658 and 514 publications respectively. The active participation of countries like China and Canada, with 410 and 389 publications, respectively, indicates the international and multicultural nature of research in this area.

Figure 2

Top 10 countries by the number of publications in the field of bilingualism and education: analysis of Scopus data for 2000-2023 (Source: own calculations based on data from publications indexed by Scopus)

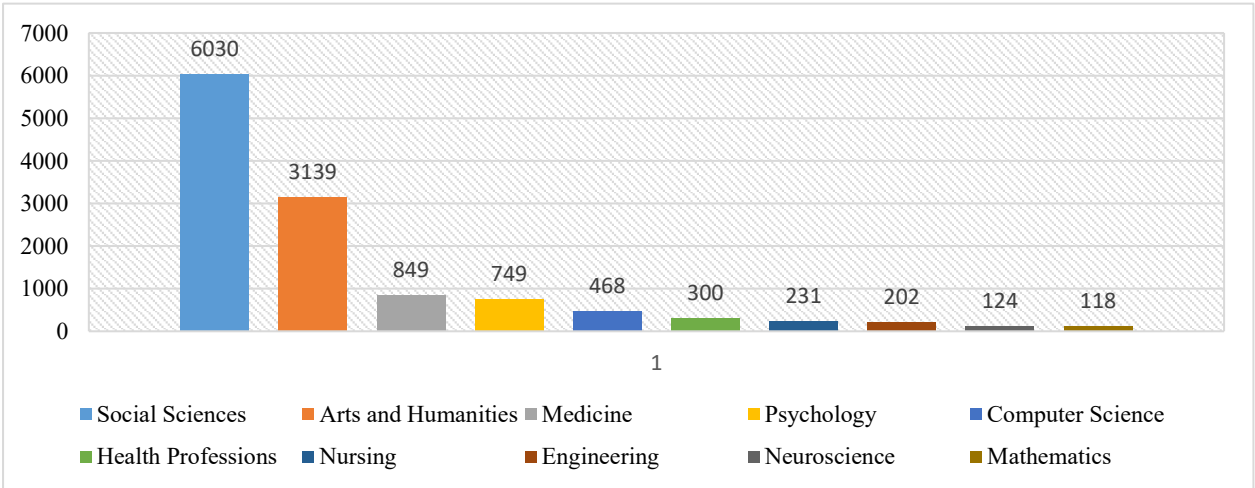


In addition to geographical leaders, there is a strong presence of research from developing countries and countries with economies in transition, indicating the expansion of the research field and interest in bilingual education beyond traditional academic centers. These data not only reveal the contribution of each country to the global science of bilingualism but also emphasize the importance of global cooperation and knowledge exchange between different cultural and linguistic communities.

An analysis of the number of scientific publications indexed in Scopus and devoted to the topic of bilingualism reveals a significant predominance of social sciences with 6,030 works, reflecting the multilayered and sociocultural significance of bilingualism in modern society (Figure 3). Arts and humanities occupy the second place with 3,139 publications, emphasizing the contribution of these areas to the understanding of intercultural communication and multilingualism. The field of medicine and psychology is also actively exploring bilingualism, with 849 and 749 publications respectively, reflecting its impact on cognitive processes and health.

Figure 3

Top 10 industries by the number of scientific publications in the field of bilingualism and education: analysis of Scopus data for 2000-2023 (Source: own calculations based on data from publications indexed by Scopus)

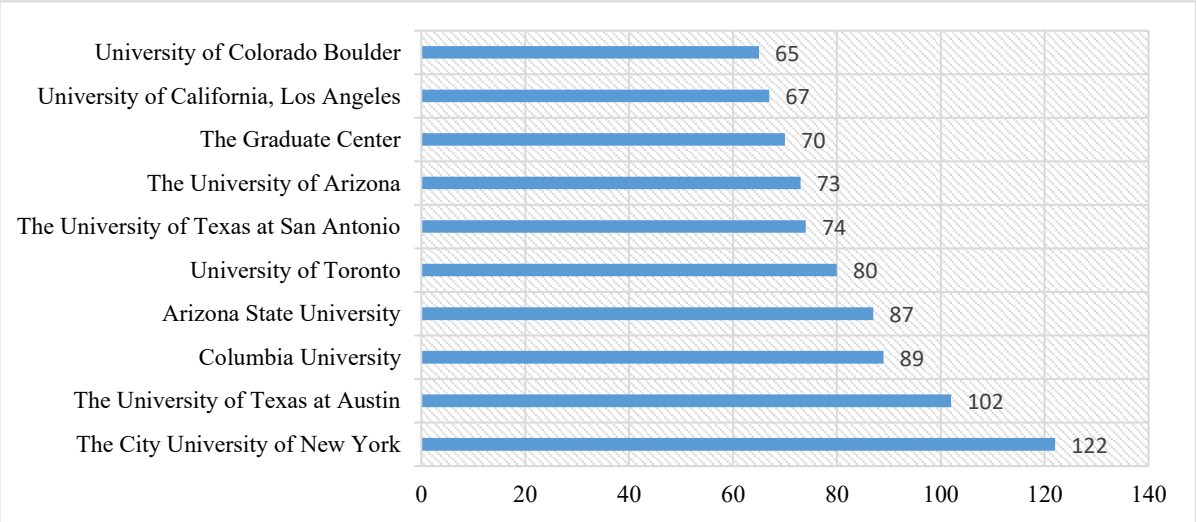


Disciplines such as computer science and engineering, with 468 and 202 publications respectively, reflect the contribution of the technical sciences to the development of technologies to study and support bilingualism. For example, in the creation of training programs and artificial intelligence for language education. All these data combined highlight the interdisciplinary and transdisciplinary nature of research in the field of bilingualism, indicating significant academic interest and the importance of integrating knowledge from various fields.

An analysis of the number of publications on organizations represented in the Scopus database and dealing with the topic of bilingualism revealed the activity of the world's leading universities. City University of New York tops the list with 122 publications, which highlights its significant contribution to the development of this field of research (Figure 4). Organizations such as the University of Texas at Austin and Columbia University also demonstrate high research activity, reflecting strong academic positions and innovative approaches in the study of bilingualism and education.

Figure 4

Top 10 organizations by the number of scientific publications in the field of bilingualism and education: analysis of Scopus data for 2000-2023 (Source: own calculations based on data from publications indexed by Scopus)

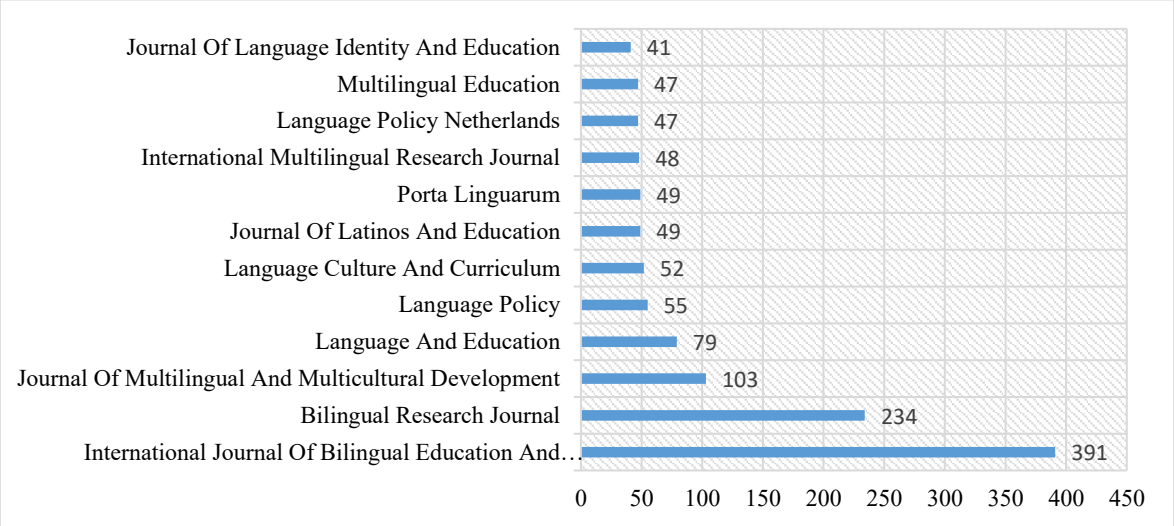


In addition to American universities, educational institutions from various parts of the world, including the University of Toronto and the University of Hong Kong, make significant contributions, indicating a global spread and multilateral interest in research in the field of bilingualism. The presence of universities from diverse cultural and linguistic contexts on the list of leaders confirms the international and multidisciplinary nature of bilingual education as a subject of research and reflects its importance in the global academic community.

An analysis of scientific publications dealing with the topic of bilingualism shows that the International Journal Of Bilingual Education And Bilingualism is the leader in the number of publications with 391 papers. This reflects the key role of the publication in shaping academic discourse in the field of bilingual education and bilingualism. The Bilingual Research Journal and the Journal Of Multilingual And Multicultural Development also significantly contribute to the expansion of the research field with 234 and 103 publications, respectively, emphasizing the multidisciplinary nature of the topic (Figure 5).

Figure 5

Top 10 scientific publications by the number of publications in the field of bilingualism and education: analysis of Scopus data for 2000-2023 (Source: own calculations based on data from publications indexed by Scopus)



Publications such as Language And Education and Language Policy, with 79 and 55 publications, respectively, reflect the importance of these areas for the study of bilingualism and its impact on educational processes and policy. These journals and other leading publications, including the Journal Of Latinos And Education and the international Multilingual Research Journal, present a variety of approaches to the study of bilingualism and its aspects, from theoretical foundations to practical applications, and stand out as important platforms for the exchange of knowledge and ideas in this field. The study of keywords in the titles of scientific articles devoted to the topic of bilingualism reflects the accents and priorities in this field of research. The term "language" is present in 809 titles, which emphasizes the fundamental importance of language in the study of bilingualism. It is followed by the word "bilingual" with 610 mentions and "education" with 601, reflecting the centrality of the educational aspect in bilingualism and the importance of integrating a bilingual approach into curricula (Table 1).

Table 1

Top 20 keywords found in the titles of scientific publications on bilingualism: analysis of Scopus data for 2000-2023 (Source: own calculations based on data from the database of articles indexed by Scopus)

Keywords	Number Of Keywords	Keywords	Number Of Keywords
language	809	school	114
bilingual	610	development	113
education	601	linguistic	105
bilingualism	413	cognitive	98
children	212	multilingual	96
english	206	teaching	95
learning	163	teachers	93
students	150	case	85
policy	132	languages	83
study	121	early	79

The analysis of citations of outstanding works on the topic of bilingualism and its impact on education demonstrates the special attention of the academic community to these issues. The leading place is occupied by the book "Immigrant America: A Portrait" by Portes, A. and Rumbaut, R.G., published in 2006 and cited more than 3,500 times, which reflects the importance and relevance of research on immigration and its impact on linguistic adaptation and social processes (Table 2).

Table 2

Top 10 most cited works in the field of bilingualism and education: analysis of Scopus data for 2000-2023 (Source: own calculations based on data from the database of articles indexed by Scopus; Export Date: April 13, 2024)

Authors	Title of the Work	Classification	Year	Citations
Portes, A., Rumbaut, R.G.	Immigrant America: A portrait	Sociology	2006	3593
Marian, V., Blumenfeld, H.K., Kaushanskaya, M.	The Language Experience and Proficiency Questionnaire (LEAP-Q): Assessing language profiles in bilinguals and multilinguals	Linguistics, Language Acquisition	2007	1195
Otheguy, R., Garcia, O., Reid, W.	Clarifying translanguaging and deconstructing named languages: A perspective from linguistics	Linguistics	2015	1004
Carlson, S.M., Meltzoff, A.N.	Bilingual experience and executive functioning in young children	Developmental Psychology, Cognitive Science	2008	714
Bialystok, E., Craik, F.I.M., Freedman, M.	Bilingualism as a protection against the onset of symptoms of dementia	Neuropsychology, Aging	2007	608
Minow, M.	Making all the difference: Inclusion, exclusion, and American law	Law, Social Policy	2016	539
Anderson, L.M., Scrimshaw, S.C., Fullilove, M.T., Fielding, J.E., Normand, J.	Culturally competent healthcare systems: A systematic review	Public Health, Health Services Research	2003	539
Lewis, G., Jones, B., Baker, C.	Translanguaging: Origins and development from school to street and beyond	Educational Theory, Linguistics	2012	487
Hornberger, N.H., Johnson, D.C.	Slicing the onion ethnographically: Layers and spaces in multilingual language education policy and practice	Educational Research, Anthropology	2007	462
Hornberger, N.H., Link, H.	Translanguaging and transnational literacies in multilingual classrooms: A biliteracy lens	Bilingual Education, Literacy Studies	2012	413

The article "The Language Experience and Proficiency Questionnaire (LEAP-Q): Assessing language profiles in bilinguals and multilinguals" by Marian, V., Blumenfeld, H.K., and Kaushanskaya, M., published in 2007 in the Journal of Speech, Language, and Hearing Research, has more than 1,000 citations demonstrating a deep interest in the study of language experience and competencies in the context of bilingualism. This highlights the importance of

developing effective tools for assessing the language profile of bilinguals and multilinguals in an educational environment.

An analysis of the methods, results, and conclusions of the five most cited articles in the field of bilingualism and education revealed a deep academic interest and a multidisciplinary approach to this topic. For example, the study "Immigrant America: A portrait" by Portes, A. and Rumbaut, R.G. uses both qualitative and quantitative methods to analyze the socio-cultural dynamics of immigration to the United States, revealing the typology of political scenarios regarding immigration and identifying the negative consequences of forced assimilation for immigrant communities. Meanwhile, the work of Marian, V., Blumenfeld, H.K., and Kaushanskaya, M. "The Language Experience and Proficiency Questionnaire (LEAP-Q): Assessing language profiles in bilinguals and multilinguals" demonstrates the importance of taking into account the history of language acquisition and recommends the use of objective measures of language performance in studies involving bilinguals (Table 3).

Table 3

Top 5 comparative analysis of research in the field of bilingualism and education: methods, results, and conclusions (Source: own calculations based on data from the database of articles indexed by Scopus)

Authors	The title of the work	Methods Used	Results	Conclusions
Portes, A., Rumbaut, R.G.	Immigrant America: A portrait	The authors employ a combination of qualitative and quantitative research methods to analyze the socio-cultural dynamics of immigration in the United States. They draw on historical data, case studies, and statistical analysis to explore the various ideologies and policies shaping immigrant integration.	The study reveals a typology of political scenarios regarding immigration, ranging from tolerant stances to militant nativism. It also highlights the negative consequences of forced assimilationism on immigrant communities, particularly in terms of cultural preservation and intergenerational dynamics. Additionally, the authors discuss the changing global context and the potential benefits of bilingualism in an interconnected world.	Portes and Rumbaut conclude that policies promoting forced assimilation can have detrimental effects on immigrant communities, leading to dissonant acculturation and weakening familial bonds. They argue for a more inclusive approach that values linguistic diversity and recognizes the benefits of bilingualism in a globalized society. The authors emphasize the importance of informed policymaking and community engagement to support the educational and cultural needs of immigrant populations.
Marian, V., Blumenfeld, H.K., Kaushanskaya, M.	The Language Experience and Proficiency Questionnaire (LEAP-Q): Assessing language profiles in bilinguals and multilinguals	The study involved administering the LEAP-Q questionnaire to bilingual participants to gather self-reported data on language proficiency and experience. Additionally, objective metrics of language performance were used to confirm the proficiency and dominance profiles identified by the LEAP-Q.	Bilinguals who rated their English proficiency as 7 or above performed similarly to monolinguals on the listening task. However, there were instances of false-positive cases where participants rated themselves as highly proficient but performed poorly on the task. Considering factors like language dominance and age of acquisition improved the grouping of bilinguals based on their behavioral performance.	The study emphasized the importance of considering aspects of bilinguals' language acquisition history, in addition to self-ratings of proficiency, to characterize bilingual participants accurately. It was recommended that researchers use objective measures of language performance to validate the proficiency and dominance profiles identified by the LEAP-Q. The study highlighted the significance of including measures of proficiency and experience in research protocols involving bilingual participants.
Otheguy, R., García, O., Reid, W.	Clarifying translanguaging and deconstructing named languages: A perspective from linguistics	The methods used in the study involved analyzing language practices that challenge the traditional boundaries of named languages. Researchers examined instances of translanguaging and deconstructed named languages to understand the fluidity and complexity of bilingual	The results of the study highlighted the interconnectedness of linguistic features across named languages. Researchers found that bilingual speakers often draw from their entire linguistic repertoire when communicating, blurring the lines between distinct languages. This fluid	In conclusion, the study emphasized the need to move beyond rigid notions of named languages and embrace the dynamic nature of language use in bilingual settings. By recognizing translanguaging as a valuable practice, educators and researchers can better support bilingual individuals in their language development and promote a more inclusive approach to language learning. The findings

		language use. They also explored the concept of language repertoires and the unity of mental grammars in bilingual individuals.	language use was observed to be a natural and effective way for bilingual individuals to express themselves and navigate communication in diverse contexts.	suggest that understanding and appreciating the complexity of translanguaging can lead to more effective language education strategies and a deeper appreciation of linguistic diversity.
Carlson, S.M., Meltzoff, A.N.	Bilingual experience and executive functioning in young children	The study included three groups of children: Bilingual, Immersion, and Control. The Bilingual group consisted of children with equal exposure to Spanish and English, the Immersion group included children attending a language immersion school, and the Control group comprised English monolingual children with limited exposure to a second language. Various executive function tasks were administered to the children, and demographic information was collected through questionnaires. Tasks were conducted in English, Spanish, or a combination based on the child's preference.	The Bilingual group outperformed both the Immersion and Control groups on tasks requiring inhibition of attention to misleading stimuli. Specifically, they scored significantly higher on tasks like Visually Cued Recall, the Advanced DCCS, and the C-TONI. Pairwise comparisons indicated significant differences between the Bilingual group and the other groups on these tasks. However, there were no significant differences between the Immersion and Control groups on most tasks.	The findings suggest that bilingual experience may enhance certain aspects of executive functioning, particularly inhibitory control skills, in young children. Bilingual children demonstrated superior performance on tasks requiring attention and inhibition compared to monolingual controls. These results highlight the potential cognitive benefits of bilingualism and emphasize the importance of considering language experiences in early childhood education and development.
Bialystok, E., Craik, F.I.M., Freedman, M.	Bilingualism as a protection against the onset of symptoms of dementia	The study selected a sample of patients referred to a Memory Clinic with cognitive complaints. Language history information, including languages spoken, English fluency, place of birth, date of birth, and year of immigration to Canada, was collected. This information was provided to 11 judges who classified each patient as monolingual or bilingual based on criteria that required regular use of at least two languages from early adulthood. Inter-rater reliability for language classification was high. Patients who did not reach a consensus on their language status were eliminated from further analyses.	The final sample consisted of 184 patients, with 91 monolinguals and 93 bilinguals. Both language groups had a similar proportion of patients diagnosed with probable Alzheimer's disease (AD). Bilingual individuals showed a significant delay of 4.1 years in the age of onset of dementia symptoms compared to monolinguals. The mean values for relevant variables, such as age of onset, age at first appointment, years of education, and MMSE scores, were reported and compared between the two language groups.	The study suggests that bilingualism may act as a protective factor against the onset of symptoms of dementia, as bilingual individuals demonstrated a delayed onset of dementia symptoms compared to monolinguals. This finding highlights the potential cognitive benefits of bilingualism in aging and its impact on cognitive health.

Additional works, such as "Clarifying translanguaging and deconstructing named languages: A perspective from linguistics" by Otheguy, R., Garcia, O., and Reid, W., explore the practices of moving away from the traditional boundaries of named languages, emphasizing the dynamism of language use in bilingual settings and offering more inclusive language teaching methods. Research in the field of bilingualism and cognitive development, for example, "Bilingual experience and executive functioning in young children" by Carlson, S.M. and Meltzoff, A.N., highlights the potential cognitive benefits of bilingualism, especially in relation to inhibition skills in young children. Another important contribution to the understanding of bilingualism as a protective factor against the onset of dementia symptoms is the work of Bialystok, E., Craik, F.I.M., and Freedman, M. "Bilingualism as a protection

against the onset of symptoms of dementia". These studies reflect the depth and complexity of the issues of bilingualism and its effects, ranging from cognitive and social adaptation of immigrants to protection from cognitive impairment in old age. The totality of these works shows not only the importance of bilingualism for individual cognitive development, but also its role in social integration and cultural enrichment of communities.

The study conducted a comprehensive analysis of publications on the topic of bilingualism and education in the Scopus database for the period from 2000 to 2023. Based on data on the frequency of publications by year, country, scientific branches, organizations, and journals, significant trends and dynamics of interest in this topic in the academic community were identified. The analysis of keywords in the titles of the articles emphasized the emphasis on aspects such as multilingualism, learning, and cognitive development, reflecting a multidisciplinary approach in bilingualism research. The high citation of individual works indicates a deep interest in studying the influence of bilingualism on cognitive processes and educational practices. These results not only highlight the importance of bilingualism in the educational field but also point to the potential for further research aimed at optimizing learning and education in a multicultural context.The results confirmed the importance of global and interdisciplinary interest in bilingualism and education, which is emphasized in the works of authors such as Kayadibi (2022), whose bibliometric analyses highlight the prevalence of bilingualism research, especially in journals such as the International Journal of Bilingual Education and Bilingualism. The Sun et al. (2020) study highlights the importance of disseminating early bilingual education results in regions such as China, emphasizing the significant potential of bilingualism in shaping educational policy and practice. Ozfidan et al. (2016) focus on the positive impact of bilingual education programs on the development of inclusive language competence and the preservation of minority languages, which once again confirms the multicultural approach in education.

The Poza (2017) study explores translanguaging in the context of bilingual education, emphasizing its role in training qualified workers for the global economy, reflecting the need to adapt educational programs to the requirements of the modern world. The Dubetz (2014) study highlights the importance of the participation of bilingual educators in professional organizations, contributing to a more active promotion of the interests of bilingual education. An analysis by Ilhan & Aydin (2015) shows that teachers of higher education institutions in Turkey have a positive perception of bilingual education, confirming its importance and potential for integration into curricula. The study of studies such as Yang's (2023) work highlights the increasing prevalence of bilingual education among children in modern society. Zhang's (2022) study analyzes the views of bilingual and monolingual parents on bilingualism and bilingual education, allowing for a better understanding of the diversity of approaches and attitudes in this area. The work of Kirsch et al. (2020) discusses the development of multilingual practices in early childhood education based on research in the field of bilingualism and neuroscience, indicating the importance of scientific support for the development of bilingual programs. These studies emphasize the importance of bilingualism not only as a linguistic but also as a cultural competence that promotes a deep understanding of different cultures, making bilingual education an important component of the modern educational system. In light of the data obtained, further development of research in the field of bilingualism is recommended, taking into account its impact on cognitive abilities, cultural interaction, and educational outcomes. Our research has revealed significant implications for the understanding and development of bilingual education. The analysis showed not only an increase in the number of publications but also an increase in international participation, which indicates the globalization of interest in this topic. This is especially noticeable in the increase in the number of studies from countries with different linguistic and cultural contexts, which enrich bilingual education with new methods and approaches. It also confirms the importance

of inclusive education that takes into account the linguistic and cultural characteristics of students. The results of our research can contribute to the development of policies aimed at supporting multilingualism in educational systems, as well as provide valuable data for the adaptation of curricula that will take into account the needs of bilingual and multilingual students.

Based on the results of the study, several key recommendations can be proposed for future research in the field of bilingualism and education. First, it is important to continue studying the impact of bilingualism on the cognitive development and academic success of students using advanced data and analytics methods. Second, attention should be paid to the development and testing of innovative educational programs that will contribute to a deeper and more effective mastery of two or more languages. In addition, the scientific community should strive to strengthen interdisciplinary cooperation to study bilingualism from the perspectives of various sciences — from psychology and neuroscience to sociolinguistics and educational policy. This will allow not only a better understanding of the processes occurring in bilingual education but also an effective implementation of the acquired knowledge into the practice of educational institutions.

In the context of globalization and multicultural societies, bilingualism and bilingual education are becoming particularly relevant. This study presents an analysis of scientific publications in the Scopus database, which allows us to assess the trends and main directions of development of this topic. In the light of the data obtained, a number of issues arise that require further consideration for a deep understanding of the problems and opportunities of bilingual education:

1. Which pedagogical approaches are most effective in the bilingual education of different age groups?

2. Does the level of second language proficiency affect the cognitive abilities of children and adults in the long term?

3. What are the psychological barriers to learning a second language and how can they be overcome?

4. What factors contribute to the successful integration of bilingual programs into national educational systems?

5. What methods can be used to assess and improve the quality of bilingual education?6. How does the interaction of cultures in bilingual educational institutions affect the socio-emotional development of students?

7. What strategies can help teachers and educators work more effectively with bilingual students?

8. What are the long-term socio-economic effects of the introduction of bilingual education in different regions?

9. Does bilingualism affect the preservation and development of minority languages and cultures?

10. What are the prospects for the development of online education to support bilingual education?

This study highlights the importance of bilingualism and bilingual education in the modern multicultural world. An analysis of publications in Scopus has shown not only an increase in interest in this topic, but also the need for further research to gain an in-depth understanding of effective strategies and methods in the field of bilingual education. Researchers will have to answer many questions concerning both theoretical and practical aspects of teaching and learning in a bilingual environment. This will optimize educational processes and ensure deeper cultural and linguistic interaction in educational institutions around the world.

Conclusion

In this paper, we sought to assess the dynamics and scope of academic research on bilingualism and bilingual education, as well as identify key aspects shaping modern approaches in this field. After analyzing the data from the Scopus database, we found a significant increase in the number of publications, which reflects the increased attention to bilingual education in the academic community. This interest is explained not only by globalization and migration processes but also by the growing understanding of the importance of bilingualism in cognitive development and intercultural communication.

The international nature of the research highlights that bilingualism is a global topic requiring collaboration and knowledge sharing between different cultures and language groups. The study of bilingual education in different countries and cultural contexts reveals unique methods and strategies that can be adapted and applied in other regions to improve language learning and cultural exchange.

Our study also showed that bilingualism has the potential to develop not only linguistic skills but also cognitive abilities. This is especially important in the context of educational programs aimed at supporting children and adults in multicultural societies. Bilingual education promotes not only language development but also cultural understanding, contributing to the formation of a more open and inclusive society.

In conclusion, the results of our study emphasize the need for further analysis of the effectiveness of bilingual educational programs and their impact on social adaptation and cognitive development. It is also important to continue research on the impact of bilingualism on cultural and linguistic diversity, which will contribute to the development of teaching methods and interaction in multilingual and multicultural contexts. We hope that our work will form the basis for future research and development in this exciting and important field.

Conflict of interest Statement

The authors declare no potential conflicts of interest regarding the research, authorship, or publication of this article.

Author Contributions

Zhanzhigitov Syrym: Conceptualization, Methodology, Data curation, Software, Formal analysis, Investigation, Visualization, Writing – Original Draft Preparation, Writing – Reviewing and Editing, Supervision, Project administration, Funding acquisition. Tasbulatova Gulnara: Validation, Resources, Methodology, Writing – Reviewing and Editing.

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APPLICATION OF THE CRITERION-BASED ASSESSMENT METHOD IN TEACHING A FOREIGN LANGUAGE AT A TECHNICAL UNIVERSITY

Abstract: This article describes the conditions of modernization changes in the field of higher education concerning the use of the Common European Framework of Reference for Languages (CEFR) and criterion-based assessment (CA) in teaching a foreign language at a technical university. The purpose of the study is to substantiate the need and effectiveness of using CA in the process of teaching foreign languages to students of technical educational programs, as well as to identify the problems and prospects for its implementation in the practice of higher education. The prerequisites for the introduction and successful use of criterion-based assessment of students' educational results are delineated. The study reports that criterion-based assessment is a process based on clearly defined criterion that provide rational assessment of students' achievements and formation of their competencies necessary for the use of a foreign language in professional activities.

The article presents a review of the works of foreign and domestic scholars, discusses their views and ideas, which are the theoretical basis for this study. The characteristics of the structure of criterion-based assessment are given, including its main concepts, purpose, tasks and functions. The article presents an analysis of a survey of the faculty of the Department of Foreign Languages on the introduction and implementation of criterion-based assessment in teaching English to students of technical specialties at the Karaganda Technical University named after A. Saginov. The difficulties that appeared during the introduction of criterion-based assessment are identified, recommendations are proposed for solving the problems that have arisen and further improving the application of the criterion-based assessment method in the educational process.

Keywords: criterion-based assessment, CEFR, higher education, technical university, foreign language, criterion, rubrics, descriptors, competencies, academic achievements, learning outcomes.

Introduction

By now, significant changes have occurred in the field of teaching foreign languages at the university, caused by a number of reasons concerning the competence-based approach to teaching a foreign language and the transition to level-based learning in order to obtain educational results comparable at the international level. The main provisions of level-based learning of foreign languages of the CEFR system (Common European Framework of Reference) were developed back in 2001, the purpose of which was to determine the level of proficiency of a student in a foreign language, according to the formed language competencies at each stage of learning a foreign language. Moreover, this system became the basis for the development of educational standards and programs, textbooks, curricula and collections of tests, and also helped in overcoming difficulties in the process of interaction with various education systems

In the Republic of Kazakhstan, the transition to level-based teaching of foreign languages at a university began in 2008 with the introduction and implementation of the national cultural project "Trinity of Languages". Today, according to the State Compulsory Standard of Higher and Postgraduate Education of the Republic of Kazakhstan (State

compulsory standard, 2022) "Foreign language" is a part of general education disciplines and is an integral element of higher professional education. Consequently, the modern problem is to increase the effectiveness of training students of technical specialties to use a foreign language, which can be solved by choosing the right content of language training and a methodological strategy covering various aspects of language teaching. Since modern education is a continuous process of upbringing and training, carried out for the purposes of moral, intellectual, cultural, physical development and the formation of professional competence (Law on Education of RK, 2023), it is necessary to develop professionally oriented foreign language competence at all levels of foreign language teaching. This strategy will ensure continuity and consistency in the formation of not only communicative, but also professional competence in a foreign language. Proficiency in a foreign language will also open up more opportunities for Kazakhstani students to participate in academic mobility and receive an education that meets international standards without leaving their university. In addition, educational results will be comparable at different levels, which will improve the university's rating and increase the attractiveness of the university for foreign scientists and students.

Undoubtedly, the modernization of the learning process necessitates the optimization of the system of assessment of educational achievements. In the provisions of the State Compulsory Standard of Higher and Postgraduate Education of the Republic of Kazakhstan dated from July 20, 2022 (State compulsory standard, 2022) clearly sets out the requirements for the criterion-based assessment system, which is also reflected in the Academic Policy of the Karaganda Technical University (Regulation on the Academic Policy, 2023).

Literature review

The issues of assessing educational achievements are of great significance in pedagogical research, attracting the attention of both domestic and foreign scientists. A significant contribution to the study of criterion-based assessment was made by foreign researchers D. Wiliam and P. Black (Black el al., 2009), who developed the concepts of formative assessment aimed at increasing the effectiveness of the educational process, as well as L. Shepard (Shepard, 2000), who studied the impact of assessment practices on student motivation. B. Bloom (Bloom, 1968). laid the foundations for the taxonomy of educational goals, which formed the basis of the criterion-based approach to assessment, focusing on measuring various levels of cognitive development.

The theoretical foundations and justification of the need for criteria-based assessment in the educational process are presented in the works of Russian scientists. A.A. Krasnoborova (Krasnoborova, 2010) developed the methodological principles of criterion-based assessment, emphasizing its role in ensuring the objectivity and transparency of knowledge assessment. E.N. Zemlyanskaya (Zemlyanskaya, 2020) studied the issues of integrating the criterion-based approach into school practice, focusing on its influence on the formation of educational motivation. M.I. Shakirov (Shakirov et al., 2012) [9] contributed to the development of criteria for assessing competencies adapted to modern educational standards.

Foreign researchers H. Goodrich Andrade, J. Marzano and J. Popham focused on the practical aspects of using criterion-based assessment. H. Goodrich Andrade (Goodrich Andrade, 2000) developed approaches to using rubrics to assess academic achievements, J. Marzano (Marzano, 2006) proposed models for integrating criterion-based assessment into curricula, and J. Popham (Popham, 2008) concentrated on the development of reliable and valid assessment criteria.

Special attention to the issues of criterion-based assessment is paid by Kazakhstani researchers O.I. Mozhayeva, A.S. Shilibekova and D.B. Ziedenova (Mozhayeva et al, 2017), whose works contain extensive practical material on the implementation of the criterion-based approach in the educational process. Their research includes an analysis of the effectiveness of

criterion-based assessment in schools in Kazakhstan and the development of methodological recommendations for teachers. R.O. Kenzhetayeva (Kenzhetayeva, 2021) focused on studying the impact of criterion-based assessment on the development of students' meta-subject competencies, and A.T. Aitpukeshev (Aitpukeshev, 2014) proposed approaches to adapting criterion-based assessment in the context of digitalization of education, including the use of digital tools for monitoring academic achievements.

The contents of works by these researchers underline the importance of criterion-based assessment as a tool for improving the quality of education, ensuring objectivity, transparency and motivation of students. Their contribution forms the theoretical and practical basis for further improvement of assessment practices in the educational system.

Thus, criterion-based assessment can be defined as a process based on comparing the educational achievements of students with clearly defined, developed criterion known in advance to all participants in the educational process, corresponding to the goals and content of education, contributing to the formation of key competencies of students (Concept of implementing the criterion-based assessment system, 2012). The purpose of criterion-based assessment is to obtain objective information on the learning outcomes based on the assessment criterion and provide it to all interested participants for further improvement of the educational process (Patton, 1990). It is noteworthy that the purpose of criterion-based assessment is set in advance, it is difficult to falsify, since it is strictly conditioned by the criterion representing the expected educational outcome.

In the process of criterion-based assessment, it is necessary to solve a number of tasks:

- creation and functioning of an objective assessment system;
- creation of unified assessment mechanisms that meet international standards;
- organization of conditions that promote independence and responsibility of students in achieving educational results;
- providing objective feedback to all participants in the criterion-based assessment process;
- involvement and subjectification of students directly in the process of criterion-based assessment;
- creation of a bank of template tasks that allow for objective assessment of learning outcomes;
- monitoring the academic performance of each student in accordance with developed criterion;
- conducting an analysis of learning results with the aim of further improving the criterion-based assessment system.

Having analyzed the available published works and studies on this topic, it became obvious that most of the works are devoted to criterion-based assessment in the field of secondary education. In many such works, the authors offer practical lesson plans, share their teaching experience and give valuable recommendations for solving the problems that have arisen. As for criterion-based assessment in higher education, it is still at the stage of development and implementation, which raises a number of questions and difficulties and thus requires further research. For example, some authors have doubts about whether formative assessment is necessary in higher education, how to make the transition of assessing the formed skills and abilities from control to motivation, to self-education and professional self-development (Zemlyanskaya, 2020). There are a small number of works offering various methods and examples of criterion-based assessment in higher education, such as the portfolio method, the case method, the interactive lecture method, the project methodology, the interview and presentation method, mutual assessment and self-assessment of students, etc. However, there are extremely few scientific developments and theoretically sound recommendations for assessing students' academic achievements.

In this regard, the authors of this article conducted a study on the introduction and implementation of criterion-based assessment at the Karaganda Technical University named after A. Saginov.

Research methodology

The research methods: literature review, observation, survey questionnaire, survey and reporting documentation analysis.

The survey questionnaire was prepared using the method of targeted selection of respondents according to the instructions of Patton M.K. (Patton, 1990), which recommends this method as a process for selecting respondents who have sufficient information on the topic of interest, capable of providing reliable data for conducting the planned study. As a result, a selection of the survey audience was carried out, which mainly included the teaching staff of the Department of Foreign Languages of the Karaganda Technical University named after Abylkas Saginov, where the criterion-based assessment of students' academic achievements in mastering the English language was introduced and is being implemented. The survey procedure included notifying respondents about the planned event, later the questionnaire was sent according to the link to the online GOOGLE FORM PLATFORM, the deadline for sending the completed questionnaires was determined.

The purpose of the survey was to identify teachers' understanding/misunderstanding of the essence of criterion-based assessment, the methods and tools used, the methods used to provide feedback to students, as well as the difficulties and problems that arise when conducting criterion-based assessment.

Results and discussion

Respondents were asked to answer 13 questions, 9 of which were with a choice of answers from a list, 4 questions assumed a detailed answer from respondents. The respondents' answers were ordered and analyzed in the way to reflect the attitude of the department staff to this type of assessment, its real practical application.

According to the results of the first question, "How often do you use criterion-based assessment of English language skills (reading, writing, listening, and speaking)?" 69.2% of respondents indicated that criterion-based assessment is often used in their teaching activities. 15.4% of teachers claim that this assessment system is always used. The remaining 15.4% are ready to use criterion-based assessment only sometimes. The frequency of using CR was approximately 65%, excluding the answer rarely or never.

When answering the second question, "What methods and tools do you use when conducting criterion-based assessment," where respondents were asked to independently indicate the assessment methods used, the following methods were suggested by teachers among the answers:

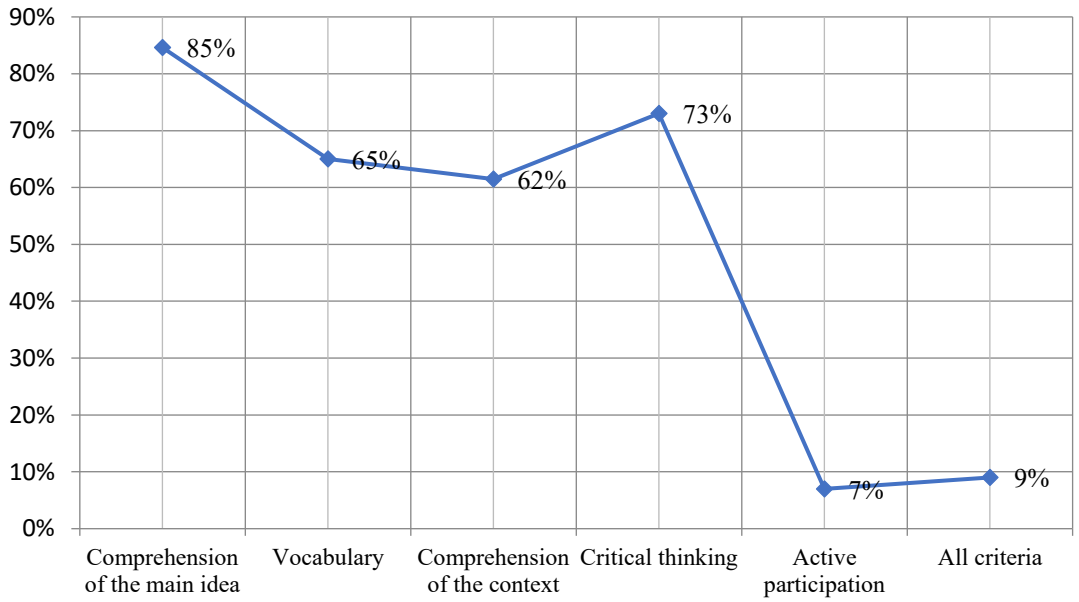
- Analytical rubrics. Create analytical rubrics that include specific criterion and levels of performance for each criterion. Assessors use the rubric to assign grades.
- Rating on a scale. Using numerical ratings (e.g. 1 to 5) or letter ratings (A, B, C, etc.) for each criterion in the rubric.
- Sample comparison. Comparison of students' work with samples of work that demonstrate different levels of performance. This helps assessors better understand what grade to assign.
- Grade moderation, where multiple assessors compare their grades to ensure consistency and fairness in the assessment.
- Electronic assessment systems. Use of specialized software products for assessment and recording of results. These systems help to automate the assessment process and ensure data safety.

- Feedback and comments. Provision students with detailed feedback based on criterion and rubrics so they understand where they have possibilities for improvement.
- Descriptors / Reflection / Peer-assessment
- Developed rubrics for reading, speaking and writing.
- Method of uncompleted sentences, self-assessment, peer-assessment
- Listening, testing, essay
- Testing, project work

The diagram in Figure 1 shows that the assessment of reading skills is distributed among the following criterion and rubrics accordingly: the main percentage of 85% use understanding the main idea of the text as a criterion for assessing text comprehension. 65% of respondents take into account the use of the student's vocabulary, 62% also take into account the students' understanding of the context of what they read. The above criterion "logical inference and critical thinking" is used by 73% of respondents. 7% of respondents assess student's ability to give feedback, participate in a discussion. 9% of respondents periodically use all of the above. In this question, each respondent was allowed to select multiple response options.

Figure 1

Reading Skills Assessment



The diagram in Figure 2 illustrates attitudes towards criterion-based assessment. The diagram shows that 96% of respondents believe that criterion-based assessment is fair and reliable for assessing students' writing skills. However, 4% of respondents disagree with this opinion.

Figure 2
Attitudes towards criterion-based assessment

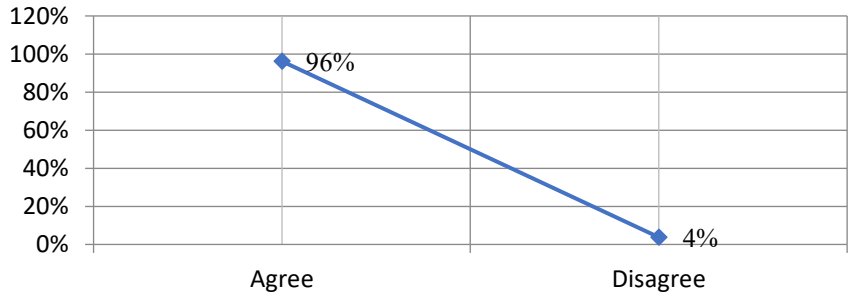
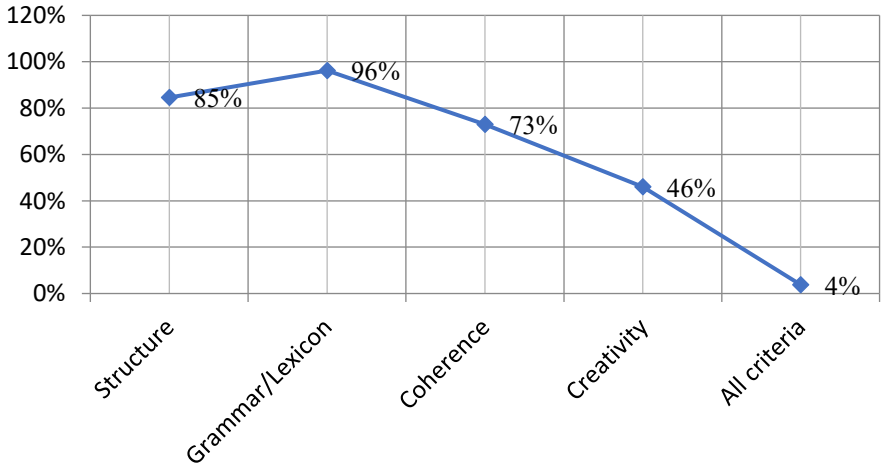


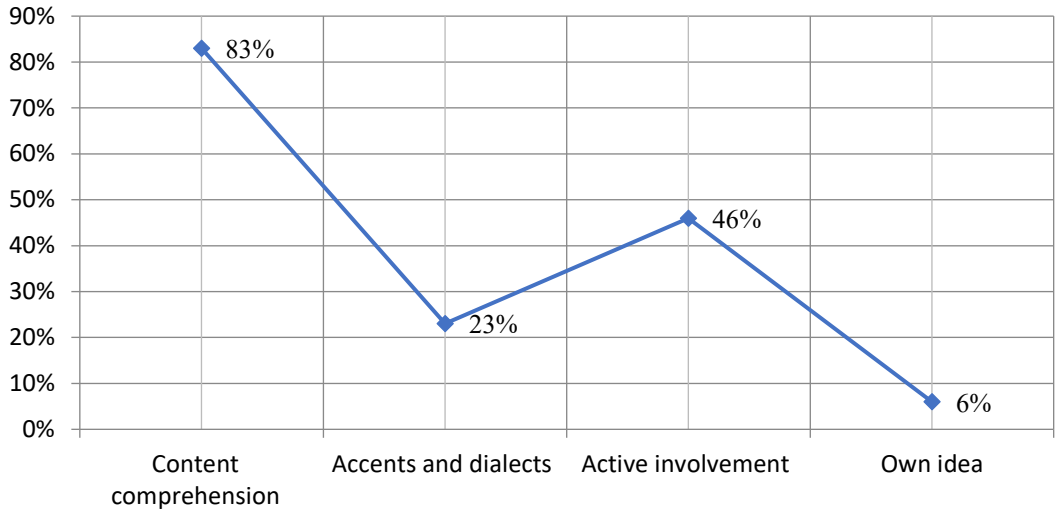
Figure 3 shows the criteria or rubrics that teachers use when assessing students' writing skills. 85% of respondents primarily pay attention to the organization and structure of the written statement. 96% continue to assess the grammatical and lexical components of the text. For 73%, criteria such as clarity and coherence of the written response are important. Creativity and originality of writing play an important role for 46% of respondents. And only 4% of teachers use all of the above rubrics when assessing.

Figure 3
Writing skills assessment



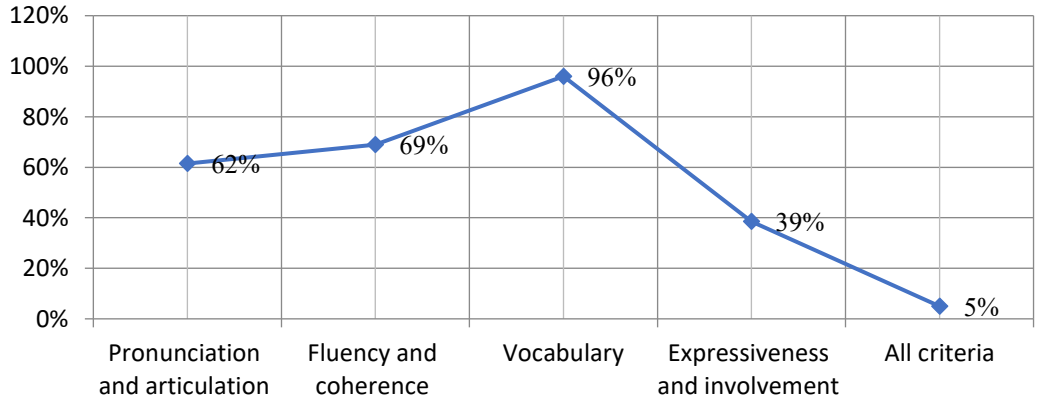
The diagram in Figure 4 shows the percentage ratio of various criteria for assessing listening comprehension. When assessing listening skills, the most important thing for respondents is understanding the content of the audio material, which is 83% of respondents. Accuracy in understanding accents and dialects and the ability to see notes scored the same percentage, namely 23%. Active involvement and response is assessed by 46% of teachers. 6% offered their own option, indicating that if this form of work is for understanding the main idea of the content (Listening for gist), then understanding the context is assessed. If the goal of the task is a detailed understanding of the listened material (Listening for details), then the examiner takes into account the understanding of the detailed content of the audio text when assigning a grade.

Figure 4
Criteria for assessing listening comprehension



The use of criteria and rubrics and their application by teachers of the Department of Foreign Languages to assess speaking skills in percentage terms can be traced using the data in the diagram in Figure 5. Pronunciation and articulation are the main criterion for 61.5% of respondents. 69% of teachers assess the student's oral speech, paying special attention to fluency and coherence of speech. The most popular answer, which scored 96%, is the use of vocabulary and choice of words. Expressiveness and involvement are important for 38.5% of respondents. 3.8% of interviewees use all the above criterion depending on the purpose of the statement, actively paying attention to the word order in the sentence, the correctness of grammar and the content of the topic of the statement.

Figure 5
Speaking skills assessment



According to the answers to the eighth question, "Do you differentiate tasks by difficulty with the corresponding number of points when conducting criterion-based assessment?" 70% of respondents answered "yes", 30% chose the answer "sometimes". The answers "no" and "rarely" were not used.

The ninth question was related to the use of the grading scale, where the respondents gave the following answers: 57.7% use a ten-point system, 34.6% use a rating in the range from

0 to 100 points, the five-point system is not used by teachers. 7.7% of respondents use the Bloom pyramid to assess students' language skills.

The next question in the questionnaire was open-ended: “How do you provide feedback to students based on assessment results and do you think it is effective?” The following response options were received:

1. “I take into account the individual needs and level of preparation of each student. Some students may require more detailed explanations, while others may require more complex tasks”.

2. “Provide feedback within a reasonable time after the assignment is submitted. This allows students to use the information to improve their work”.

3. “I help students develop self-assessment and self-control skills so that they can analyze their mistakes and learn from them on their own. I think this is effective”.

4. “Upon completion of the control, immediately, orally. Yes, I consider it to be effective”.

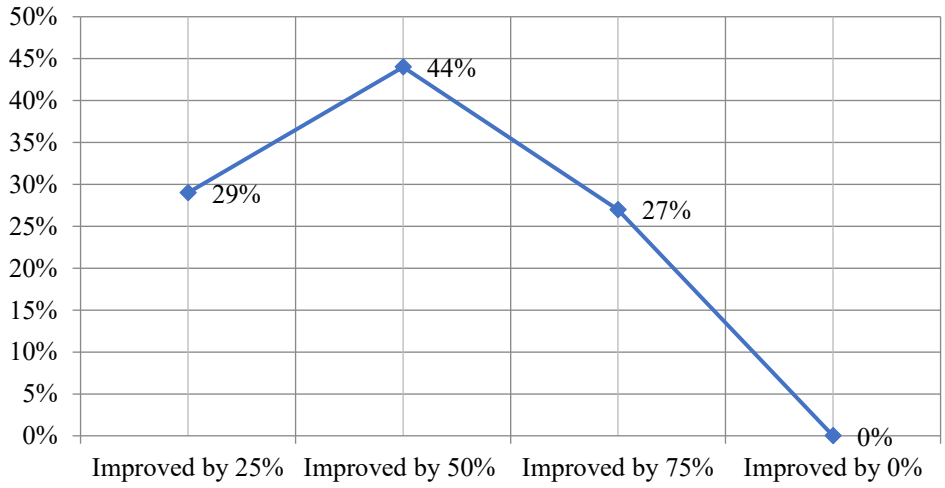
5. “I write down the student’s mistakes and the points they succeeded and voice them at the end of the lesson”.

6. “I think it is effective. Students are familiar with the 10-point system. I always explain what exactly I am assessing in a particular task”.

The eleventh question is reflected in the following diagram in Figure 6. Here, we can see how much the quality of teaching has improved with the use of the criterion-based assessment method according to the teachers of the Department of Foreign Languages, 29% of those who believe that it has improved by no more than 25%. 44% are of the opinion that the quality of teaching has increased by 50%. 27% of respondents answered that the quality of teaching has changed by 75%. None of the respondents believes that there is no improvement in the quality of education when using a criterion-based assessment. The 0% improvement option was not selected.

Figure 6

Teaching improvement by means of the criterion-based assessment method



The analysis of respondents' answers allowed us to determine how efficiently and effectively the criterion-based assessment method is applied in the educational process of the university. According to the survey data, most of the department's teachers regularly apply the criterion-based assessment method of students' knowledge. However, certain difficulties and shortcomings remain, mainly related to the development of universal headings and criteria for

assessing all four types of speech activity (listening, speaking, reading, writing). In addition, the problem of implementing an individual approach to students, taking into account their psychological and pedagogical characteristics, remains relevant.

The findings are consistent with the findings of H. Goodrich Andrade, who emphasizes that "rubrics not only make teachers' expectations transparent, but also help students understand what quality work looks like" (Andrade, 2000). As the survey showed, the department's teachers face similar challenges related to the need to increase the transparency and predictability of assessment. The use of rubrics facilitates more objective and understandable feedback, which, in turn, increases student motivation and helps them better understand the goals of learning.

Respondents also pointed out the need to introduce formative assessment at the university, constant monitoring of knowledge acquisition and the use of the criterion-based assessment not only as a means of control, but also as a tool for motivating and developing self-education skills and professional growth of students. These provisions are reflected in the concept of J. Marzano, who claims that “formative assessment is one of the most powerful tools for improving student achievement” (Marzano, 2006), since it provides students with regular feedback and promotes active participation in the learning process.

The survey pays special attention to the role of students as active participants in the assessment process. According to the CEFR principles, students should become subjects of educational activity, and not just objects of assessment. This idea is reflected in the provision of feedback by department teachers and in the practice of involving students in self- and peer assessment, which is confirmed by the position of J. Popham: "students must be active participants in assessment if it is to support learning" (Popham, 2008). He emphasizes that the criteria should not only be valid and reliable, but also understandable to the students themselves. This contributes to the development of students' ability to self-reflect and critically understand their progress.

Thus, the analysis of empirical data confirms the relevance and productivity of theoretical approaches proposed by foreign researchers. The practical application of the criterion-based assessment in teaching English at a technical university demonstrates a high degree of compliance with modern requirements for the quality of education. At the same time, the identified problems indicate the need for further research and methodological developments aimed at creating adapted headings, formative strategies and mechanisms of a personalized approach in the context of technical higher education.

Conclusion

Criterion-based assessment allows obtaining objective information about the results of the acquired knowledge by students. It is aimed at motivating students and their direct and regular participation in this process to achieve the desired results. The development of generally accepted criterion, norms and mechanisms to ensure the reliability, transparency, objectivity and validity of the results will certainly improve the quality of the assessment procedure and its compliance with both international standards and the needs of students.

The regulatory documents on the organization of the educational process at the university (State compulsory standard, 2022; Regulation on the Academic Policy, 2023) recommend the comprehensive use of communication technologies (projects, debates, discussions, interviews, role-playing games, dramatizations, conferences, forums, competitions, etc.), as well as the active use of digital technologies and extracurricular activities. Such organization of educational activities helps to create conditions for increasing motivation to study disciplines, as well as increasing the cognitive activity of students, their verbal interaction and the development of creative potential. In this regard, it is important to regularly use educational technologies that allow simulating situations of verbal communication in a foreign language

and ensure the highest possible degree of independence of students in interpreting the phenomena of intercultural communication.

Based on the results of the survey, the authors of this article give the following recommendations for improving the system of level-based education, taking into account the international CEFR standard and criterion-based assessment of knowledge at the university:

1) Professional development. It is necessary to provide opportunities for training and education according to CEFR and criterion-based assessment for the university's teaching staff. The training should include familiarization with CEFR descriptors, examples of tasks and assessment rubrics, and methods of assessing language competence. This will help teachers better understand and apply the assessment standards and criterion.

2) Developing adapted materials. To develop teaching materials and tasks that correspond to the CEFR descriptors at different levels. To include a variety of tasks that assess different language skills, involving reading, writing, speaking and listening. To provide assessment rubrics so that learners can understand how their work is assessed against the CEFR criterion.

3) Regular assessment. To introduce regular assessment of students' language skills using the CEFR criterion. To ensure that assessment is transparent and objective so that students and teachers understand how their language learning progress is assessed.

4) Monitoring progress. To introduce systematic monitoring of students' progress at each CEFR level. To use formative assessment to identify where students need further support and development.

5) Feedback. To provide feedback to students and help them set clear goals to improve their language skills. To provide students with regular feedback on their progress against the CEFR criterion. To help students to be aware of their strengths and areas for improvement. To provide individual consultations and discussions so that students can ask questions and receive support in developing their language skills.

6) Involving students in the assessment and feedback process. To introduce them to the CEFR descriptors and assessment rubrics so that they can assess their own progress and participate in setting language targets. To provide opportunities for self-assessment and peer assessment so that students can develop metacognitive skills and responsibility for their learning.

7) Partnerships with other institutions. To establish partnerships with other institutions or organizations that also use the CEFR. Sharing materials, experiences and best practices on the use of the CEFR and criterion-based assessment. To organize joint professional developments, training seminars and exchanges of experiences to jointly develop and improve the system of level-based learning.

8) Updating and adapting. Regular updating the level-based learning system and criterion-based assessment to take into account changes in the CEFR and new practices. To analyze the results of assessments and monitoring, collect feedback from teachers, students and other interested participants, and make necessary adjustments to the learning system. To involving students in the process of updating the system. To conduct surveys, focusing groups and discussions to find out their opinions on the learning system, assessment and language skills development. To use their feedback to make changes that meet their needs and improve the quality of education.

9) Resources and support. To ensure access to quality teaching materials, resources and tools that are aligned with the CEFR levels and assessment criterion. To promote the development and dissemination of educational resources that will help teachers and students work effectively within the CEFR framework.

10) Continuous improvement. The implementation of a level-based learning system using the CEFR and criterion-based assessment is a long-term and continuous improvement

process. To evaluate regularly the effectiveness of the system and its compliance with international standards. To analyze data on student progress, feedback from teachers and students, as well as examination and assessment results. To apply this data to identify areas for further development and improvement of the system.

Continuous improvement of the system of level-based teaching in accordance with the CEFR and criterion-based assessment will allow for a more accurate evaluation of students' language competencies and provide them with high-quality education.

Conflict of Interest Statement

The authors declare no potential conflicts of interests regarding the research, authorship, or publication of this article

Author Contributions

Damira Jantassova: Conceptualization, Methodology, Supervision; Anna Bogdanova: Original Draft Preparation, Data collection and curation, Resources, Validation, Writing; Kristina Arabadji: Visualization, Data Analysis, Writing, Editing, Reviewing.

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TEACHERS' PERSPECTIVES ON THE USE OF ARTIFICIAL INTELLIGENCE AND IMMERSIVE TECHNOLOGY IN THE PROCESS OF TEACHING GEOGRAPHY

Abstract: Artificial intelligence (AI) and immersive technologies (VR, AR) are deeply embedded in modern education and are becoming an integral part of it. The main feature of these technologies is that they allow you to make lessons interactive, making teaching methods more interesting and effective. One of the most important factors influencing the future of education at high institutions is the attitude and acceptance of teachers towards the use of these technologies in their educational practice. In this article, we will examine how successfully teachers' attitudes can be implemented in this process. While some teachers are ready to use new technologies, others may be skeptical. In this regard, the relevance of the study is to identify the possibilities of using new technologies in the process of teaching geography by analyzing teachers' opinions. To achieve the research goal, an 8-question survey was developed and conducted based on the analysis of scientific articles and Google Forms. The survey was conducted among 116 university teachers, 77 of whom were women and 39 were men. The data obtained during the study were processed and analyzed using the SPSS Base software package. The survey results highlighted the key research questions and demonstrated the potential and challenges of AI, VR, and AR technologies in improving the quality of education. In the final section, the effectiveness and difficulties of introducing these technologies into the process of teaching geography are systematically analyzed, and scientifically based conclusions are drawn on their integration.

Keywords: Immersive technology, artificial intelligence, geographic knowledge, innovation, VR, AR.

Introduction

In modern times, the prosperity of any state, the level of socio-economic development of society, and the well-being of its citizens are directly related to the quality of education in that country. As the share of qualified, professionally competent citizens in society increases, the state's global competitiveness increases and the country's economic potential strengthens. As the share of qualified, professionally competent citizens in society increases, the state's global competitiveness increases and the country's economic potential strengthens (Bógdał - Brzezińska, 2023).

Education policy is a set of comprehensive measures aimed at improving the quality of education and ensuring access to education at the national and global levels (Saulembekov A. R., 2023). Modern education policy aims to modernize the education system, supporting innovations and prioritizing their integration. The main priorities in education policy are the introduction of innovative technologies and the digitalization of the education system. The interrelationship of innovation and digitalization is aimed at increasing the efficiency and accessibility of the education system. Digitization makes the education system accessible to all participants, providing a wide range of educational resources and platforms. Innovative technology plays an important role in improving the quality of education. New teaching

methods, including artificial intelligence and virtual and augmented reality, increase student engagement by making the learning process interactive. Technological progress brings about significant changes in every era. In the era of Industry 4.0, the use of technological tools by people in various industries and environments is constantly increasing (Asmiatun et al., 2020; Bécue et al., 2021; Wendt, 2023).

The rapid development of technology requires teachers to master new technologies and teach modern lessons. One of such technologies is artificial intelligence (AI) and immersive technologies (VR, AR). Such educational technology refers to the integration of digital tools, resources and pedagogical practices to enhance teaching and learning (Gocen & Aydemir, 2020; Dignum, 2021). It includes interactive whiteboards, e-learning systems, mobile learning programs and, more recently, various platforms and devices such as artificial intelligence (AI) and augmented reality (AR) (Korinth et al., 2019*).*

The combination of virtual reality and augmented reality with AI is revolutionizing education around the world. VR and AR are not artificial intelligence in themselves, but AI has played an important role in their use in the learning process (Russell & Norvig, 1995; Tahiru, 2021; Zhang & Aslan, 2021). These technologies become more powerful and flexible when used in conjunction with artificial intelligence. These technologies can work more effectively by integrating artificial intelligence tools (Jasim Sharki et al., 2024).

Artificial intelligence (AI) stands out as an effective and accessible tool that adapts educational content to the individual needs of learners, provides visual presentation, and provides instant access to information. The term artificial intelligence is derived from the combination of the words "artificial" and "intelligence". Here, "artificial" means made by humans, and "intelligence" means the ability to think. Thus, the concept of artificial intelligence means "the ability to think made by humans" (Rangel-de & Duart 2023). In addition, the ability to flexibly restructure content and systematically track student progress allows educators to adapt teaching strategies and provide additional resources during the learning process, taking into account individual needs (Baker, T., et al., 2019). Artificial intelligence can mimic human abilities to know, reason, understand, make sense of, generalize, infer, learn and effectively multitask. There is no reason to doubt the technologies that have developed today. Augmented reality (AR) and virtual reality (VR) stand out as technologies that offer new experiences to users in the field of education (Christou, 2010; Kavanagh et al., 2017; Jagdish Deshmukh et al., 2023). However, both of these technologies have their own advantages and limitations. Understanding the differences between augmented reality (AR) and virtual reality (VR) allows to better understand their impact on the field of education. (Tira Nur Fitria 2023).

Virtual reality is a computer-generated environment that simulates reality. The definition of the word "virtual" means not physically present, while "reality" is something that you experience as a human. Thus, the term "virtual reality" basically means "close to reality" and is basically an illusion that allows them to be in a computer environment, so people can feel like they are actually there, even though they are not actually in it. VR applications aim to engage users by interacting with different senses (vision, hearing, touch, etc.) and blocking out external stimuli (Daniel Egunjobi & Oladele J Adeyeye 2024). Virtual reality technology is being used effectively in the field of education. It increases students' interest in learning by presenting knowledge in a game format and ensures their active participation in the lesson (Freina & Ott, 2015). In short, virtual reality is emerging as a new tool to make learning more effective, interesting and engaging.

Augmented reality is a current field of research for using objects such as computer models, text, and video in the real world. Augmented Reality (AR) is a technology that creates a virtual environment by integrating virtual information into the physical real world. AR not only adds virtual information to the real environment, but also to streaming videos and games, providing the user with a more immersive experience (Sutopo, 2022).

Mobile devices for students and teachers are an immediately available tool for using AR technologies. This technology has great potential and advantages in education. Its exercises enhance the learning process by clarifying the topic, increasing memory, increasing interest and satisfaction, providing the opportunity for repetition, and providing multimedia support (Yapici & Karakoyun, 2021).

Augmented Reality (AR) is a technology that combines real and virtual objects interactively through 3D elements displayed on the screen. Augmented Reality is widely used in various fields, including education. In the field of education, AR technology is used as a teaching tool to make the learning process more interesting and effective (Adami & Budihartanti, 2016). Augmented reality can serve a variety of purposes in education: from helping students to better acquire, process, and remember information, to making learning more engaging and engaging. Therefore, it needs to be engaging to achieve its goals (Demirezen, B. 2019). Augmented reality helps students master abstract and complex subjects like geography because it adds a new dimension to classroom learning (Emiola, A. G.2022).

In general, VR and AR technologies contribute to creating an interactive and realistic learning environment (Sunder Kala Negi 2024). For example, VR offers students the opportunity to directly experience and experience geographical phenomena, while AR focuses on enriching real-world geographical concepts with digital information. These two technologies can be considered two sides of the same coin. This is because with AR, people can interact with 3D objects in the real world, while with VR, they are completely immersed in a virtual world (Sidiq, M., Lanker T. & Makhdoomi K., 2017). These technologies, in turn, pave the way for the development of interactive educational materials in geographical education, the organization of virtual trips, the modeling of natural phenomena, and the increase of students' learning activity. VR and AR technologies help to create an interactive and realistic learning environment (Saduakasova**.**A., 2024). As technology continues to advance, the future of immersive learning environments holds exciting prospects (Luan et al. 2020; Ng et al., 2023; Kumar S 2023).

The purpose of the study is to comprehensively study the scientific and pedagogical possibilities of introducing artificial intelligence (AI) and immersive technologies (virtual reality - VR and augmented reality - AR) into the process of geographical education. This goal is defined by the following component areas:

- Determining teachers' perspectives: An empirical study of geography teachers' professional and psychological readiness to use AI, VR and AR technologies, their level of acceptance and attitude towards innovative technologies

- Pedagogical impact analysis: Determine the impact of the mentioned technologies on the content and quality of education, including their contribution to the mastery of geographical concepts, the development of spatial thinking, and increasing the effectiveness of teaching.

- Evaluate the impact on students' interest in the subject: Analyze the impact of immersive environments and personalized AI tools on students' enthusiasm for the subject of geography and active cognitive activity.

- Propose solutions to difficulties encountered during application: Identify technical, methodological, and organizational obstacles and provide specific methodological recommendations and practical solutions aimed at overcoming them.

Research methods and materials

This study was conducted using analytical and survey methods. In order to comprehensively describe the scientific and pedagogical potential of introducing artificial intelligence (AI) and immersive technologies (virtual and augmented reality - VR and AR) into the process of geographical education, the article is structured in two main stages.

The first stage of the study involved a comprehensive analysis of the scientific literature and previous studies on the topic, and the theoretical foundations of the research direction were identified (Wendt & Bógdał-Brzezińska, 2018; Bógdał-Brzezińska et al., 2023). Analysis of scientific articles is an important stage in studying the current state of the research field, as well as identifying the main issues and research objectives related to the research topic. Using this approach allows the researcher to form a comprehensive understanding of the established theories in this area, the methods used, and the results of previous research.

In the second stage of the study, an electronic survey was conducted among teachers of geography at higher educational institutions in order to comprehensively study the scientific and pedagogical potential of introducing artificial intelligence (AI) and immersive technologies (virtual and augmented reality - VR and AR) into the process of geographical education. The survey was prepared on the basis of the Google Forms platform and consisted of 8 questions. This platform allows you to develop a survey for free and distribute it widely through social networks and web resources, as a result of which it was possible to quickly and effectively receive feedback from a wide range of respondents.

The collected data were processed and analyzed quantitatively using SPSS Base software. This method allowed us to systematize and structure the survey results and interpret the information obtained in a clear and reliable way. In addition, based on the respondents' answers, the main directions and common trends in their views were identified. This approach allowed for a deeper understanding of the research problem in terms of content and structure, and strengthened the scientific basis of the study.

To ensure the development and effective use of these technologies and teaching practices, it is important to address the following key issues.

1.Advantages and opportunities of AI, VR, and AR technologies in geographical education. Success criterion: To systematically describe the effective aspects and functional capabilities of AI, VR, and AR technologies in the field of education based on scientific literature and previous research.

Currently, the question of what impact artificial intelligence and immersive technologies can have on geography lessons is becoming increasingly relevant. If we focus on practical examples of the use of artificial intelligence in geographical education, some universities are introducing machine learning algorithms for analyzing geographic data. For example, such programs can process satellite images and provide students with data on the state of ecosystems and climate change. And they can predict the risk of various natural disasters, such as avalanches, earthquakes, and floods. This means creating conditions for students to learn through real examples, not just learning theory, thereby making lessons more visual and interesting (https://chatgpt.com).

Another notable example is the combined use of virtual reality (VR) and artificial intelligence. With the help of these technologies, students can “travel” to different regions of the world and explore their geographical location and features, climatic conditions, and cultural geography. Such experiences not only broaden students’ worldview, but also contribute to a deeper understanding of the material. For example, in lessons on the topic of climate zones, students can see how nature changes depending on geographical conditions, which is impossible to do with traditional teaching methods. These technologies increase students' memory skills and allow them to understand the topic more deeply. In short, virtual reality is emerging as a new tool to improve learning, make it more interesting and engaging (Gizéh & Josep, 2023).

The collaboration between AR and AI is transforming the educational experience by creating immersive learning environments that engage learners more deeply than traditional methods. AR adds digital information to the real world, enhancing the learning context, while

AI analyzes data and personalizes content according to the individual needs of learners (Jasim Sharki et al., 2024).

They can provide a personalized learning experience that responds to real-time student interaction. This is where artificial intelligence and immersive technologies can take advantage of traditional teaching methods. These technologies can create a unique learning experience and increase student engagement by providing an unparalleled learning environment for students (Suchitra Labhane., 2024). AI, VR, and AR have also played a significant role in accommodating diverse learning styles and abilities. The future of these technologies in education is based on technological advancements, expanding content options, and a greater focus on inclusiveness and ethical considerations. As these technologies continue to evolve, they have the potential to revolutionize the way students learn, teachers teach, and educational institutions operate globally. These technologies are making the educational process accessible and engaging across challenging subjects, creating immersive learning environments. AI-powered gamification helps make learning more interactive and engaging (Deeksha Saraswat., 2024).

2.Applications of AI, VR, and AR technologies in geography teaching. Success Criterion: To identify specific platforms and tools that can be used in geography lessons.

When considering ways to incorporate these technologies into geography education, it is clear that the types of applications used will increase the interest and activity of teachers and students in the lesson, as well as the possibilities for its use. Therefore, Table 1 below provides a summary of the types and content of the most accessible applications and platforms in the process of geography education (Emiola, A. G. (2022)., Anubis G. de Moraes Rossetto et al.,2023., Jie Geng.,2019., Open AI. (2025). *ChatGPT* (May 2025 version).

Table 1

AI and VR and AR applications for geography teaching.

Application types	Application content
Artificial Intelligence (AI)	
Google Maps AI	Analyzing map data and exploring geographic information
Knew ton	Adapting geography materials to the student's level of knowledge
Quizlet	AI capabilities for memorizing geographical terms
Planet AI	Satellite image processing and analysis of natural phenomena
Google Maps AI	Analyzing map data and exploring geographic information
Open Street Map AI	Research of urban infrastructure. Processing of cartographic data.
Climate AI	Predicting natural disasters and analyzing climate change.
Magic School. AI platform	Helps make geography lessons interactive, data-driven, and tailored to individual needs.
Socratic by Google	Finds geographic resources and provides students with information when it is most needed.
Edmentum platform	Offers automated geography tests and quizzes, maps, charts, and climate data.
Virtual reality (VR)	
Google Earth VR	Explore anywhere in the world in VR
Google Cardboard	Virtually view geographical locations
zSpace	Interactive work with geographic models
Ocean Rift	A virtual app for exploring ocean ecosystems

National Geographic Explore	A tool for teaching geography in a fun and interactive way
	Augmented reality (AR)
Merge Cube	Display geographical 3D models (earth's crust, volcanoes).
AR Flashcards	Designed to explain geographical terms and landforms.
Augment Education	An app designed to improve students' visual perception and explain complex concepts in an easy way.
POPAR planets Smart book	An app to be used in conjunction with a special interactive book to learn about space and the solar system. This app often uses Augmented Reality (AR) technology.
Night Sky	A mobile application designed for astronomy enthusiasts and people interested in the stars, allowing you to explore the sky and get information about astronomical objects in real time.

While the artificial intelligence technology applications and platforms presented in this table help to improve the skills of geography teachers and create lessons tailored to the individual needs of students, virtual and augmented reality technologies help to create interactive and realistic learning environments. That is, in geography lessons, virtual tours using AR/VR, working with 3D models, and exploring various data using AI make the lesson more interesting and engaging. Visual materials make it easier to understand abstract and complex geographical phenomena. For example, studying the movement of tectonic plates, atmospheric processes, and the formation of relief through VR has become more understandable and interesting for students. In modern society, the introduction of artificial intelligence and immersive technologies into the educational process in secondary schools teaches students to use these tools from the very beginning of school. This experience, in turn, significantly contributes to the development of skills that are in demand in the future labor market and marketing (Vlačić et al., 2021).

3. To examine the challenges of fully integrating AI and VR/AR technologies into the educational process and explore ways to overcome them.

The success criterion for this task includes identifying the most common challenges based on survey results. The introduction of artificial intelligence and immersive technologies into the process of geographical education is a modern way to ensure high-quality and effective learning. However, there are significant challenges that prevent their full use in geographical education. Since geography is a constantly evolving science, some of the data provided by new technology applications may become outdated and inaccurate. Table 2 below presents the challenges of fully integrating AI, VR and AR technologies into the process of geographical education (Suchitra Labhane et al., 2024., Emiola, A. G.2022.,Enitan Shukurat Animashaun et al.,2024).

Table 2

Challenges of implementing AR, VR AR technologies into the process of geographical education

N	Types of difficulties	Reasons
1	Financial issues	High cost of equipment and insufficient financial support.
2	Pedagogical difficulties	Inability to use AI, VR and AR technologies or lack of experience.
3	Limited technical infrastructure	Low internet speed and lack of devices.

4	Possibility of mental problems	Prolonged use of AI, VR, and AR devices can cause eye strain, dizziness, and nervous exhaustion in some students.
5	Challenges in adapting the curriculum	Content limitation, i.e. the lack or insufficiency of ready-made content for the subject of geography.
6	The risk of people losing touch with each other	Failure to maintain a balance of use, i.e., increasing dependence on the virtual world.

To effectively implement AI, VR, and AR technologies in the educational process, we need to consider ways to overcome the challenges presented in Table 2:

- Continuously improve the skills of teachers through various interactive trainings.
- Provide financial support from the state to provide schools with modern equipment:
- Increase access to the Internet and equip classrooms with the necessary devices and equipment.
- Ensure data security and confidentiality when using AI technologies.
- Solving these challenges will allow for the effective use of new technologies in teaching geography and will direct the educational process towards innovation.

To study teachers' attitudes towards the use of artificial intelligence and immersive technologies in their teaching practices and provide effective recommendations.

We will consider conducting a survey to determine teachers' attitudes towards technology as a measure of success for this task and providing methodological recommendations or practical guidance based on the survey results.

A) Develop a teacher community and professional experience exchange network

The goal is to ensure mutual exchange of experiences, dissemination of best practices and professional support mechanisms among teachers on the effective use of artificial intelligence (AI), virtual (VR) and augmented reality (AR) technologies in geography teaching. Implementation mechanisms include creating a professional community for geography teachers, for example, establishing regular online communication by opening special groups on Telegram or WhatsApp messengers under the name “AI + Geography Teachers KZ”; and organizing monthly online meetings on the topic of “Digital Geography”. At these meetings, teachers will present their experience, introduce new methods, and exchange views on the use of digital technologies in the educational process.

B) Formation of a database of digital platforms

The goal is to develop a structured and systematic list of educational platforms based on artificial intelligence, virtual and augmented reality technologies adapted to the subject of geography. Implementation mechanisms include development of an online catalog of platforms based on AI/VR/AR technologies. This catalog should indicate the description of each platform, its methodology of use, level of accessibility (free/paid), language support capabilities and thematic areas.

This study was conducted among geography teachers in the form of an online survey based on the Google Forms platform. The data obtained were processed and analyzed using the SPSS Base software package.

Summary of the literature review

As a result of the literature review, it was found that the number of scientific publications devoted to the use of virtual reality technology in higher education institutions is quite large. In recent years, the number of scientific studies aimed at the use of artificial intelligence (AI), virtual reality (VR) and augmented reality (AR) technologies in the educational process has increased significantly. This trend clearly demonstrates not only the relevance of this direction, but also its scientific and practical value. Many studies currently

underway comprehensively analyze the impact of AI, VR and AR technologies on the educational process of students, demonstrating a number of advantages in improving the quality of their education, developing cognitive activity and increasing motivation for learning. However, there are still few works that study the advantages and effectiveness of introducing AI, VR and AR technologies in the process of teaching geography. This situation indicates that the topic has not been fully studied scientifically and is an urgent issue that requires further study (Sadvakasova, A. K., et al., 2024). Table 3 below provides a list of studies that have been specifically reviewed within the framework of the topic of using AI, VR and AR technologies in the educational process.

Table 3

Main results of the scientific works included in the review

No.	Researchers	Concepts
1	Bogusevschi D., Muntean C. & Muntean G. M.	The experiment conducted among young students showed that the use of VR makes the learning process more interesting .
2	Kornılov Iy.V., Mykasheva M.Y., Sarsımbaeva S.M.	The issues of optimal student learning using virtual reality technologies have been studied.
3	Hodgson P., et al.	They showed that VR enhances students' understanding of subjects and increases satisfaction with learning .
4.	Hamilton, D., et al.	Systematic literature review concluded that VR is generally beneficial, though a few studies reported negligible effects. One of the greatest advantages of virtual reality in education and learning is that it allows students to perform complex and dangerous tasks in a safe environment.
5.	Al-haimi B. et al.	Artificial intelligence helps students adapt to new paradigmatic learning systems, namely blended learning, location-independent and time-independent learning, and flexible learning. Thus, artificial intelligence tools optimize the responsibilities of the teacher.
6.	Serik M, et al.	In the works of researchers, it was noted that the level of creative thinking and practical skills of students increases during practical work with the help of artificial intelligence and neural networks. This study demonstrates that the use of artificial intelligence by children enhances their interest and activity in the classroom.
7.	Mukhamediyeva K.M., et al.	During the study, the authors concluded that the use of elements of artificial intelligence in STEM teachers training field provides effective opportunities. Overall, researchers explained that the use of artificial intelligence technologies, especially in STEM subjects, will open up new opportunities and change traditional teaching methods.

While the vast majority of current research focuses on assessing students' experiences with VR and AR technologies, there are few studies that directly analyze the impact of these technologies on academic achievement. In particular, it is clear that the theoretical and methodological aspects of introducing artificial intelligence (AI), virtual reality (VR), and augmented reality (AR) technologies into the teaching of geography have not been fully explored. The peculiarity of the proposed study is that it is not limited to assessing the current level of development of the research area by analyzing scientific articles, but also focuses on identifying relevant scientific and practical problems and specific tasks that need to be solved within the framework of the topic. This approach allows the researcher to form a comprehensive and systematic understanding of the theoretical foundations of the field, the applied methodological principles, and the results of previous studies.

In the second stage of the research, an electronic survey was conducted among teachers of geography at higher education institutions to comprehensively study the scientific and pedagogical potential of introducing artificial intelligence (AI) and immersive technologies (virtual and augmented reality - VR and AR) into the process of geographical education.
The survey was developed on the Google Forms platform and consisted of a total of 8 questions. It assessed teachers' access to these technologies and their level of readiness to use them in their professional activities. The effective use of AI and VR technologies in the classroom is directly related not only to technical capabilities, but also to the level of teachers' mastery of these technologies. In this regard, the survey allowed us to identify the main methodological and organizational obstacles encountered in the process of teaching geography and develop recommendations aimed at overcoming them.

116 geography teachers working in higher education institutions of Kazakhstan participated in the survey (Table 4). Of these, 77 participants were women and 39 were men (Figure 1). The collected data was processed using SPSS Base software, and the respondents' answers were subjected to quantitative analysis. This method allowed for a systematic structuring of the obtained data and a high-level interpretation of the results.

Table 4
Number of survey participants

		Statistics	
		Gender Distribution	Pedagogical qualification
N	Valid	116	116
	Missing	0	0

Figure 1
Gender of participants

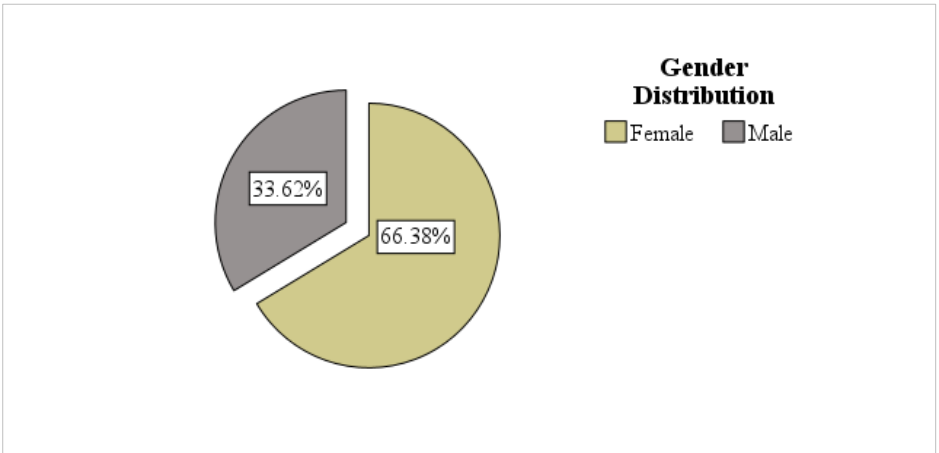
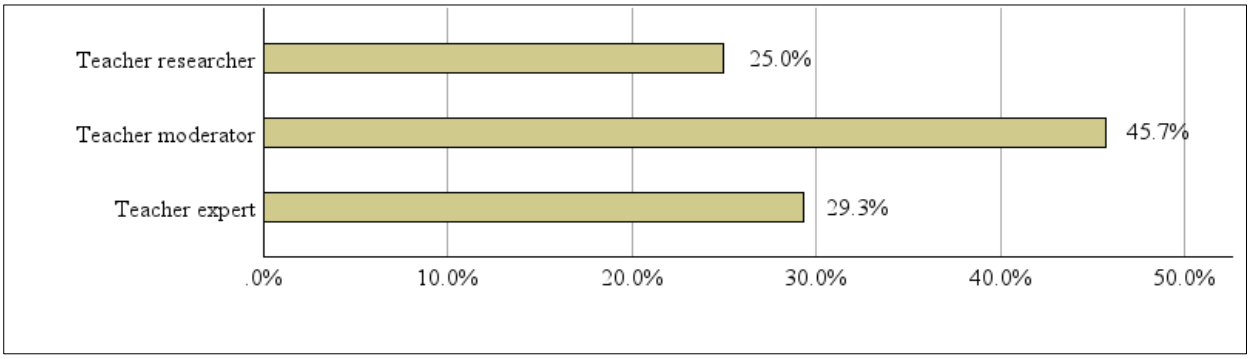


Figure 2

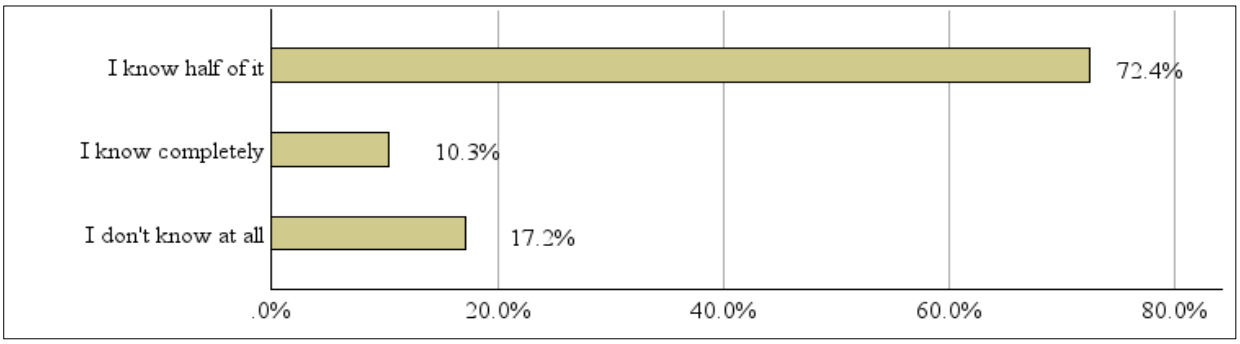
Data on the pedagogical qualifications of teachers participating in the survey «Pedagogical qualification»



The main questions and results of the survey were developed by the authors based on online surveys in the Google format.

Figure 3

How would you rate your knowledge of AI and AR/VR technologies?



As indicated in the first question above, the data indicate that teachers are not sufficiently knowledgeable about AR/VR technologies. Specifically: The majority (over 72%) are aware of these technologies to some extent, but not fully mastered, indicating that additional training is needed to effectively use them in the classroom, while 17.2% are completely unaware, indicating that AR/VR has not yet been widely introduced into geography education in high educational institutions in Kazakhstan, or its importance has not been sufficiently explained to teachers. Only 10.3% are fully aware, which indicates that very few teachers actively use these technologies in the educational process. In general, such indicators indicate the need to strengthen the education and training of teachers in the use of AR/VR technologies.

Table 3

Have you used AR/VR or AI technologies in Geography?

	Frequency	Percent	Valid Percent	Cumulative Percent
I refuse to use it	1	9	9	9
No, but I plan to use it	47	40.5	40.5	41.4
No, I have not used it	29	25.0	25.0	66.4
Yes, I used it	39	33.6	33.6	100.0
Total	116	100.0	100.0	

The results of the second question showed that the level of use of AR/VR and AI technologies in geography is still low, but there is a generally positive attitude. More specifically: more than 40.5% plan to use them, which means that teachers are interested in this technology, but have not yet introduced it into the teaching process. This, in turn, may be due to their level of preparation or lack of necessary tools, while the fact that 25% did not use these technologies at all indicates that these technologies are not widely used in geography lessons. Meanwhile, 33.6% used them, that is, every third teacher has tried to implement AR/VR or AI technologies in their practice. Only 0.9% refused to use them. These results indicate that teachers are interested in these technologies. However, additional training and methodological support are needed for their widespread implementation.

Table 4

*How much do you value the use of AR/VR or AI technologies in geography lessons***?**

	Frequency	Percent	Valid Percent	Cumulative Percent
Average	20	17.2	17.2	17.2
Effective	62	53.4	53.4	70.7
Inefficient	1	9	9	71.6
Very effective	33	28.4	28.4	100.0
Total	116	100.0	100.0	

The answers to the third question showed opinions on the overall effectiveness of using AR/VR or AI technologies in geography lessons: 53.4% (62 people) rated them "Effective", meaning that more than half of the respondents considered these technologies useful, while 28.4% (33 people) rated them "Very Effective", indicating that they are confident in their high effectiveness. 17.2% (20 people) answered "Average", meaning that they recognize the benefits of the technologies, but believe that the effectiveness effect is not significant. 0.9% (1 person) considered it "Ineffective", which means that they did not see the benefits of AR/VR and AI or thought that there were difficulties in using them. Summing up this question, a small number of respondents considered their impact to be weak and were skeptical about the need to use them in the learning process, while the majority admitted that these technologies are effective in geography lessons.

Table 5

In which geography topics will the use of AI or augmented/virtual reality tools be effective?

	Frequency	Percent	Valid Percent	Cumulative Percent
Climate change	16	13.8	13.8	13.8
Land resources and environment	19	16.4	16.4	30.2
Natural disasters and geographical processes	28	24.1	24.1	54.3
World maps and topography	53	45.7	45.7	100.0
Total	116	100.0	100.0	

In the fourth question, the responses showed that the effectiveness of using AI or AR/VR technologies in geography lessons varies depending on the topic. According to the survey results, the highest percentage (45.7%) considered it effective when teaching world maps and topography. From this, we can see that AR/VR tools are very effective and useful in teaching spatial thinking and cartography. Students can better understand the terrain, elevation differences, and geographical features through interactive maps. The topic of Natural Disasters and Geographical Processes was chosen by (24.1%) of respondents.

This, in turn, led to the opinion that virtual simulations would help them see the effects of earthquakes, tsunamis, volcanic eruptions, and other phenomena. In this regard, AI could teach students to analyze data and predict natural disasters. 16.4% of respondents considered it appropriate to use it in the topic of Land Resources and Environment. In this area, AI can be used for monitoring, remote sensing of the earth, and resource management. The lowest indicator was the topic of "Climate Change" (13.8%). The use of AI and AR/VR in this topic is also useful (for example, in modeling climate change and analyzing weather trends), but we can see that respondents considered this topic less important than others. Summing up this question, these technologies allow us to teach cartography in a more transparent and experience-based way than traditional methods. Therefore, it can be confidently said that AR/VR is one of the most effective tools in cartography and topography.

Table 6

What do you think about the impact of AR/VR or AI technologies on student learning outcomes in geography?

	Frequency	Percent	Valid Percent	Cumulative Percent
Increases students' interest	41	35.3	35.3	35.3
Increases understanding	27	23.3	23.3	58.6
Reduces the difficulty level of the topics	17	14.7	14.7	73.3
The learning process will be very interesting and interactive	31	26.7	26.7	100.0
Total	116	100.0	100.0	

The fifth question showed that the use of AR/VR and AI technologies in geography lessons has a positive impact on student learning outcomes. 41 respondents (35.3%) said that it increases student interest, 27 (23.3%) said that it improves understanding, and 17 (14.7%) said that it reduces the level of difficulty of topics. There is certainly a reason for this, because some geographical topics (for example, geodesy, climate change, cartography) are difficult for students. However, with the help of AI, data processing and interactive tasks make it easier to master the topic. The remaining 31 (26.7%) answered that the learning process using these technologies will be very interesting and interactive. This is because geography lessons, enriched with active learning methods, allow students to gain experience-based knowledge. Experiences such as climbing mountains, exploring the ocean floor, and seeing the terrain in three dimensions through VR, clearly make the learning process more interesting.

Table 7

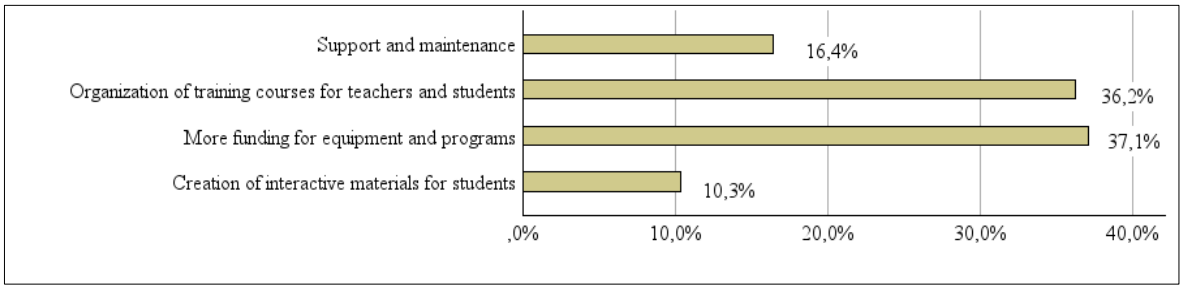
What do you think are the advantages of using AR/VR or AI technologies in teaching geography?

	Frequency	Percent	Valid Percent	Cumulative Percent
Allows you to adapt training to individual needs	7	6.0	6.0	6.0
Facilitates interpretation of topics	12	10.3	10.3	16.4
Increases students' interest in the subject	55	47.4	47.4	63.8
It shows geographical phenomena and processes in a clear visual way	42	36.2	36.2	100.0
Total	116	100.0	100.0	

The results of the sixth question show that AR/VR and AI technologies play an important role in teaching geography. Most respondents noted that these technologies increase students' interest in the subject (47.4%) and allow for a more realistic and visual representation of geographical phenomena (36.2%). In addition, facilitating the explanation of topics (10.3%) and tailoring teaching to individual needs (6.0%) were also considered important factors. These data indicate that the effective use of AR/VR and AI technologies in geography lessons can increase students' cognitive interest and improve their mastery of educational materials.

Figure 4

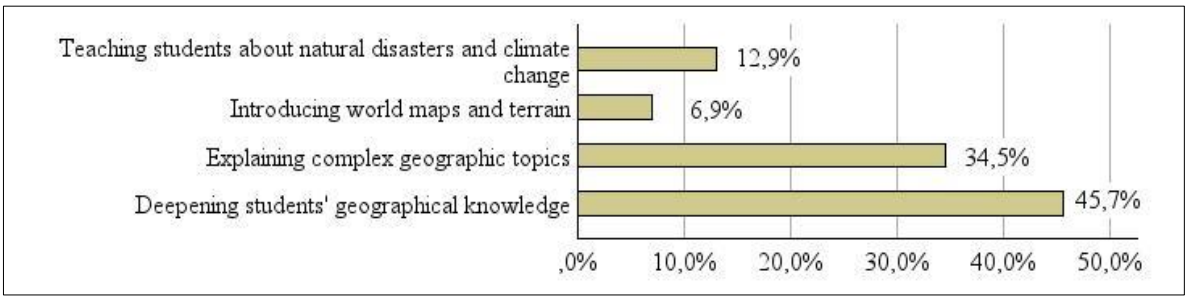
In your opinion, what measures are needed for the widespread use of AR/VR or AI technologies in geography lessons?



Based on the results of the seventh question, it was found that for the widespread use of AR/VR and AI technologies in geography lessons, it is necessary, first of all, to train teachers and students (37.1%) and strengthen the material and technical base (36.2%). In addition, the organization of technical support (16.4%) and the development of interactive educational materials (10.3%) are important factors. By implementing these measures, the process of teaching geography will be based on modern technologies, students' interest in the subject will increase, and the quality of education will improve.

Figure 5

What do you think AR/VR or AI technologies can improve in teaching geography?



As a result of the eighth question, respondents noted that these technologies could improve the following aspects:

- Deepening students' geographical knowledge - 45.7%
- Explaining complex geographical topics - 34.5%
- Introducing world maps and landforms - 12.9%
- Educating students about natural disasters and climate change - 6.9%

These results show that AR/VR and AI technologies are primarily used to deepen students' geographical knowledge (45.7%) and explain complex geographical topics (34.5%). In addition, introducing world maps and landforms (12.9%) and teaching about natural disasters and climate change (6.9%) were also considered important areas. The widespread use of these technologies in geography lessons has allowed students to better master the material, understand the topics in a clear and visual way, and develop practical skills.

Conclusion

The survey results highlighted the key research questions and demonstrated the potential of AI, VR, and AR technologies to enhance the quality of education. Studies have shown that immersive technologies have increased awareness of environmental issues and contributed to the formation of beneficial behaviors (Demirezen, B. 2019).

The respondents' answers showed a generally positive view of the effectiveness of these technologies in developing geographical knowledge in line with modern requirements. While the results of the study prove the potential of VR and AI technologies to improve learning outcomes, it also shows that teachers' ability to fully utilize these tools is still insufficient in some areas. Therefore, there is a need to effectively integrate these technologies into current educational methodologies and learning materials. Overall, the research results show that although AI and VR technologies are still in their early stages of development, they have great potential for education.

However, the issue of providing teachers with the necessary tools and resources to effectively implement these technologies in their lesson plans remains relevant. In this regard, there is a need to conduct additional research and ensure their practical application in order to fully realize the potential of the technologies considered in the education system. In the course of studying this topic, we analyzed a large number of materials and scientific articles. We also examined the advantages and disadvantages of modern educational methods compared to traditional teaching methods and summarized teachers' views on the introduction of these technologies into the learning process based on the conducted research.

Conflict of Interest Statement

The authors declare no potential conflicts of interest regarding the research, authorship, or publication of this article.

Author Contributions

Aizharkyn Nurgazina: Data curation, Writing - Original draft preparation,Investigation; Jan A. Wendt & Erkin Tokpanov: Validation, Formal analysis, Visualization; Sholpan Karbayeva: Conceptualization, Methodology, Resources

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TRENDS IN THE DEVELOPMENT OF KAZAKHSTAN'S HIGHER EDUCATION SYSTEM

Abstract: This work describes, systematizes and summarizes the problems of quality assurance, efficiency and effectiveness, in the context of the global competitiveness of the higher education system, which has been and remains one of the most acute problems of the development of modern society in the Republic of Kazakhstan. The persistence of challenges and gaps, despite the measures taken, is associated with the demographic growth of young people and the aging of teachers. Ensuring access to education, its quality, and the transformation of higher education to meet the needs of the labor market are becoming the primary goal for ensuring economic growth. The authors have identified the relationship and mutual influence of higher education trends with economic development trends, and provided recommendations for the development of the higher education ecosystem.

Keywords: higher education, educational development trends, competitiveness, education ecosystem, advanced training system, global competitiveness.

Introduction

Technological changes are inextricably linked to changes in the education system. The emergence of speech has enabled people to share their experiences and led to the formation of an oral culture. Education was pragmatic in nature. Education was carried out using the sales analogy based on the Educator to Student model (E2St). Writing made it possible to separate experience and knowledge from the subject, preserving them, thereby forming a modern understanding of education as a process of transition from the culture of society to the education of the teacher, while the education process itself became elitist, accessible to a select few and limited by the capabilities of teachers.

The invention of printing in the 14th century made it possible to ensure the availability of knowledge and expand an alternative channel for obtaining knowledge. Book printing has made it possible to create alternative information flows of knowledge, which have reduced the direct communication time of each teacher with each student. The spread of knowledge and its accessibility made education more and more attractive, which led to the creation of a classroom system in the 16th century by Jan Amos Kamensky. At that time, the model of a School (any educational organization) for a student (School to student - S2St) or a university for a student (U2St) began to be implemented.

The advent of electricity increased the length of daylight hours, reduced the time used by people for routine household work, which allowed people to devote more time to research and education, and facilitated the dissemination of information through film and television. The invention of computers and the Internet has led to an exponential growth of available information and its dissemination. Education has become understood as a universal good that satisfies the needs of the state and society. Educational systems have transformed into ecosystems, as the labor market's demand for educated personnel and research results has

increased. Universities have expanded the range of business processes and training and research, commercialization and interaction with the labor market have been added. Educational systems began to have stable links with society and industry, with potential employers. This interaction has received a new name – the ecosystem of education. Education has become possible to describe with the model School for Society (S2So) or University for the Labor Market (U2L).

Digital technologies, including artificial intelligence, have created unique opportunities for generating new information outside the human brain and have increased human responsibility for its adequacy and reliability. Technological changes are one of the triggers for the development and transformation of education itself as a process and as a system. Education has become asynchronous, barrier-free, and access to information has expanded. The reliability of the information has ceased to be unambiguous. Virtual and mixed realities have transformed the process of learning and access to knowledge. Digital generative technologies provide personalization of the learning process, and at the same time begin to replace employees. The current practice can be described as two competing models: Digital Technology and Artificial Intelligence for the student (DT&AI2 St) and Digital Technology and Robotics for the labor market (DT&AI 2 L). In addition to technological challenges, the state of the education ecosystem is influenced by the historical context, traditions and stereotypes. Together with trends and "black swans", it forms a complex of cause-and-effect relationships that reflect the development of the ecosystem of education, including Kazakhstan.

Materials and methods

In this study, we applied a comprehensive approach to analyzing statistical data on the education system in Kazakhstan in order to identify key trends and problems affecting the country's educational ecosystem. The research consists of several stages, each of which is aimed at a deep understanding of the current state and dynamics of the educational system. At the first stage, a preliminary assessment of the existing data and literature on the topic was carried out. At the second stage, statistical information was collected and processed. The third stage included data analysis and formulation of conclusions. Finally, at the last stage, recommendations were developed to improve the educational system based on the results obtained.

We used secondary data obtained from official sources such as the Ministry of Education and Science of the Republic of Kazakhstan, the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, as well as national reports on the state of science and higher education, data from the World Bank and UNESCO on education in Kazakhstan. In order to identify common patterns, an analysis of existing research on the development and transformation of education and educational systems, as well as an analysis of documents related to educational reforms and a SWOT analysis were conducted. In addition, an analysis of articles and reviews on the research topic was carried out.

We used both quantitative and qualitative methods to analyze the collected data. Quantitative analysis included the use of statistical methods such as regression analysis and correlation analysis to identify the relationships between different variables). The qualitative analysis was conducted using content analysis to interpret data on education policies and strategies.

During the research process, we followed ethical standards, ensuring the confidentiality of data and respecting the rights of all participants in the study. All data was anonymized, and only aggregated metrics were used for analysis.

Thus, this study is a systematic analysis of the state of education in Kazakhstan, aimed at identifying key factors affecting its development and quality. The results of the study can

serve as a basis for further research and development of strategies to improve the country's educational ecosystem.

The results of the study and discussions

Key trends in the transformation of educational systems

Analyzing publications in the field of education, we can identify seven key trends that determine the development of educational systems at the global level:

1. Digitalization as a trend affects both the field of human activity and the educational process itself. Digitalization of education involves the integration of technology into the learning process, which allows access to educational resources anytime, anywhere. Online learning platforms - MOOCs (Massive Open Online Courses), contribute to the democratization of education by providing the opportunity to gain knowledge to a wide audience. Digitalization of education makes it possible to spread information without barriers, scaling it up and delivering it to any place at any time. Kazakhstani universities have nationwide access to educational platforms, recognizing learning outcomes and integrating them into educational programs. Flexible learning in a broad sense, which allows you to combine different ways and models of building the learning process, including online, offline, internship and work. Hybrid learning models combine traditional teaching methods with online formats, which allows for more flexible and adaptive learning environments. (Müller, C., & Mildenberger, T., 2021) These models provide a balance between personal interaction and the use of technology, which promotes deeper learning and increases the availability of education. In March 2024, changes were made to the Kazakh rules, regulating the possibility of recognizing learning outcomes obtained within the framework of continuing education, which makes it possible to optimize educational trajectories (Republic of Kazakhstan, 2023).

2. Personalized learning involves adapting educational programs to the individual needs and learning styles of students (Burbules, N.C. 2020). Tracking the educational trajectory and monitoring the development of learning outcomes provide sufficient data to artificial intelligence. Predicting academic performance, recommending resources, evaluating knowledge, improving the educational process, image analysis, content analysis, and determining the zone of immediate development (Crompton, H., & Burke, D., 2023) are the main areas of use of AI in higher education. In modern universities, AI is used to identify students, digital analytics, predict educational prospects, create personal assignments and recommendations, form individual curricula, increasing the effectiveness of learning and engagement of a particular student, taking into account his level of knowledge, character traits and personality traits. Generative AI systems allow you to create individual assignments for each student and become an AI assistant and mentor. This year, every lecturer at a Kazakh university is required to take advanced training courses in AI. The AI-SANA project has been created to teach AI students, which ensures the integration of Both into the content of education (Ministry of Science and Higher Education of the Republic of Kazakhstan, 2023).

3. Modern challenges require educational programs to integrate knowledge from various disciplines. The post-industrial economy is based on knowledge and needs people who are able to identify and solve problems using tools and methods. The rapid development of technology has already led to the fact that modern students cannot even imagine which jobs they will apply for (Akour, M. & Alenezi, M., 2022) and what set of competencies they need.

An interdisciplinary approach promotes the development of critical thinking and creativity, which is essential for solving complex problems in a rapidly changing world (James Jacob, W., 2015). Interdisciplinarity, cross-culturality and integration have already been demonstrated in Kazakhstan's sectoral and regional Atlases of new professions and competencies. Based on descriptions of the requirements for the professions of the future, Kazakhstani universities are developing innovative educational programs.

4. Globalization promotes knowledge exchange and cultural interactions between countries. International exchange programs, joint research and transnational universities create conditions for the formation of a global educational community, which expands the horizons of students and promotes the development of intercultural competence (De Wit, H., & Altbach, P.G., 2021). Education has become a successful segment of the economy, attracting financial flows to the countries providing educational services. There is a stratification between countries and cities in one country in terms of the demand and attractiveness of education. These factors are well observed in Kazakhstan, creating poles of attraction for visiting students in Almaty and Astana. Academic mobility and the development of joint educational programs are an essential component of the development strategies of Kazakhstani universities. The Ministry of Science and Higher Education has initiated the creation of Centers of Academic Excellence on the basis of regional universities and the opening of branches of leading foreign universities in the regions.

5. Stakeholders pay special attention to the formation of different types of intelligence and the development of soft skills necessary for successful life and work in modern society. One of the important integrated skills is working in an interdisciplinary team (Nancarrow S.A., 2013). These skills include critical thinking, creativity, cooperation, teamwork, and digital literacy. Kazakhstani universities include soft skills in their learning outcomes, defined in relevant professional standards and in Atlases of New Professions and Competencies.

6. Sustainable development is becoming an important aspect of educational initiatives. Universities are increasingly introducing the principles of sustainable development into their programs, and they are also encouraged to do so by university ratings. by teaching students the importance of social responsibility and environmental awareness, which forms their active citizenship. Kazakhstani universities actively participate in internationally recognized rankings that contain criteria for sustainable development.

7. Education is being transformed by the needs of the labor market, which force not only to study and retrain, but also to discard non-constructive approaches, learning models and skills. Rosak-Szyrocka, J. (2024) emphasizes that modern society and the economy are moving to the 5.0 model, when emotional competencies are becoming more important, and universities are becoming fully digital organizations. Web 5.0 – becomes a sensory-emotional network in which communication is carried out both between people and between people and generative technologies. Even now, the quality of the generative response depends on the emotional context and communication style. Society 5.0 contains real and virtual components that are closely related to each other.

Each of these trends plays a key role in the transformation of educational systems, creating new opportunities for learning and development for both students and teachers.

Stages of transformation of the education system in Kazakhstan

Since 1991, Kazakhstan has gone through eight stages of development of the higher education system. In the first stage, from 1991 to 1994, work was carried out on the formation of the legislative and regulatory framework for higher education, which is typical for many countries moving to a new management system. At that time, there was a separation from the traditional Soviet education system based on administration and centralized bureaucratic process management. The first educational development programs in Kazakhstan have been developed.

The second stage, covering the period from 1995 to 1998, was devoted to the modernization of the higher education system and updating its content. During this period, as in a number of other countries, special attention was paid to developing students' practical skills and improving the quality of education. In addition, information and communication

technologies were actively introduced, which contributed to the digital transformation of the educational process and was the beginning of the influence of the corresponding trend.

The third stage, from 1999 to 2000, was characterized by the decentralization of management and financing of education, which also reflects global trends towards increasing the autonomy of educational institutions. At that time, new knowledge assessment technologies were introduced. In order to reduce corruption risks when applying to universities, a unified national Testing was introduced in 1999. At this stage, students were able to independently choose a university to master the educational program, which served as an impetus for the formation of educational hubs in Almaty and Astana, attracting students from all over the country. This stage reflects the first manifestations of the trend of globalization of education at the national level.

The period from 2001 to 2010 was the fourth stage, and was aimed at the strategic development of the higher professional education system, its recognition at the international level and the optimization of the network of universities. This corresponds to the desire of many countries to increase the international competitiveness of their educational institutions. At that time, the first attempt was made to accredit universities based on formal quantitative criteria. The year 2010 was the last year of the functioning of the Soviet classification of education levels.

By signing the Bologna Declaration on March 11, 2010 and becoming the 47th member state of the Bologna process, Kazakhstan entered the fifth stage of higher education reform. From 2010 to 2017, the principles of the Bologna process were implemented in Kazakhstan, the internationalization of higher education was expanded, and a national education quality assurance system was built. Thus, the commitment to European approaches and principles in ensuring the quality of higher education and building a European Higher Education Area was demonstrated. Since 2010, Kazakhstan has begun the transition from quality control to quality assurance, and the process of accreditation has begun according to the requirements and criteria of standards developed by accreditation bodies based on European Standards and Quality Assurance Guidelines (ESG). The fifth stage made a significant contribution to the emergence of Kazakhstan as a prominent figure in the international educational space, ensured confidence in Kazakhstani diplomas and attracted new students to the country.

From 2017 to 2020, Kazakhstan was in the sixth stage of implementing academic freedoms, expanding digitalization and transparency in university management processes, as well as modernizing quality assurance systems at universities. These steps were in line with global trends towards digitalization of education and improved management of educational institutions. In 2018, fundamental changes were made to the Law on Education, increasing the academic freedom of higher and postgraduate education organizations. Kazakhstan has begun an active movement towards standardization of content not only at the BA-MA-PhD levels of education, but also within the framework of the National Qualifications System: Industry-specific Qualifications Frameworks by industry have been developed, on the basis of which existing professional standards have been updated and new ones developed. Since 2018, the Atameken National Chamber of Entrepreneurs has begun to conduct a rating of educational programs of Kazakhstani universities, including an analysis of the demand for graduates and an analysis of educational programs. It was at this stage that the impact of labor market demands for vocational training at universities increased, which stimulated the involvement of more stakeholders in the educational process and the formation of an understanding of the national ecosystem of higher education.

The COVID-19 pandemic has become a test for education systems around the world, and Kazakhstan is no exception, having actually entered the seventh stage of education reform. In the period 2020-2022, the educational process switched to an online format, which required rapid adaptation of universities, teachers and students. Kazakhstan's higher education system

has successfully passed this test, ensuring compliance with quality standards, including access to digital resources and libraries, as well as the introduction of a proctoring system during exams. A new meaning has been given to the concept of academic honesty, which began to include not only anti-plagiarism, but also ethical behavior. Transparency of decision-making and information about educational programs has become one of the trends in Kazakh education, which has led to the integration of university LMS (education management systems) with national databases, which has been reflected in the creation of a unified national register of educational programs, access to verification of information on the authenticity of diplomas, and the posting of reports on visits by external expert commissions within the framework of accreditation on the single European resource DEQAR. At this stage, the national education ecosystem has successfully passed the exam and demonstrated a sufficient level of digitalization.

The eighth stage of the development of Kazakh education began in 2023, and one of its key trends was advanced training, which includes the development of educational programs based on an Atlas of new Professions and occupations. Thus, the results of foresight of the needs of the economy became the basis for the development of innovative educational programs. Work continues in the regions to create Centers of Academic Excellence based on universities. In addition, the trend towards academic mobility and globalization is also having a significant impact on the Kazakh education system, attracting students from India, Pakistan, China and other countries in the region to study at Kazakh universities, as well as in strategic partnerships and branches of foreign universities. The concept of higher education and science development in the Republic of Kazakhstan For the period from 2023 to 2029, it provides for expanding access to education, the transition to a broad international understanding of the concept of inclusivity, providing targeted psychological support to students, the introduction of hybrid forms of education, digitalization of education, the use of AI, the introduction of foresight methods to predict the advanced need for personnel and the development of innovative educational programs (Republic of Kazakhstan, 2023). The concentration of students entails infrastructural changes, the strengthening of regional universities and the construction of dormitories. The opening of branches of leading foreign universities, the creation of innovative educational programs, and the creation of a National portfolio of educational programs will contribute to the implementation of the idea of an educational hub. Thus, the trends of globalization and the impact of the labor market continue to stimulate changes in the higher education system and its transformation into a distributed network ecosystem, providing for the creation of Centers of Academic Excellence and Competence Centers in the regions. It should be noted that the trend of globalization manifests itself both as an opportunity and as a threat, therefore, in the ecosystem of higher education there are systemic measures for the development of education in the regions and the formation of a network distributed model of the educational ecosystem.

Increasing access to knowledge and education

Competition in education is taking place at a global level, driven by the development of digital educational platforms, video telephony, and corporate training. The national subscription has provided access to Coursera for many Kazakhstani students. The exponential growth in the number of children and youth is an incentive for both the opening of new universities and branches of foreign universities, as well as qualitative changes in the organization of the educational process.

At the beginning of the 2023-2024 academic year, 112 organizations of higher and postgraduate education operated in Kazakhstan, including 77 universities, 14 academies, 9 institutes and equivalent universities, 1 conservatory, 8 national higher education institutions and 3 national research universities. Besides them, there were 3 branches of foreign

universities. Over the past 5 years, the number of universities has decreased by 9.6%. State ownership extends to 44 universities - these universities usually operate in an organizational and legal form - a non–profit joint-stock company. 67 universities have a private form of ownership. 1 university and 3 branches are foreign-owned. At the same time, systematic actions are being taken at the EOM and university levels to open branches of foreign universities. For two years now, a branch of the National Research Nuclear University MEPhI at al-Farabi Kazakh National University has been operating, which trains specialists in the field of nuclear physics. The establishment of the branch promotes the development of nuclear technologies, which is of strategic importance for Kazakhstan's energy security. As part of the development of the energy agenda, a branch of the Uzbek University is being opened in Taraz on the basis of a new University of Water Management and Irrigation, which was dedicated this summer.

Engineering educational programs will receive a new impetus for development within the framework of the Herriot-Watt University (Scotland) branch based on K. Zhubanov Aktobe Regional University and the Kazakh-German Institute of Sustainable Engineering based on Yessenov University. These programs are aimed at sustainable development and modern technologies, which is relevant in the light of global challenges related to climate change. A branch of the Northwestern Polytechnic University (PRC) on the basis of the Al-Farabi Kazakh National University also trains masters in engineering. The strategic partnership of M. Kozybayev North Kazakhstan University with the University of Arizona (USA) also involves the development of programs in the field of biotechnology, agriculture, business and management, which is important for increasing the competitiveness of Kazakhstani companies. The branch of the University of Hong Kong on the basis of the Kazakh National Research Technical University named after K. Satpayev can offer programs in the field of digital technologies and artificial intelligence. In addition, inDriver programs are being opened on the basis of Satpayev University. The Graduate School of Artificial Intelligence and Computer Science of Seoul National University of Science and Technology on the basis of Korkyt Ata Kyzylorda University responds to global trends in the field of digitalization and artificial intelligence, which is a priority for Kazakhstan. Lu Ban Workshop (D. Serikbayev East Kazakhstan Technical University and Tianjin Professional University) It focuses on the training of technical personnel in the field of road transport, which is important for the development of the country's transport infrastructure. The Shakarim University branch of the University of Economics in Bydgoszcz (Poland) offers programs in economics and management aimed at effective resource management and business development in the modern market.

Thus, in recent years, Kazakhstan has been actively developing its educational infrastructure, providing for the opening of branches of foreign universities in various regions of the country. This is due to the new requirements of stakeholders expressed by the desire to integrate the Kazakh education system into the international space, to transform Kazakhstan into an international hub provider of educational services.

Kazakhstan actively attracts foreign universities to open branches, which allows students to obtain international diplomas without having to travel abroad, which simultaneously affects the development of potential and at the same time allows them to maintain it in the country, preventing brain drain, both at the global and national levels. Among the partners are universities from Germany, Great Britain, the USA and other countries. The Government of Kazakhstan actively supports initiatives to establish branches of foreign universities, which includes financial subsidies and tax incentives. Further expansion of the branch network is expected, which will contribute not only to improving the quality of education, but also to cultural exchange between Kazakhstan and other countries. In addition, the opening of branches of foreign universities in the regions of Kazakhstan is a strategic step towards

modernizing the educational system, implementing foreign educational technologies and attracting highly qualified foreign specialists in the field of education. It will also theoretically allow attracting foreign students from the region to study at top educational programs in Kazakhstani branches.

Demographic growth, educational migration and the attraction of the two capitals

According to the Bureau of National Statistics, 592.7 thousand people studied in Kazakhstan's higher and postgraduate education institutions at the end of 2023. Of these, 171.7 thousand applicants enrolled in 2023, and 157.1 thousand people completed their studies in educational programs, thus showing a demographic trend in the number of young people. Almost 65% of students study in Kazakh, 8.5% in English.

Kazakhstan is striving to become an educational hub for the countries of the region. 11.8 thousand students (2%) from CIS countries study at Kazakh universities, 13.4 thousand (2.3%) from non-CIS countries. Most of the students come from India – almost 9 thousand students, and from Uzbekistan – 6.9 thousand, 2.5 thousand students have the status of "candace". Ministry of Science and Higher Education.

Statistics show that the attraction of the two capitals has remained: 54.3 thousand students chose to study in Almaty, followed by Astana with 23.75 thousand first-year students, and Shymkent in third place. The outflow of students from the regions to the universities of the two capitals is a distinctive characteristic of the educational migration of students. Among the regions, there is a critically small number of students in the new Ulytau region (only 451), as well as a low number of students in Zhetysu – 1449, and in the North Kazakhstan region - 1760 enrolled.

The number of students in universities is increasing every year. Currently, 97.5 thousand students are enrolled in the final year, which is 1.8 times less than the number of students enrolled in the 1st year. The annual increase in the number of students creates challenges to the university infrastructure, the availability of resources, and, most importantly, the availability of high-quality, established teachers. Currently, when admitting students, universities can set only student scores as selection criteria, but they cannot limit the number of applicants. Of the total number of students in the 4th year, 16% of students - 97.5 thousand people study, in the third 23% of students – 136.2 thousand people, in the second 28% of students - 167.7 thousand people, in the first 29% of students – 171.8 thousand people.

Almaty traditionally remains the leader in the number of universities – 37 and students – 186.6 thousand people (31.5%). Shymkent took the second place in terms of attractiveness – 83.4 thousand people (8 universities), overtaking Astana with its 14 universities (75.0 thousand people). In total, more than 58% of the total number of students study at universities in cities with more than a million people, which indicates the concentration of students in large cities. It is these cities that make the main contribution to the educational migration of students, being the center of attraction for nonresidents – 313.1 thousand people, which is 52.8%, of which 134.6 thousand people need dormitories. The additional burden on the infrastructure of large cities leads to dissatisfaction among both city residents and students with the quality of educational services and university resources. The leader in attracting students is Almaty, where 106 thousand nonresident students study, of which 57.2 thousand students need a dormitory, the shortage of places in the dormitory exceeds 21.6 thousand, the shortage of places in the dormitory in Astana is 9.6 thousand, and in Shymkent – only 1.3 thousand places.

The total area of universities is more than 6.5 million square meters, so there are 11 square meters per student. The best ratio in Mangystau is 90 square meters per student. In Astana, there are 14 sq.m. per 1 student, in Almaty – 9.2 sq.m., in Shymkent – 6.4 sq.m. A low ratio is observed in Kyzylorda – 7.4 sq.m., Almaty – 7.9 sq.m. per 1 student, Atyrau – 7.8 sq.m., West Kazakhstan – 8.2 sq.m., Pavlodar – 9.9 sq.m.M. On average, there are 16 square

meters per 1 student who needs to stay in a dormitory. The total area of dormitories is 1.5 million square meters. At the same time, more than 134 thousand people still need dormitories, of which 93,478 people live in dormitories, due to the current shortage of places. More than 82,921 computers are used in the educational process, with almost 8 people per computer. In the Zhambul region, there are 29 people per computer, and 15 people in Shymkent, which creates an obstacle to sufficient time for individual and laboratory classes. At the same time, these data do not take into account the number of personal computers and mobile digital devices that are currently used throughout the world in the learning process.

The demographic growth of young people determines the challenges at the national level related to the need to resolve the contradiction: maintaining and increasing access to education and insufficient provision of resources (including infrastructure and teachers). This contradiction can be resolved through changing the format of education: learning in mixed environments, in virtual and augmented reality, attracting external resources to improve infrastructure, attracting "external" – foreign teachers, scaling teachers and other sources of reliable information using digital technologies, as well as by reducing students' stay at universities through dual education and recognition. the results of previous non-formal and informative education, including work experience. The regulatory foundations of this process have already been laid, but in practice it has not been fully implemented, since in this case not only the terms of study, but also the incomes of universities are reduced.

Economics of higher education

At the beginning of the 2023/2024 academic year, 227.3 thousand students studied at the expense of state educational grants, 68.2 thousand of them enrolled in the 1st year. 46.7 thousand people completed their studies in 2023. The largest number of educational grants was allocated to the group of educational programs "6B07 Engineering, manufacturing and construction industries" - 62,865 grants, of which 19,853 people received, 12,675 people graduated. The second place in terms of the number of grants is occupied by the group of educational institutions "6B01 Pedagogical Sciences" - 47,095 students, 14,801 of them enrolled, 10493 graduated. The top 3 in terms of the number of grants is closed by the 6B06 Information and Communication Technologies group - 33,477 students, 11,782 of them enrolled, 6,045 graduated, i.e. the number of grants in the IT field has increased by 94.9% over the past 4 years. The OP group "6B05 Natural Sciences, Mathematics and Statistics" ranks 4th with 21,576 grants, of which 7,384 are for 1st-year students and 3,995 people have completed their studies. These trends demonstrate the state's attention to the issues of high-tech and digital training of future specialists, the orientation of higher education towards teacher training in connection with a sharp increase in the number of children and youth.

350.5 thousand students took advantage of the opportunity for paid tuition, which is almost 60% of the total number of students, 98.8 thousand people enrolled from the lower school, and 106.4 completed their studies. Thus, there is a decrease in the number of students studying for a fee due to an increase in the number of grants. There are 115,825 people in the top OP groups attracting students to paid tuition for the 6B01 Pedagogical Sciences group (which is 2.45 times more than those studying on a grant). The change in the status of the teacher led to an increase in the prestige of the teacher, which confirms the increase in the number of students.

The year 2024 was the year of the transformation of higher education financing - financing is carried out through educational loans and differentiated grants, contributions to the Unified Voluntary Funded System "Keleshek", at the expense of the funds of the National Fund for Children program.

In the 2023/2024 academic year, the OVPO provided services totaling more than 127 billion 931 million tng, of which more than 63 billion were funded from the budget. 471 million

tng, population – 57 billion 993 million tng, enterprises – 6 billion 466 million tng. Of these, state organizations of higher and postgraduate education provided services in the field of higher education totaling 73 billion 185 million, at the expense of the budget 46 billion 831 million tng., at the expense of the population 25 billion 174 million tng., at the expense of enterprises – 1 billion. 179 million tng. Private higher education organizations provided services in the field of higher education totaling 52 billion 078 million tng, of which 15 billion 545 million tng from the budget, 31 billion 537 million tng from the population, and 4 billion 996 million tng from enterprises. The volume of services in the field of higher and postgraduate education provided via the Internet is 3 billion. 470 million tng., at the expense of the budget of 2 billion 160 milliontng., at the expense of the population of 1 billion. 269 million tng., at the expense of enterprises – 40 million tng. Thus, digital services in higher education account for less than 10%, which demonstrates the lack of offers in the educational services market and the potential capacity of this market, taking into account demographic growth, while ensuring the quality of education remains one of the main issues.

The challenge of mass higher education

The Gross Enrollment Ratio (GER) is an indicator that reflects the percentage of students who study in higher education institutions (including colleges, universities, and other institutions) compared to the total number of people of this age who are enrolled. The GER is an important indicator for assessing the accessibility of higher education in a country. A higher GER usually indicates greater opportunities for higher education in a country, which may indicate a more developed education system and an increase in the level of literacy and skills of the population.

Within the framework of government statistics, this indicator characterizes both the availability of education for this category and the continuity of education – the involvement of people over the age of 22 in the educational process, and those who are unregistered as living in a given region or city. Thus, a coefficient value of more than 100% indicates the attractiveness of the region's universities and the development of postgraduate education programs for people over the age of 22, which is part of the strategy of research universities. This indicator also indicates the involvement of older people in higher education, which is a consequence of changing labor market requirements.

In general, in Kazakhstan, the gross enrollment rate of higher education in the 2023-2024 academic year was 49.88%. The maximum value of gross coverage was noted in 2019 and amounted to 66.98%. By region, the lowest gross enrollment in higher education was in Turkestan (7.74%) and Almaty (9.84%) regions, while the highest was in Almaty (115.46%), Shymkent (99.89%) and Astana (82.90%). Thus, the maximum gross coverage is typical for cities with a population of more than 1 million people, these three regions are also among the top 3 in terms of the number of students and universities. The maximum value of gross coverage in Almaty was noted in 2021 and amounted to 186.5%, the minimum in 2023. Before that, similar values (114.55%) were in 2000, in 2010 (113.84%), and in 2013 (110.34%). A decrease in gross enrollment with an increase in the number of young people indicates a decrease in the need for higher education, and may also be a characteristic of a decrease in the availability of higher education. This coefficient is one of the key factors determining the country's place in the UN Development Program's World Education Index. The latest published UN Human Development Report for 2023-2024, Breaking the Impasse. Rethinking collaboration in a Polarized World" demonstrated the movement of Kazakhstan down 11 positions in the ranking and, as a result, 67th place, according to data for 2022 (United Nations Development Programme, 2024). However, Kazakhstan still retained its place in the group of countries with a "very high level of human development." A total of 69 countries are included in this group. The leaders are Switzerland, Norway, and Iceland. Germany and Iceland share

7th place, Finland 12th, Great Britain 15th, Canada 18th, South Korea 19th, USA 20th, Estonia 31st, Latvia 37th, Russia 56th, Georgia 60th, Belarus 69th.

The Government is striving to increase the gross enrollment rate of higher education. The gross girth demonstrates the high level of economic development of the country. A high level of education contributes to economic development, as educated people can better adapt to changing market conditions and foster innovation. Educated citizens often have more employment opportunities and a better quality of life, which contributes to social stability. Increasing the level of education in the country contributes to the development of human capital, which in turn can improve the quality of life and increase the competitiveness of the country. Ensuring equal access to higher education helps to reduce social and economic inequalities in society. Therefore, increasing the gross enrolment ratio in higher education is an important goal for many countries seeking to develop education, the economy and society as a whole.

The main contingent of students consists of young people aged 17 to 22 years, which indicates the priority of obtaining higher education immediately after school (71.7%). Quotas are provided for socially vulnerable segments of the population – 64.3 thousand people (10.8%) study under them. 45.1% of students study at public universities, 54.1% at private universities, 0.7% at foreign universities and branches operating in Kazakhstan.

Reforms in the field of secondary education and measures to improve the status of a school teacher led to an increase in the number of students enrolled in pedagogical educational programs. Engineering and technical educational programs attracted 16.5%. In recent years, there has been a change in demand for training in business, management and law educational programs to 14.5%. Digitalization as a trend in the development of all fields of activity and, consequently, the employment of graduates attracted 9.5% of students to study IT.

The availability of higher education is traditionally determined by various factors, including, first of all, financial parameters such as tuition fees, the availability of scholarships and grants, and the possibility of obtaining loans for study

Conclusions

Kazakhstan's education ecosystem is influenced by general trends in the development of education, which at the national level identify both opportunities and threats. In order to prevent the negative effects of which and ensure the global competitiveness of universities, it is possible to implement the following recommendations:

1. Establishing networking between universities, research centers, and businesses at both thenational and international levels. This will allow for the exchange of experience and resources, as well as the creation of joint projects.
2. Establishing stable partnerships with the world's leading universities for student and faculty exchange, joint research, and dual degree programs. This will not only improve the quality of education,but also create an international reputation.
3. Development of unique educational programs for advanced preparation of students for the requirements of the labor market and society, including within the framework of a network partnership that will be attractive to foreign citizens. Conducting regular labor market research to adapt curricula to the requirements of employers. Updating the Atlas of new Professions and occupations.
4. Development of programs that promote international student mobility, including scholarships and grants to study abroad. This will help students gain international experience and broaden their horizons. Integrating international topics and comparative studies into the curriculum so that students can better understand global issues and contexts.

5. Implementation of support programs for students from socially vulnerable groups, including financial assistance, mentoring programs, and customized courses. This will help ensure equal access to quality education.

6. The introduction of digital literacy courses at all levels of education, so that students can confidently use modern technologies and tools in their studies and future careers, which will also lead to a reduction in the time spent studying digital technologies (for non-core professions) at the university.

7. The analysis of the content of higher education and the redistribution of educational content between the school and the university, which will avoid duplication, will reduce the duration of study at the university and its cost, which will help attract international students to educational programs, as the international format of the duration of study in bachelor's degree programs will be provided.

8. Development of flexible educational formats providing 24/7 access to education, such as evening and weekend courses, as well as distance learning courses. This will allow students to combine their studies with work or other commitments. It will also attract students and teachers from other countries, with a time gap for online learning programs.

9. Creation of open educational resources and online platforms for access to high-quality educational materials and courses, with further recognition of learning outcomes. This will ensure access to education for a wider audience.

10. Development of high-quality online courses based on the best practices in the field of distance learning, including interactive elements, video lectures and practical tasks

11. The introduction of artificial intelligence technologies to personalize the educational process, including adaptive learning systems that can adapt to the individual needs of students.

12. The introduction of blockchain technology to ensure the safety and transparency of information about personal advancement along a continuous educational trajectory throughout life.

13. To ensure that researchers and university administrators have access to the data stored in the Epvo.kz in order to conduct comparative studies and identify trends.

14. The introduction of a "second postgraduate" education, which will provide those who wish with the necessary level of competence development, will create additional financial flows for the sustainable development of universities. As a result, access to education will be ensured, and the barrier limiting admission to graduate school will be removed.

15. Implementation of assessment systems that take into account not only academic achievements, but also skills acquired during the learning process (for example, critical thinking, teamwork and creativity), such as portfolio and project protection, etc. This will help to better prepare students for the demands of the modern labor market.

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Author Contributions

Marina Skiba: Conceptualization, Formal analysis, Writing - Original Draft, Writing - Review & Editing; Farkhad Kuanganov: Methodology, Verification; Timur Buldybaev:

Conceptualization, Investigation,Writing - Review & Editing; Renata Kudaibergenova: Conceptualization, Investigation; Anuar Nurtazin: Formal Analysis.

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INTEGRATED MODEL FOR DEVELOPING ENVIRONMENTAL COMPETENCE: SCIENTIFIC FOUNDATIONS, TECHNOLOGIES, AND REFLECTION

Abstract: The article is devoted to the development, testing, and evaluation of an integrated model for developing environmental competence in students at higher education institutions. The model is based on a comprehensive approach that includes cognitive, axiological, and practical components and combines theoretical, practice-oriented, and reflective blocks. This ensures the holistic formation of environmental knowledge, value orientations, and practical skills necessary for solving sustainable development tasks in students. The model was tested at the Sarsen Amanzholov East Kazakhstan University with the participation of 88 students divided into control and experimental groups. Quantitative and qualitative methods were used to evaluate its effectiveness: testing, questionnaires, observation, and expert assessment. The results showed a significant increase in the level of environmental competence in the experimental group, especially in the axiological and practical components. The developed model has proven its effectiveness and can be implemented in educational programs for training specialists in the fields of ecology, biology, and pedagogy, contributing to the formation of environmentally responsible and professionally competent personnel.

Keywords: environmental competence, cognitive component, axiological component, practical component, sustainable development, educational model, environmental education.

Introduction.

In the context of rapid technological progress, globalization processes, and growing environmental threats, the higher education system faces the urgent task of training a new generation of specialists with environmental competence. Education is increasingly seen as a key factor in sustainable development, capable of shaping a responsible attitude toward the environment and stimulating behavioral change in society (Liulenko & Podzerei, 2022; Dlimbetova et al., 2015).

Contemporary environmental challenges such as climate change, biodiversity loss, and pollution of water, soil, and air resources, require future specialists to have not only fundamental knowledge, but also advanced practical skills, the ability to think in an interdisciplinary manner, and values aimed at finding and implementing sustainable solutions (Stagl, 2017; Özkan et al., 2024). In this context, environmental competence is defined as an integrative personal quality that includes knowledge, skills, values, and a readiness to take practical action to protect the environment (Karter, 2019; Klochko & Fedorets, 2023).

The formation of environmental competence is becoming an integral part of the training of specialists, regardless of their professional profile. This requires the introduction of scientifically based educational models that combine cognitive, practical, and reflective components. The development of such models involves the use of modern techniques, including environmental modeling, eco-trails, visualization of the social environment through eco-mapping, and participation in real projects (Jørgensen, 2008; Zameliuk, 2020; McKay et

al., 2022). This article aims to present an integrated model for the formation of students' environmental competence, which combines theoretical training, practical implementation, and reflective methods. Particular attention is paid to involving students in project activities and developing their skills in analysis, decision-making, and sustainable behavior.

The purpose of the study is to substantiate the scientific and methodological foundations of the proposed model, demonstrate its structure, and characterize the results of its testing in the university educational environment. The authors seek to show how a comprehensive and interdisciplinary approach to the formation of environmental competence contributes to the training of professionally competent and environmentally responsible specialists who are ready to solve sustainable development tasks.

Methods and organization of research.

The research methodology was based on a comprehensive approach that included elements of systems analysis, interdisciplinary interaction, and pedagogical diagnostics. The main objective of the study was to develop, test, and evaluate a model for the formation of environmental competence aimed at training specialists capable of effectively solving modern environmental problems. The research was based on theoretical approaches presented in the works of Ponomarova (2018), Palshkova (2003), Sotska and Kuzmenko (2019), as well as on contemporary aspects of environmental education proposed by Vdovenko (2022). This provided a scientific basis for the development of a methodology that considers the cognitive, axiological, and practical components of environmental competence.

The research methodology consisted of three stages. At the analytical stage, an in-depth analysis of existing models for the formation of environmental competence and their effectiveness was carried out. This process was based on the theoretical and methodological principles proposed by Palshkova (2003), who focused on the professional training of teachers in the context of environmental education. Various concepts and approaches were studied, including models that integrate theory, practice, and reflection. This stage made it possible to identify the key elements necessary for the formation of competence: the cognitive component, the axiological component, and the practical component.

During the design phase, a model for developing environmental competence was developed, which included three interrelated blocks: theoretical, practical, and reflective. The model was based on Vdovenko (2022) recommendations on environmental education. As part of the cognitive component, the model included interactive lectures and multimedia materials aimed at forming basic knowledge about environmental problems, the principles of sustainable development, and ways to solve them. This component contributed to the development of analytical thinking and the ability to apply theoretical knowledge in practice. The axiological component was focused on forming values of sustainable development, environmental responsibility, and a conscious attitude toward the environment. To this end, reflective methods were used, including discussions, training sessions, and essay writing aimed at developing students' values. The practical component included real-world tasks such as environmental monitoring, developing projects for the conservation of natural resources, and using digital technologies (e.g., GIS platforms). This component helped strengthen students' ability to apply their knowledge in real-world situations and develop innovative environmental solutions.

The developed model was tested during the experimental stage. The study involved 88 students from Sarsen Amanzholov East Kazakhstan University majoring in Biology and Natural Sciences and Pedagogical Biology. The participants were divided into control and experimental groups, which was in line with Palshkova (2003) recommendations for organizing a pedagogical experiment. The control group was taught according to the standard educational program, while the experimental group used the developed model, which simultaneously focused on the cognitive, axiological, and practical aspects of competence.

Both quantitative and qualitative methods were used to collect data. Testing was used to assess the level of students' environmental competence before and after the model was tested. As part of the cognitive component, students' basic knowledge related to environmental problems and their solutions was analyzed. Questionnaires completed by students and teachers provided data on satisfaction with the educational process and identified the strengths and weaknesses of the model, including the formation of values within the axiological component. Observation of students' work made it possible to analyze their involvement and level of practical skills application, which is especially important for assessing the practical component. Expert assessment methods were used to analyze the quality of students' performance of practical tasks and projects, which also made it possible to assess the formation of cognitive and practical competencies.

The data obtained was processed using quantitative and qualitative analysis. Quantitative analysis included mathematical processing of test and questionnaire results, which made it possible to identify the dynamics of changes in the cognitive, axiological, and practical components of competence. Qualitative analysis included the study of students' reflective reports and teachers' observations, which allowed for a deeper understanding of the process of forming environmental knowledge, values, and skills. A comparative analysis of the control and experimental groups showed a significant improvement in all components of environmental competence among students who studied according to the proposed model.

Thus, the methodology combined traditional and innovative approaches, which made it possible to create a model that ensures the comprehensive development of the cognitive, axiological, and practical components of environmental competence in students. The integration of theory, practice, and reflection into the educational process contributes not only to the development of professional knowledge and skills but also to the formation of value orientations necessary for sustainable development. This makes the proposed model promising for further implementation in educational programs.

Research results and their discussion.

The development of environmental competence is becoming one of the key tasks of modern education in the context of sustainable development. Scientific literature highlights the importance of integrating theoretical knowledge, practical skills, and reflective thinking in the process of environmental education. Liulenko and Podzerei (2022) emphasizes that environmental competence is a fundamental component of education for sustainable development. The authors view environmental competence as a set of knowledge, skills, and values that contribute to awareness of environmental problems and participation in their solution. Their work highlights the need to implement environmental approaches at all levels of the educational process.

Pedersen and Bang (2015) proposed a dialectical ecological-social model in which the development of competence is viewed through the prism of the interaction between the individual and the environment. Their research emphasizes the importance of a subject-oriented approach to learning, which allows for the development of environmental awareness and critical thinking. Stagl (2017) justifies the importance of ecological economics as an integrative approach that combines interdisciplinary knowledge and methods. According to the author, ecological economics forms the basis for sustainable education that promotes decision-making that takes environmental factors into account. Ogbu (1981) proposes a cultural-ecological approach to competence formation. The author focuses on cultural aspects and emphasizes that understanding of environmental issues must be adapted to the cultural context of learners.

Karter (2019) proposes an ecology-oriented model of conceptual competence based on an interdisciplinary approach. The author points out that the integration of ecological and

psychological knowledge contributes to the formation of professional skills necessary for solving modern problems in various fields. Zameliuk (2020) in his study considers the ecological trail as an effective tool for the formation of ecological competence in preschool children. The author argues that practical activities and work in the natural environment allow students to develop a value-based attitude towards nature. Jørgensen (2008) emphasizes the diversity of models for developing environmental programs. He proposes a systematization of models that can be used for educational purposes to assess and predict environmental changes.

Klochko and Fedorets (2023) address the conceptualization of a cultural-artistic model of environmental competence for mathematics teachers. The authors note that integrating an environmental approach into educational disciplines can increase environmental awareness even among professionals working in traditionally non-environmental fields. Khuraskina (2017) examines the development of students' environmental and legal competence through environmental education. The author emphasizes the importance of combining educational and upbringing methods to form environmentally responsible behavior. Ridei and Tolochko (2018) explore issues of improving the environmental competence of teachers in the postgraduate education system. Their work demonstrates the importance of professional development for teachers in spreading environmental knowledge among students.

Dlimbetova et. al (2015) focus on the development of environmental competence in future specialists. They emphasize that environmental aspects should be integrated into professional training to promote the development of sustainable thinking and practical skills. McKay and colleagues (2022) consider the development of environmental models from the perspective of assessing their systemic quality. The authors highlight the role of qualitative modeling in educational programs aimed at developing environmental literacy. Özkan et al. (2024) propose the integration of environmental elements into STEM education through architectural design. Their research demonstrates new perspectives on environmental education based on a creative approach and interdisciplinarity.

The analysis of the presented studies confirms the need for a comprehensive approach to the formation of environmental competence. The integration of theoretical knowledge, practical skills, and reflective thinking, as well as the use of interdisciplinary and culturally adapted approaches, create the prerequisites for the successful development of environmental education. To achieve this goal, it is important to consider the relationship between theoretical training, practical tasks, and reflective activities.

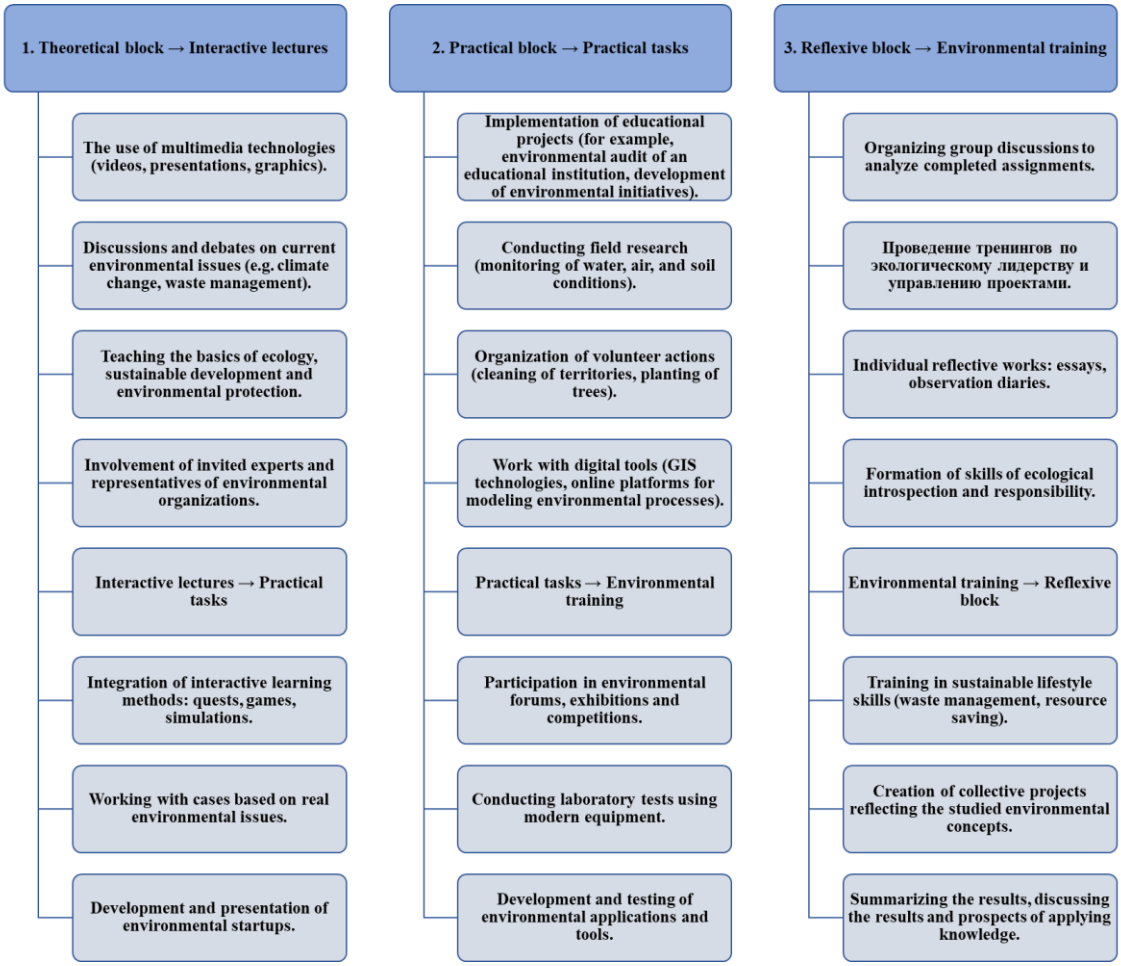
In response to these challenges, we have developed a model for building environmental competence aimed at creating a systematic approach to learning. This model combines theoretical study, practical activities, and reflective thinking, ensuring the comprehensive development of students. The main goal of the model is to develop the knowledge, skills, and values necessary for students to gain a deep understanding of environmental issues, make responsible decisions, and actively participate in solving them (Figure 1).

The goal of the integrative model for developing environmental competence is to create a holistic educational environment that ensures the systematic development of students' knowledge of ecology and sustainable development (cognitive component), practical skills for solving environmental problems (practical component), and value orientations aimed at environmentally responsible behavior (axiological component) (Figure 1).

The model aims to integrate theoretical, practical, and reflective components through interactive lectures, practical assignments, and environmental training. It promotes the active involvement of students in the learning process, develops their critical thinking and independent analysis skills, and encourages their willingness to participate in environmentally significant activities.

Figure 1

Model for developing environmental competence: integrating theory, practice, and reflection



This model is focused on training environmentally literate specialists who can respond effectively to modern challenges of sustainable development. It provides for close interaction between all stages of training, creating conditions for students to develop environmental thinking and skills that can be applied both in their professional and everyday lives. Each block of the model performs its own unique function and contributes to the comprehensive development of environmental awareness and skills in students.

Theoretical block - Interactive lectures. The first step in developing environmental competence is to provide students with basic knowledge about ecology and sustainable development. The use of interactive lectures accompanied by multimedia presentations, video materials, and graphs contributes to the creation of an engaging educational environment and better assimilation of the material. To enhance understanding of complex environmental issues, discussions and debates are organized in which students discuss contemporary challenges and propose possible solutions. This is consistent with the approach proposed by Pedersen and Bang (2015), who emphasizes the importance of a subjective environmental position and dialectical analysis. The involvement of experts from environmental organizations enhances the practical focus of the training, which is in line with Vdovenko (2022) recommendations on the need to integrate external resources into the educational process. The conceptual basis of the block also echoes the work of Stagl (2017), which emphasizes the role of an interdisciplinary and integrative approach in the formation of environmental literacy.

Practical block - Practical tasks. Practice-oriented training is aimed at consolidating theoretical knowledge by completing tasks that are close to real-life conditions. Students conduct environmental audits of the territory, develop greening projects, and monitor water, air, and soil. These forms of activity shape project thinking and decision-making skills, as emphasized in the works of Özkan et al. (2024) on the importance of project and STEM activities for the formation of competencies. The use of digital technologies such as GIS and environmental process modeling plays an important role, as confirmed by the research of Jørgensen (2008) and McKay et al. (2022), which emphasizes the importance of model quality assessment and systematic analysis of environmental data.

Reflective block - Ecological training. Reflective activity plays a key role in helping students understand the significance of their actions and develop a personal position. The block includes environmental training, group discussions, and leadership sessions. Individual assignments (essays, observation diaries) contribute to the formation of a critical attitude towards environmental issues and personal responsibility, which is in line with the approach of Cotska and Kuzmenko (2019), who emphasize the role of artistic and value analysis and reflection in teacher training. The effectiveness of such methods is also confirmed by Vdovenko (2022), study, which emphasizes the need to develop internal motivational attitudes in students through reflection on personal contribution.

Practical tasks - Ecological training. Student activity outside the classroom expands the scope of formal education. Participation in environmental forums, competitions, the development of digital applications, and laboratory research allow students to apply their knowledge in practice and contribute to the creation of innovative solutions that reflect contemporary challenges, as proposed by Özkan et al. (2024) in the context of STEM education and architectural solutions.

Ecological training - Reflective block. The educational process culminates in collective projects that reflect the environmental concepts and sustainable behavior skills that have been learned. Practices such as waste sorting, energy conservation, and responsible lifestyles are integrated into students' daily practices. Final discussions allow for an assessment of the effectiveness of the material's assimilation and the prospects for its application, which is in line with the ideas of McKay et al. (2022) on the need to evaluate the quality of systemic changes and behavior models.

Interconnection of blocks. The model assumes a logical continuity between blocks: theoretical knowledge gained in lectures is applied in practical tasks, the results of which are interpreted within the framework of environmental training. The cycle is completed by reflection, allowing students to assess their environmental activity and formulate new goals. This approach corresponds to the systemic model of environmental education focused on sustainable development, as emphasized in the works of McKay et al. (2022) and Jørgensen (2008).

The model for developing environmental competence presented in this paper demonstrates a systematic approach to learning that combines theory, practice, and reflection. This organization of the learning process helps students develop not only in-depth knowledge but also the practical skills needed to solve contemporary environmental problems.As a result of implementing this model, students achieve the following learning outcomes, as shown in Table 1.

Table 1

Expected learning outcomes according to the model

	Learning component		
	Cognitive component	***Practical component***	***Axiological component***
Learning outcomes	Mastering the basic concepts and principles of ecology, sustainable development and environmental protection.	Knowledge of methods of environmental monitoring, field research and laboratory work.	Formation of a valued attitude towards nature and an understanding of personal responsibility for its preservation.
	Ability to analyze modern environmental problems (climate change, waste management, etc.).	Experience in implementing educational projects, participating in volunteer actions, forums, competitions, and startup development.	Development of sustainable lifestyle skills (resource conservation, waste minimization).
	The ability to apply theoretical knowledge to solving applied problems.	Digital technology skills (GIS, modeling, environmental applications).	The ability for environmental introspection and collective project activity.

Thus, the model we have developed ensures the formation of environmentally literate, motivated and socially responsible specialists who are ready for professional activity and active participation in solving the problems of sustainable development.

During the testing of the model for developing environmental competence, significant improvements were observed in the cognitive, axiological, and practical components among students in the experimental group compared to the control group.

Table 2 demonstrates changes in the levels of cognitive, axiological, and practical components of environmental competence among students in the experimental and control groups in the areas of “Biology-Natural Science” and “Pedagogical Biology.” The data on the initial and final levels of competence are presented, allowing us to assess the impact of the proposed model for the formation of ecological competence. The experimental groups showed a more significant increase in all components, which confirms the effectiveness of the model, especially in the development of axiological and practical skills (Table 2).

Table 2

Changes in the levels of environmental competence of students in the experimental and control groups

Groups / Components	Cognitive (%)	Axiological (%)	Practical (%)
Entry level Experimental (Biology-Natural Sciences)	45	35	57
Final level Experimental (Biology-Natural Sciences)	65	65	85
Entry level Experimental (Pedagogical Biology)	48	45	65
Final level Experimental (Pedagogical Biology)	61	74	84
Entry level Control (Biology-Natural Sciences)	36	51	49
Final level Control (Biology-Natural Sciences)	58	79	67
Entry level Control (Pedagogical Biology)	42	36	57
Final level Control (Pedagogical Biology)	69	78	84

This Table 2 demonstrates changes in the levels of cognitive, axiological and practical components of environmental competence among students of experimental and control groups. In the experimental group in the Biology-Science direction, the level of the cognitive component increased from 45% to 65%, indicating a significant increase in knowledge and effectiveness of the proposed model. The axiological component increased from 35% to 65%, indicating the formation of environmental values and the successful use of reflective methods. The practical component showed an increase from 57% to 85%, which confirms the development of practical skills and high performance of tasks. In the experimental group in the direction of “Pedagogical Biology”, the cognitive component increased from 48% to 61%, which reflects an increase of 13% and indicates a good assimilation of theoretical material. The axiological component increased from 45% to 74%, which demonstrates a significant increase in awareness and environmental responsibility.

The control group in the direction "Biology-natural science" also showed positive dynamics, but the results are inferior to the experimental group. The cognitive component increased from 36% to 58%, reflecting the influence of the standard educational program, although the increase was lower. The axiological component increased from 51% to 79%, demonstrating some effectiveness of traditional approaches to the formation of values. The practical component showed an increase from 49% to 67%, indicating a positive effect, but it was also lower than in the experimental group. In the control group in the direction of "Pedagogical Biology" the cognitive component increased from 42% to 69%, the increase amounted to 27%, which even surpassed the indicators of the experimental group. The axiological component increased from 36% to 78%, which demonstrates a high level of value formation, probably due to the features of the standard program. The practical component increased from 57% to 84%, which is a significant improvement and comparable to the experimental group.

To statistically evaluate the obtained data, correlation analysis and calculation of Student's t-criterion were carried out to identify the relationships between the components of environmental competence, as well as the differences in effectiveness between the experimental and control groups.

The correlations between cognitive, axiological and practical components of environmental competence were calculated using Pearson's correlation coefficient according to the formula:

$$r = \frac{\sum(x_i - \overline{x})(y_i - \overline{y})}{\sqrt{\sum(x_i - \overline{x})^2 \cdot \sum(y_i - \overline{y})^2}}$$

The results showed:

- A strong positive correlation between cognitive and axiological components ($r = 0.81$; $p = 0.014$),
- a very strong positive correlation between cognitive and practical components ($r = 0.96$; $p = 0.0002$),
- moderate but significant correlation between axiological and practical components ($r = 0.73$; $p = 0.039$).

These data confirm that the development of one of the components of environmental competence is accompanied by the growth of the rest, which proves the need for an integrated approach to training.

To identify the statistical significance of differences between the experimental and control groups, Student’s T-criterion for independent samples was used according to the formula:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

$\bar{x}_1$, $\bar{x}_2$ — are mean values of increment,
s_1^2, s_2^2 —are variance,
n_1, n_2 — are sample sizes.

The results showed:

- for the direction “Biology-Science”: t = 0.79; p = 0.47 - differences between groups are statistically insignificant,

- for the direction “Pedagogical Biology”: t = -1,71; p = 0,16 - also the absence of statistically significant differences, despite the presence of positive dynamics.

Despite the absence of a significant difference according to the t-criterion (which may be due to the small sample), the experimental group showed higher gains in all components, especially in the axiological and practical aspects. This is confirmed by the high correlation between the components and indicates the effectiveness of the proposed model of environmental competence formation.

In general, the experimental group showed more significant improvements in all components, especially in the formation of axiological and practical skills, which confirms the effectiveness of the proposed model. The control groups also showed positive dynamics, which indicates a certain effectiveness of standard educational programs. However, the increment in the experimental groups was higher, which emphasizes the advantages of the proposed model. The differences between the directions manifested themselves in the fact that students of pedagogical biology showed a greater increase in the cognitive component, while students of biology-natural science had a more noticeable improvement in practical skills. Thus, the proposed model contributes to a more effective formation of environmental competence, especially in the aspects of values and practical skills, compared to standard educational programs.

Figure 2

Dynamics of changes in the levels of cognitive, axiological and practical components of environmental competence of students of experimental and control groups.

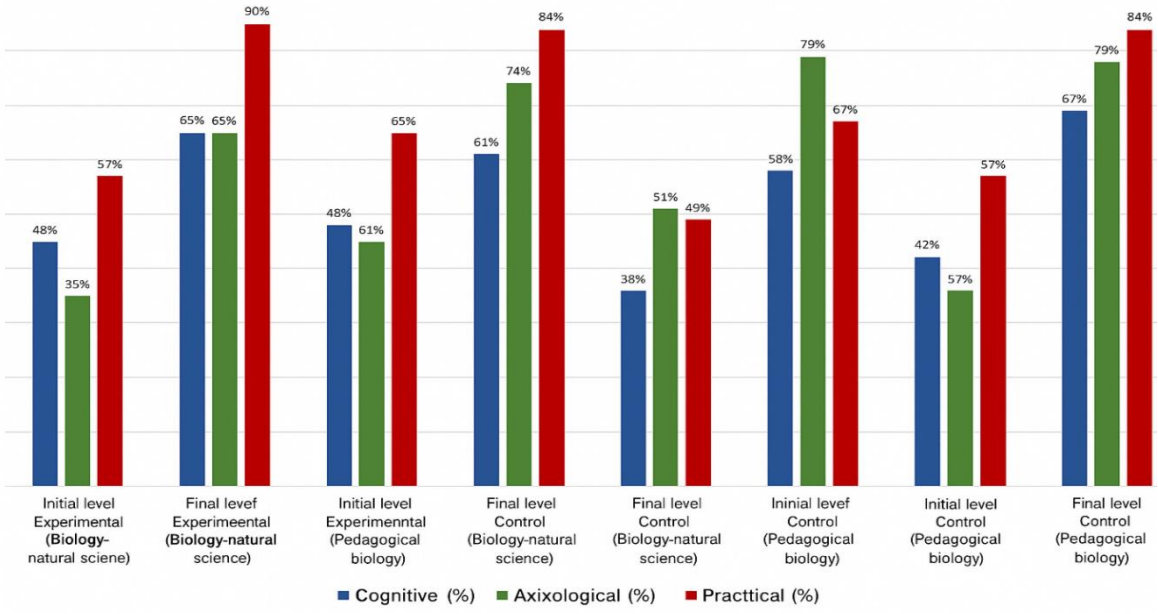


Figure 2 demonstrates the dynamics of changes in the levels of environmental competence for each component for both groups. The significant increase of indicators in the experimental group confirms the effectiveness of the proposed model, which combines theoretical study, practical activity and reflexive reflection. This indicates the high potential of the model for further implementation in the educational process to form sustainable knowledge, values and skills necessary for solving environmental problems. The proposed model thus contributes to a more effective formation of environmental competence, especially in the aspects of values and practical skills, compared to standard educational programs.

Conclusion.

The study confirmed the high significance of the systemic, integrative approach to the formation of environmental competence in the system of higher education. The developed model, including interrelated theoretical, practical and reflexive blocks, demonstrated its effectiveness in the formation of students' key components of environmental competence: knowledge, values and practical skills necessary for solving actual environmental problems.

The results of approbation showed that students of the experimental groups achieved significantly higher indicators of cognitive, axiological and especially practical components compared to the control groups. This was possible due to the introduction of practice-oriented tasks, the use of digital technologies (including GIS-platforms), participation in environmental projects, as well as the use of reflection methods that promote the awareness of personal responsibility and the formation of sustainable value orientations.

The control groups trained under traditional programs also demonstrated positive dynamics, but their rates of environmental competence development were lower. This allows us to conclude that the proposed model is more effective than standard educational approaches.

The main advantages of the developed model are as follows:

- Integration of cognitive, axiological and practical components, providing holistic development of environmental competence.
- Increased motivation and involvement of students through participation in real environmental projects and the use of modern digital tools.
- Formation of sustainable values and environmentally responsible behavior necessary for professional activity in the conditions of sustainable development.

The proposed model has a high degree of adaptability and can be implemented in educational programs of different orientation - biological, ecological, pedagogical and interdisciplinary. The results of the study emphasize the need for its further improvement, including the integration of new digital platforms, flexible learning formats and interdisciplinary interaction.

Thus, the developed model is a significant step towards the modernization of environmental education, contributing to the training of competent, ecologically literate and socially responsible professionals who are able to effectively respond to the challenges of the modern world and contribute to the sustainable development of society.

Conflict of Interest Statement

The authors declare no potential conflicts of interest regarding the research, authorship, or publication of this article.

Author Contributions

Nazerke Maratkyzy: Conceptualization, Supervision, Writing – Review & Editing, Project administration; Anargul Sharipkhanova: Methodology, Formal analysis, Investigation,

Writing – Original Draft; Sholpan Abilova: Validation, Data Curation, Writing – Original Draft; Aiman Karabalayeva: Visualization, Writing – Original Draft, Formal analysis.

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STUDY OF THE QUALITY LEVEL OF THE HIGHER EDUCATION SYSTEM BASED ON CLUSTERED INFLUENCE FACTORS

Abstract: The article presents the results of a study aimed at assessing the quality of the higher education system. The emphasis is placed on using clusters – groups of interrelated factors that affect the overall effectiveness of the educational process. Identifying groups of similar influence factors made it possible to assess the impact of various components more accurately on the overall level of education quality. The used methodology (Clustered Influence Factor) was to analyse the influence of various factors as teaching staff and administrative and managerial staff on quality level in HEIs grouped into clusters based on similar characteristics. And the main characteristics of a modern university, the role of subjects in the university's development, the internal quality assurance system, etc., were considered cluster factors. This methodology allowed a structured approach to the analysis of complex systems, highlighting key factors and their interrelationships, which simplifies the decision-making process to enhance quality assurance. The results provide valuable information for higher education quality managerial decisions and strategic planning. They can also serve as a basis for making improvements in the development of the internal quality assurance system. The study identified problems and challenges in higher education, allowing the university's relevant structural units to assess the difficulties they face. Identified positive aspects can be used to increase the attractiveness of educational organizations for students, teachers, and potential partners. The study provides a starting point for the subsequent comparison of quality assurance factors and makes a specific contribution to the development of the methodology for assessing the quality of education, establishing quality assurance systems within the university, and improving the quality of education at the system level.

Keywords: Higher education system, education quality assessment, higher education quality level, clustered influence factors, quality assessment system, quality culture.

Introduction

In the context of the ISO International Standard, the quality of higher education is defined as the set of properties and characteristics of a service that give a system the ability to meet perceived or anticipated needs (International Standard, 2005). At the same time, quality is based on three groups of quality characteristics: the quality of the potential to achieve the goal of education, the quality of the process of forming professionalism and the quality of the education result.

The Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG, 2015), acknowledging the different purposes of the definition, defines quality as "a result of the interaction between teachers, students, and the institutional learning environment. Quality assurance should ensure a learning environment in which the content of programs, learning opportunities, and facilities are fit for purpose".

The modern domestic higher education system faces the challenge of ensuring a high level of education that meets the changing needs of students and the expectations of employers and the labor market. Universities are undergoing another stage of transformation emphasizing the critical elements of the Bologna process that increase their competitive-ness, including the expansion of academic independence and integrity and the internationalization of education (Decree, 2023).

The complex and dynamic environment of modern higher education requires a systematic approach to assessing the quality of the educational process and identifying the potential for its further development, which involves an analysis of the factors affecting the effectiveness of the higher education system and its quality.

We consider clustering of factors to be the most appropriate and promising method of assessing the quality of higher education, since cluster analysis as a multidimensional statistical procedure allows the collection and systematization of information on homogeneous groups of parameters, properties and characteristics of the object studied. In this regard, the purpose of our study is to identify the quality of higher education based on cluster analysis.

Literature review

The review of scientific research indicates the connection between the trends in the development of higher education and the change in its quality. The research team has been examining this issue earlier but in the way of forming the information and educational System for quality education management (Biloshchytskyi et al., 2024).

It demonstrates the dependence of the processes taking place in the system on the socio-economic and scientific-technical directions of the development of society.

From the standpoint of our research, comparative studies of quality assurance policies and practices in higher education in different countries are of interest, based on which common and unique aspects are identified (Schmidt, 2017).

The practical application of the principle of humanization of education, in which higher school teachers organize their pedagogical activity as a process of purposeful active interaction with students, actualizes methods and tools for assessing the quality of teaching in higher education (Greatbatch, 2016), including assessment of students' feedback through questionnaires, surveys and interviews, teacher's self-assessment of the effectiveness of teaching methods; analysis of students' progress based on exam results; evaluation by teachers or the administration of the university based on observation of teaching activities and analysis of teaching materials; analysis of the effectiveness of the use of educational technologies for teaching and mastering the material by students; analysis of teachers' participation in the development of educational programs. Of practical interest are the studies that identify the administrative challenges faced by higher education institutions in the context of quality improvement and how academic leaders can promote and manage quality (Cobbinah & Agyemang, 2020; Hénard & Mitterle, 2021), actualizing the role of administrative personnel in overcoming them, and ensuring effective management in higher education and its quality or even commit re-sources to support quality assurance process (Trivellas et al., 2012). Researchers point to the influence of leadership style on quality assurance in universities (Kumar, 2017) and associate effective leadership in higher education with academic administrators influencing the improvement of the quality of the educational process (Setiawati, 2016; Abdallah & Forawi, 2017; Adu-Oppong, 2014).

According to R. Barnett, there are two concepts of the quality of higher education. The first is the concept of intellectual values in academia. The second concept of quality is the concept of efficiency, in which higher education is viewed as a product with costs and benefits. From this point of view, the quality of higher education is measured in terms of productivity and is reflected in performance indicators (Barnett, 1992).

Researchers Dill et. al highlight the distribution of responsibility in the quality assurance process, forming a sense of responsibility for quality management (Dill, 2010; Campbell & Rozsnyai, 2002). Stensucker refers to the growing debate about quality management as a management "trend" (Stensaker, 2008). Sluijsmans and Struyven view quality assurance as measures taken to determine the guaranteed quality of education (Sluijsmans & Struyven, 2014). According to Jessop and others, "Quality assurance requires a comprehensive, integrative approach, as it in-volves a comprehensive evaluation of program outcomes that reflect both the 20 philosophy of the educational program and the complexity of the outcomes". Continuous improvement and quality assurance of evaluation requires "a shift from quality control (with an emphasis on accountability) to greater autonomy based on the experience and knowledge of stakeholders" (Jessop et. al, 2012). According to scholars Laura M., Portnoi and S. Bagley, the university's competitive positions are the creation of a world-class university, quality assurance of educational programs, internationalization of the university, expansion of cross-border higher education, and creation of regional alliances (Laura et al., 2016).

The role of the students is important for assessment and enhancement of quality of assurance in HEIs as they are main stakeholders of higher education system. In that case the voice of students should be counted to afford students enhanced capabilities to intervene in their higher education environments (Klemenčič, 2018; Hazelkorn, 2018).

The researchers considered students in their studies on quality assurance in the context of higher education institutions (Prakash, 2018) to foster trust and transparency to improve educational outcomes and institutional credibility (Tinapay, 2024). Students' perception as the essential internal stakeholders is the point for study in different regions of the world (Ta, 2023; Uludağ, 2021; Elassy, 2013). It justifies the necessity to engage students in the survey for determination of quality level of the higher education.

The engagement of all stakeholders into the quality assurance process could establish a system that sustain this to quality culture (Verschueren, 2023) that in turn may be dependent on different factors (Dagiene et al., 2022) and consequently to achieve employer and customer satisfaction (Girmanová et al., 2022).

Thus, the quality of higher education depends on many factors. The analysis of scientific sources made it possible to identify the following parameters in the group of factors influencing the quality of higher education:

1. Academic staff. The teachers' qualifications and experience, their active participation in scientific research activities, and the ability to effectively transfer knowledge to students.
2. Curricula. Relevance, updating, and compliance of curricula with the labour market requirements, the availability of practical components, and the possibility of choosing specializations.
3. Research activity. Participation of teachers in scientific research, publications in scientific journals, and involvement of students in research work.
4. Infrastructure and resources. Availability of modern classrooms, libraries, laboratories, computer equipment and other resources necessary for teaching and research activities.
5. Evaluation system and feedback. An honest and objective evaluation system, teacher feedback, and the opportunity for students to make suggestions and complaints. Availability of an internal quality assessment system.
6. Culture of quality and climate. The environment at the university, including the culture of communication, the support from the administration and the collective atmosphere, the strong culture of quality, and the subjects of education, have the same under-standing of quality and quality assurance issues.

The quality of higher education can be assessed by considering different combinations of these factors, which can have different meanings for participants.

Methods and organization of the study

The research methodology is based on the hypothesis that cluster analysis of the quality of higher education, by which we mean an independent unit combining several homogeneous elements, is the most appropriate and promising method for assessing the quality of higher education. Since we believe that cluster analysis as a multidimensional statistical procedure allows the collection and systematization of information on homogeneous groups of parameters, properties and characteristics of the studied object. In this regard, the purpose of our study is to identify the quality of higher education based on cluster analysis. Our choice of this method is based on the fact that the quality of higher education is a complex, multi-level, multi-functional social structure, for which the clustering method seems to be the most appropriate. In our case, the number of clusters is determined by the purpose of the study. This method involves the identification of clusters of factors affecting the quality of higher education. In the context of this study, the following are selected:

cluster one – internal quality assurance system

cluster two – university infrastructure;

cluster three – content of educational programs;

cluster four – faculty.

The first cluster of factors includes an understanding of the internal quality assurance system, the orientation of this system (to improve the quality of educational pro-grams, to improve the quality culture, to involve stakeholders that include faculty, management staff, students, employers), requirements for this system, academic values, monitoring of professional achievements of teaching staff. The second cluster includes: campus, library, Internet speed, Wi-Fi. The third cluster combines such factors as the relevance and usefulness of educational programs, the possibility of choosing an educational trajectory and teachers, and the format of classes. The fourth cluster includes knowledge of the teaching staff of their subject, their interaction with students, requirements for learning outcomes, knowledge of technologies and teaching methods.

One of the approaches to the theoretical understanding of the problem of the quality of the higher education system in Kazakhstan in the context of the above factors (clusters) is the expert opinion of the participants in the educational process. At the same time, the first cluster of factors can be evaluated by teaching staff and administrative, the other three clusters, in our opinion, should be evaluated by the main stakeholder of higher education – a student.

Given this, there was a need to develop a methodology for studying the current level of quality of the higher education system, which in the context of our study is understood as a set of methods of practical activity aimed at identifying a group of factors that affect the educational process and the achievements of students, in general, at ensuring the quality of education at the university. During the study, a design was used, developed in advance and recorded before the start of empirical data collection. The pattern of the study is based on the methodology of the positive paradigm. The positive paradigm aims to explain the relationship between causes and results of research and takes the following positions:

reality exists independently of the social context and can be discovered through objectively designed research;

using statistical analysis of the quantitative observations of the theory, objective truth is tested and discovered.

In this context, a methodological approach was applied using the methods of modern sociological science and interdisciplinary research. During the study, a survey method was used in questionnaires, focus groups and interviews with organizers and experts of educational activities represented by the teaching staff. In future research such surveys can be carried out through Information and educational system for quality education management (Biloshchytskyi et al., 2024).

The methodology of the study determined the following stages of its implementation:

1. Definition of the purpose of the study.
2. Formation of a cohort (group of subjects).
3. Data collection is based on developed tools.
4. An initial measurement of parameters related to the factors being studied will allow you to have a starting point for later comparison.
5. Data analysis: Based on statistical methods and comparison of indicators, various groups or factors are analyzed, and a possible relationship between factors and educational achievements is identified.
6. Interpretation of results: analysis of the results is organized. A conclusion is made about the influence of the factors studied on the educational process. Possible patterns or trends are established.
7. Discussion and dissemination of results. Approbation of the results. Dissemination of experience. Taking corrective action.

Based on the purpose of the study, the following groups of respondents were identified: teaching staff and administrative staff. The teaching staff belongs to the subjects of the educational process at the university; the administrative staff provides the conditions for the organization of the educational process. To develop tools for studying the current level of quality of the higher education system, a diagnosis of the problem was carried out and an expert assessment of the quality of education as a social category, the state and effectiveness of the education process, the degree of compliance with the requirements - the needs and expectations of internal and external consumers in the development and formation of professional competencies of the individual was obtained.

The study identified the methods of questioning and interviewing as data collection tools.

The questionnaire consisted of three stages:

preparatory stage – work on drawing up a plan and schedule for the study, selection of questions that the questionnaire includes, as well as solving organizational issues;

prompt survey of respondents or direct questioning;

calculation of results – processing of the obtained research data; analysis and summarizing.

We have developed a closed-ended questionnaire consisting of 7 questions. Each question was offered a plural number of answer options – five. The respondent chooses an appropriate answer option. This type of questionnaire is aimed at standardizing answers and simplifying data analysis.

As the analysis of theoretical research in the field of higher education has shown, one of the elements of quality assurance of higher education is the internal quality assurance system of the university, organized by universities considering the requirements of the international standard ISO 9001, the guidelines for quality assurance of higher and postgraduate education in the European Higher Education Area (ESG). Internal Quality Assurance System is considered an integral part of strategic management.

This justifies the choice of the teaching and administrative staff's survey content. The questions aimed to understand the essence of the internal quality assurance system, knowledge of its organization's requirements, and university stakeholders' involvement in ensuring the quality of education.

According to the theory of the selective method, which has been repeatedly confirmed by practice, it is not necessary to interview everyone, but only a part of the group can be interviewed, which is usually many times smaller. A methodology or measurement (questionnaire, block of interview questions) is considered valid if it captures exactly the concept or property that is planned to be measured. In our case, the characteristics of educational activities are focused on the quality assurance system. When establishing validity,

the substantiation and subsequent verification of the relevance hypothesis, that is, the correspondence of the measured parameters to the characteristics of the object under study, plays a crucial role.

The sample based on which the respondents were selected is simple, random, and non-repeated. In this case, the sample size was calculated using the formula (Cochran, 2024):

$$\boldsymbol{n} = \frac{z^2 s^2 N}{\Delta N + z^2 s^2}$$

Where is: n - the sample size; z - the confidence coefficient (z=1.96 for the 95% reliability selected in this study); s2 - the sample variance for the binomial distribution s2=pq, where p - the proportion of the trait; q=(1-p).

The product of pq is maximum when p = 0.5 since the formula assumes that there are two or more answer options for a given question, from which only one is chosen. The more equal the two answer options are, the closer the proportion is to 50/50, the larger the sample should be taken. Therefore, if this ratio is not known in advance, as in our case, it is necessary to put 50%, as done in the present study.

The study also used the focus group interview method. This is the most common qualitative method of gathering information. Implementing this method makes it possible to involve several respondents in an interview at once (focus group) gathered in one place. At the same time, the interaction of participants is ensured. The method promotes the free expression of opinions without hindering discussion between interviewees. The discussion was guided by a moderator who ensured the group discussion was developed under the study's objectives. When conducting interviews with a focus group, a pre-designed script was used, which defined the range of central issues and took the form of a general guide. The primary purpose of such tools is to focus on the problem, tune in to a particular topic, allow spontaneous statements of participants, and provide group dynamics.

Thus, this method is focused on identifying the range of opinions on the problem under consideration. The focus group method's effectiveness is because most respondents feel comfortable participating in the discussion as part of the group. With the implementation of this method, better conditions for obtaining in-depth information are formed than with individual interviews. At the same time, group dynamics makes it possible to deter-mine the significance of such a phenomenon as group influence.

A unique interview guide was developed to improve the study's effectiveness. The interview covered four topics with four questions to discuss with the focus group. The duration of the in-depth interview ranged from one to three hours, depending on the depth of the questions studied. The interview was recorded to facilitate subsequent transcription and analysis of the data and to ensure that critical information was recovered. At the end of the interview, all video and audio recordings were subjected to high-quality processing, resulting in the full text of all interviews. An analytical report was compiled based on the texts' data and the interviewer's impressions.

The developed interviewing methodology made it possible to organize field (on-site) studies of respondents' understanding of the main characteristics of a modern university and its mission. The interview was conducted using guides (Appendix 1), which allowed us to obtain information/opinions from respondents about the quality assurance system of education. Persons who were professionally familiar with the subject of discussion – the internal quality assurance system - were not allowed to participate in the interview. In this case, we are talking about the supervising vice-rector, heads of departments and specialists of the university's quality assurance departments.

When developing tools for studying the quality of the higher education system, we re-lied on scientific publications of domestic and foreign researchers in studying the problem of

the quality of higher education. The experience available in the sociology of education in developing tools for such surveys was also considered.

Results

The sample population of respondents for each category of respondents was as follows:

- Teaching staff – 830.
- Administrative and managerial staff – 107.
- Students – 7595.

The selection of respondents considered the peculiarities of academic and non-academic staff of universities, considering their functional tasks. The administrative and managerial staff of universities plays an important role in the system of ensuring the quality of educational services. On the one hand, it is a subject of management and management actions in the personnel management system of universities are directed at it. On the other hand, management personnel are the object of recruitment, use, development, dismissal, and management functions for planning, organization, motivation, and control are applied to them.

The composition of the administrative and managerial staff turns out to be significantly wider than is usually believed. The administrative and managerial staff of universi-ties, which is directly involved in the management of other groups of personnel, includes the top management of the university, departments of universities for personnel management and human resource development, administrative and managerial links of scientific, pedagogical and non-academic departments of universities. This staff plays an important role in shaping the chains of ensuring high-quality learning outcomes. The quality of decisions and actions directly affect the educational process of the university.

The academic staff, that is, directly, the teaching staff carries out the actual teaching activities.

Interviewers: students, teachers and employees of the administrative staff of S. Toraighyrov Pavlodar University, E.A. Buketov Karaganda University, Karaganda University of Kazpotrebsoyuz. Work experience at the university is from 7 to 28 years.

The analysis of the survey showed that the majority of respondents, teaching staff and administrative staff, understand the internal quality assurance system as a set of the organizational structure of the university, internal documentation, indicators, processes, and resources (83.49% and 85.98%, respectively). At the same time, there is no big gap in the answers of the teaching and administrative staff in understanding the internal quality assurance system, i.e. the absolute majority of respondents believe that the internal quality assurance system of the university should be aimed at maintaining high quality standards of educational services of the university, which are qualitatively implemented through the formation of an effective resource base, high-quality content and proper administration of processes (Figure 1).

At the same time, the response of more than 15% of respondents who perceive the structural unit of the university as an internal quality assurance system, and 7.86% of respondents who find it difficult to answer this question, indicates an insufficiently formed quality culture, which assumes the same understanding of quality issues and quality assurance by all subjects of education. Most of them are teaching staff (5.06%).

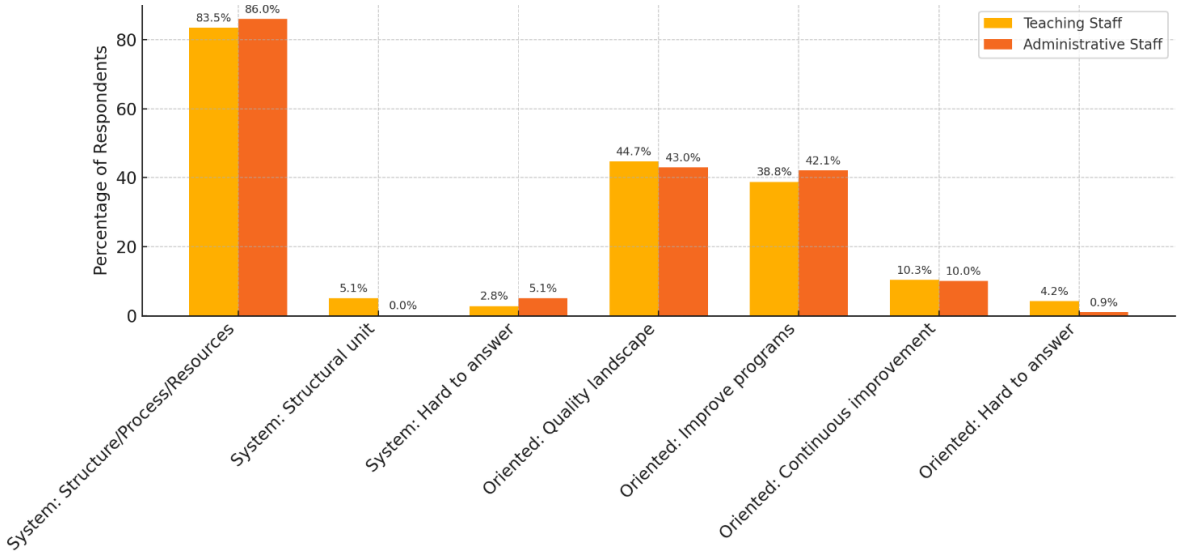
Most of the respondents from among the teaching and administrative staff determine the orientation of the internal quality assurance system to create a quality landscape of the education system by the efforts and actions of all stakeholders to meet their expectations and goals (44.70% and 42.99%, respectively).

The proportion of respondents who note that the internal quality assurance system should be aimed at improving the quality of educational programs is also significant: teaching staff – 38.80%, administrative staff – 42.06%. More than 10% of respondents as-sociate the internal quality assurance system with the development of a culture of continuous improvement of the

university's activities. At the same time, 5.15% of respondents found it difficult to answer this question. At the same time, most of them are teaching staff (4.22%), which allows us to see a correlation with the first question, where the percentage of those who found it difficult to answer the question of understanding the internal quality system is also high among teaching staff.

Figure 1

Understanding and orientation of Internal Quality Assurance System



Respondents' understanding of the degree of involvement of university stakeholders in ensuring the quality of education correlates with global trends and the use of quality assurance standards. Thus, the survey shows that the majority of both teaching staff and administrative staff believe that the involvement of university stakeholders in ensuring the quality of education is manifested through internal monitoring of the university's activities (40.24% and 42.06%, respectively). In addition, 40.5% of respondents see the involvement of university stakeholders in ensuring the quality of education through the development of quality standards .

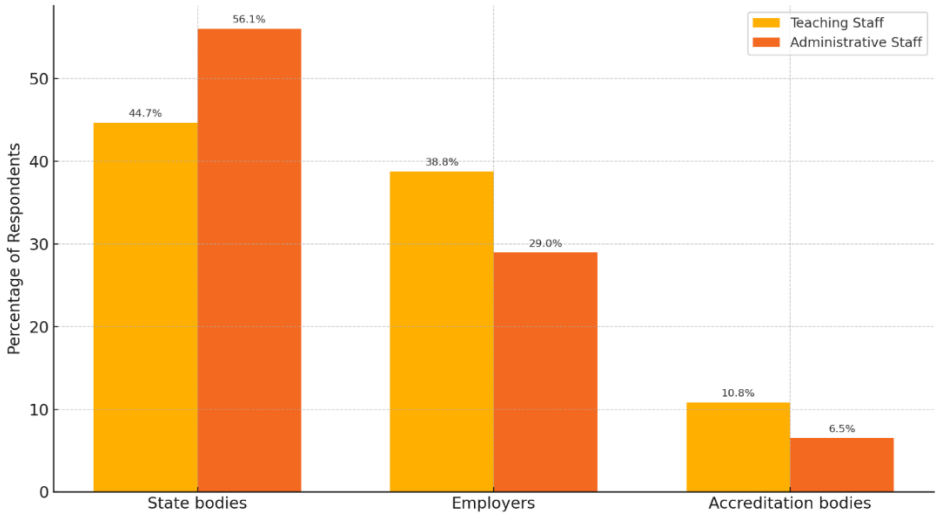
The next question in the questionnaire was related to the requirements for the organization of education.

According to the assessment of 50% of respondents, it was understood that the requirements for the organization of the internal quality system of education are set by state bodies authorized in the field of higher education (44.70% and 56.07%, respectively). This understanding can be explained by the fact that the Standard Rules of Higher and Post-graduate Education organizations regulate the processes of internal quality assurance based on international standards and guidelines for ensuring the quality of higher and postgraduate education in the European higher education area.

A fairly large number of both teaching staff and administrative staff (38.8%, 28.97%, respectively) believe that employers set the requirements for the organization of an internal education quality system. However, there are also many who believe that the requirements for the organization of an internal education quality system are set by independent accreditation bodies (17.38% of respondents). This point indicates that not all teaching staff (10.84%) and administrative staff (6.54%) understand the role of accreditation bodies, even though the accreditation process is a regular procedure for external assessment of the quality of education for Kazakhstani universities (Figure 2).

Figure 2

Perceived Sources of Internal Quality System Requirements



In our opinion, it is important for respondents to understand the methodology of the internal quality assurance system, which, according to many respondents (61.08% of teaching staff and 54.21% of administrative staff), is based on academic values and fundamental principles.

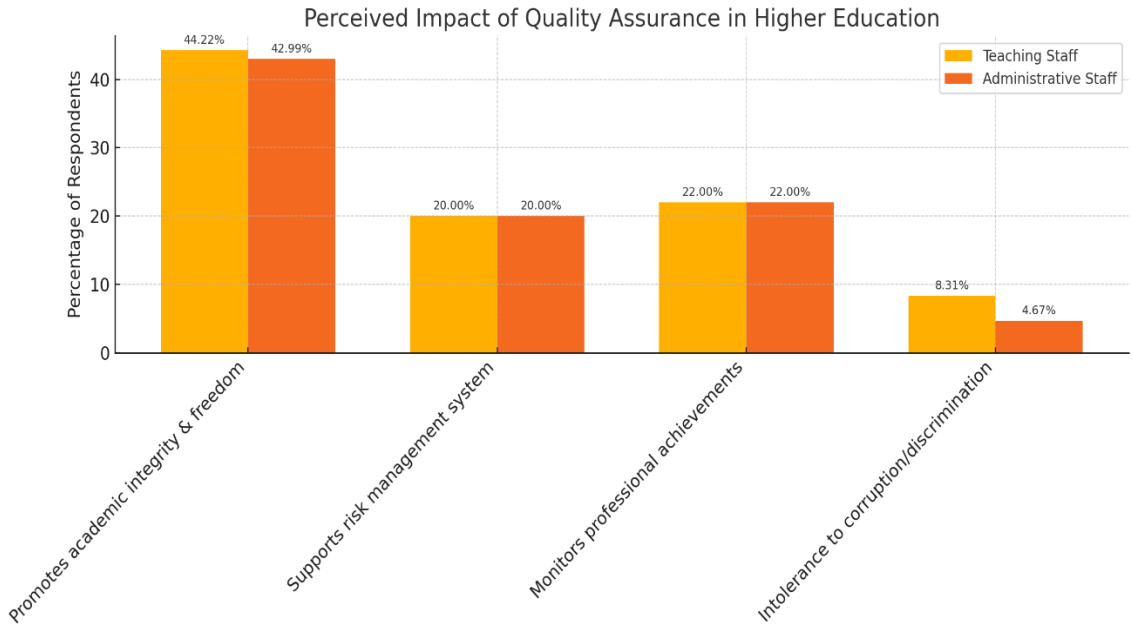
In the same context, the opinion of 53.71% of respondents (teaching staff - 21.93%, administrative staff - 31.78%) that the methodology of the internal quality assurance system is based on the commitment of the university management to quality assurance should be considered.

Generally, the teaching and administrative staff highly appreciate the importance of quality assurance in promoting academic integrity and academic freedom at the university (44.22% and 42.99%, respectively). In addition, almost 20% of respondents have an understanding that quality assurance contributes to the construction of an effective risk management system at the university. At the same time, 22% of teaching staff and administrative staff associate quality assurance with monitoring the professional achievements of university teachers and staff (Figure 3).

At the same time, it was found that the respondents, to a small extent, associate the building of a quality assurance system with the promotion of the principle of intolerance to any forms of corruption and discrimination at the university: teaching staff – 8.31%, administrative staff – 4.67%.

Figure 3

Perceived Impact of Quality Assurance in Higher Education



Thus, the study of the results of the questionnaire survey allowed us to formulate trends and initial problems inherent in the Kazakh higher education system in terms of quality assurance:

1. An internal quality assurance system is considered as a set of integrated and regularly interacting or interdependent elements created to achieve certain goals;

2. The internal quality assurance system is aimed at creating a high-quality landscape of the education system through the efforts and actions of all stakeholders to meet their expectations and goals;

3. Creating a high-quality education landscape requires sustained and long-term efforts, creating a system capable of developing effectively in the future;

4. The involvement of university stakeholders in ensuring the quality of education is manifested through internal monitoring of the university's activities, through the development of quality standards

5. The methodology of the internal quality assurance system is based on academic values and fundamental principles, as well as on the commitment of the university management to quality assurance;

6. Quality assurance contributes to the promotion of academic integrity and academic freedom at the university, building an effective risk management system at the university.

7. A comparison of the teaching staff cohort and the administrative staff allows us to conclude that these cohorts do not have a large gap in understanding the internal quality assurance system. At the same time, the issue of the formation of a quality culture at the university is still relevant.

Field (on-site) research in the form of interviews with the teaching and administrative staff was aimed at identifying the faculty's understanding of the main characteristics of a modern university, its mission, the internal quality assurance system, as well as the understanding of teaching staff of their role as a subject of the educational process.

Interviewing administrative and managerial personnel, along with identifying the idea of main characteristics of a modern university and its mission, was also aimed at determining the vision of administrative and managerial personnel of their role in providing conditions for the

educational process, as well as a well-grounded idea of the internal quality assurance system: principles, division of responsibility, tools.

According to the respondents, the main parameters of the university include the interaction of educational and research processes, modern infrastructure, highly qualified teaching staff, formed scientific schools, innovative programs, graduates who implement their competencies in the labour market, and high-rating positions, including international ones.

Respondents see the university's primary mission in integrating education, science, and business and note the university's role in the region's development. Respondents determine their role in ensuring the conditions of the educational process at the university as the implementation of the processes of internationalization of the university, ensuring the availability of education, the development of professional competencies following the in-crease in requirements for the level of education, strengthening the scientific or practical component of programs.

All respondents agreed with the thesis that the university's quality assurance is based on the values of the quality culture among the entire university community: aca-demic staff, students, administrative and managerial staff.

Among the academic values underlying the quality assurance methodology, respondents include academic freedom, honesty, quality of education, transparency, open-ness, mutual respect, and equal student opportunities.

All respondents answered positively to the question of whether the methods and tools of the internal quality assurance system should correspond to the mission and development strategy of the university.

The combined opinion of the representative staff of teaching staff and administrative staff made it possible to assess the impact of various components more accurately on the overall level of education quality.

The survey among students focused on three blocks: assessment of the quality of content and implementation of educational programs; assessment of the quality of university infrastructure; assessment of the quality of teaching staff.

The main factors of the quality of higher education include the level of development of the material and technical base (infrastructure), which affects the effectiveness of educational and scientific processes, taking into account the interests and needs of various intra-university groups, stimulates students to actively acquire knowledge, and scientists and teachers to generate and broadcast it.

According to the survey results, students show great satisfaction with the existing infrastructure in their universities. So, 44.8% are completely satisfied, 31% of respondents are rather satisfied. At the same time, the greatest satisfaction is noted in relation to the library and the university grounds, while respondents are less satisfied with the restrooms (46.1%), Wi-Fi operation, Internet speed (45.8%).

The quality of the educational program content and its implementation is a very important factor in the training of modern personnel. In this regard, it was valuable to learn from students the degree of their satisfaction with the knowledge they received, their relevance and the quality of teaching this knowledge. Thus, in the aggregate of the answers "Yes" and "Rather yes than no", 72.5% of respondents believe that the disciplines they study can be useful in the future and assess the relevance of knowledge mainly highly.

According to the survey, students are less satisfied with the possibility of choosing a teacher (39.2%), the desired course or subject (35.3%), as well as considering and pro-cessing student complaints (37.7%).

With regard to the quality of classes, students have the greatest dissatisfaction with the audience (29.7%) and the format of classes (27.9%).

When assessing the qualification level of the teaching staff, students note a good command of the subject (66.8%), interaction with students (65.1%) and demanding knowledge (66.7%) of students, which indicates a high level of qualification. On the other hand, respondents are less satisfied with their knowledge of modern technologies and teaching methods (24.9%), objectivity of assessment (22.7%) and benevolence (21.7%).

The results obtained provide valuable information for management decisions and strategic planning in the field of higher education quality and can also serve as a basis for making improvements to the development of the internal quality assurance system. The study identified problems and challenges in the field of higher education, which allows the relevant structural units of the university to assess the difficulties they face.

Discussion

This article presents the results of a study of the quality level of the higher education system based on cluster factors of influence using questionnaires and interviewing the following groups of respondents: faculty, administrative staff and students.

We assume that clustering of factors to be the most appropriate and promising method of assessing the quality of higher education, since cluster analysis as a multidimensional statistical procedure allows the collection and systematization of information on homogeneous groups of parameters, properties and characteristics of the studied object. In this regard, the purpose of our study is to identify the quality of higher education based on cluster analysis.

During the study, the main parameters of the quality of education were identified as factors influencing the formation of quality, interacting with each other and grouped for ease of analysis as follows: a modern university (characteristics; main mission; main customers of services; the role of the university in the development of the region); the subject of the educational process (role in ensuring the conditions of the educational process; opportunities at the university to improve the quality of the staff; forms of interaction with colleagues to improve the quality of the educational process); the system of internal quality assurance (its purpose; its structure; requirements for its organization; methodology of its organization; possible composition of its experts; its significance).

The results obtained during the survey show that the teaching staff and administrative staff understand the role of universities in shaping the "charge" of human potential development at a high level. It should also be noted the high demands of students on the quality of the educational process, its provision and support. There is a clear understanding of the requirements for learning outcomes on the part of customers, primarily on the part of students.

The organized interviews also showed the respondents' acceptance of the social importance of universities and the position of universities as one of the system-forming factors of regional development. The conducted research revealed the dependence of the quality of education on the level of organization of the internal quality assurance system, the involvement of all subjects of the educational process.

During the study, the participants expressed the essential elements contributing to the improvement of the quality assurance system at the university, such as the quality of personnel and continuous professional development; motivation of the teaching staff; the state of the material base of the university; innovative activities of the university.

Also, according to the participants, the developed information environment and the further transformation of the university into a digital format of both scientific and educational processes and support for all types of activities will allow the organizers of the educational process to ensure its effectiveness.

An important role in the activities of universities belongs to the existence of a well-established internal quality assurance system, the formation of a corporate culture and a policy of academic integrity through the values of a culture of quality and the availability of effective

administrative management, developing the values and principles of the quality assurance model in accordance with the mission and vision of the university.

The results obtained from the respondents' responses reflected their point of view on the importance of ensuring the quality of higher education in general, the problems of quality assurance and the corresponding impact, as well as factors contributing to the creation of a good quality assurance system.

The limitations of the conducted research are the incomplete consideration of state policy in the field of higher education, since despite the provision of academic and managerial independence to universities at some level, the regulatory role of the state in Kazakhstan is still high. Also, the opinion of employers as one of the main stakeholders in the field was not considered. But they are the objects of our next research.

Conclusion

The central problem of the development of education is to improve its quality. Approaches to solving this problem may vary. The organized study revealed the potential for the development of higher education and its quality in the context of diversification, digitalization, and academic freedom of the university through the organization of cohorts of " teaching staff" and "administrative staff".

The study of the understanding and relationship between the teaching staff and the administrative staff based on structured factors that affect the quality of education (clusters) made it possible to give a detailed description of the resources for the development of the higher education system, including the development of the value and motivational component of the activities of teachers and staff, building communications within the teams of employees of the organization, ensuring systemic improvement qualification of personnel.

The study showed the need to build an internal quality assurance system at the university based on the principles, including ensuring the unity of strategy, policies and procedures at the university; involving all employees and students' external stakeholders in quality assurance activities; maintaining academic integrity and freedom, intolerance to any form of corruption and discrimination; creation of conditions for continuous improvement of the quality assurance system and development of quality culture, etc.

Thus, the quality of education as a social category reflects the state and effectiveness of the educational process and is characterized by the degree of compliance with the requirements – needs and expectations of internal and external consumers in the development and formation of professional competencies of the individual.

Quality assurance focuses on the organization's quality and is based on the participation of all stakeholders to meet their expectations and goals as much as possible. Only a stable quality culture can ensure a high quality of work at every level. This means that all education actors have the same understanding of quality and quality assurance.

Further consideration of the development of internal quality assurance systems of universities seems relevant. Further research on the development of the competencies of university management in the organization of internal quality assurance systems and the formation of management's commitment to the culture of quality is a promising direction.

Conflict of Interest Statement

The authors declare no potential conflicts of interest regarding the research, authorship, or publication of this article.

Author Contributions

Aidos Mukhatayev: Conceptualization, Methodology; Serik Omirbayev: Data curation, Writing- Original draft preparation; Andrii Biloshchytskyi: Visualization, Investigation; Khanat Kassenov: Supervision; Saulesh Mukanova: Validation; Alibek Shokparov: Writing-Reviewing and Editing.

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THE IMPACT OF AI ON ACADEMIC WRITING: ENHANCING SKILLS OR HINDERING CRITICAL THINKING?

Abstract: This study examines the impact of AI tools like ChatGPT on academic writing among undergraduate students at a university in Kazakhstan. Using survey data from 91 students, the study used descriptive statistics, group comparisons, and correlation analysis to explore perceptions of AI in tasks such as organizing ideas, grammar correction, summarizing content and critical thinking. Students rated AI most helpful for improving writing clarity (M=3.75) and paraphrasing (M=3.74). Gender and age differences were notable: females found AI more helpful for grammar (M=3.89), while younger males used it more for organizing ideas (M=4.00). A strong correlation (r=0.59) was also observed between content summarization and idea organization, underscoring how AI tools may support higher-order thinking by helping students distill and structure complex information. The study highlights both the benefits and concerns regarding over-reliance and critical thinking, and calls for clear guidelines to ensure responsible AI use that supports academic integrity.

Keywords: academic writing, critical thinking, cognitive process, Artificial Intelligence (AI), ChatGPT, Academic integrity, AI-human collaboration, AI-generated texts, undergraduate students, ethical use.

Introduction

Artificial Intelligence (AI) is changing the way students write and learn in higher education. Tools like ChatGPT are now common in academic writing. These tools save time and simplify the writing process, but their widespread use raises critical questions about their impact on essential academic values and skills. Specifically, concerns arise regarding academic integrity, over-dependence, and the potential erosion of students' critical thinking and creative abilities.

Critical thinking, a cornerstone of academic success, involves analyzing, evaluating, and synthesizing information to form well-reasoned arguments. The reliance on AI tools may inadvertently hinder the development of these skills by automating complex cognitive processes. For example, students might bypass the iterative process of idea generation and evaluation, instead depending on AI-generated solutions that may lack depth or originality. This raises concerns about whether students are developing the ability to critically assess information, construct logical arguments, and articulate their perspectives independently.

While prior studies have explored AI tools in education, there is limited empirical evidence on how demographic factors such as gender and age influence perceptions of AI in academic writing, especially in the Central Asian context. This study looks at how undergraduate students at a university in Kazakhstan use and feel about AI tools for writing essays. It also explores how students' age and gender affect their views and how they use these tools. This study investigates how AI tools influence students' writing (e.g., organizing ideas, grammar checks), explores differences in usage by gender/age, and evaluates student perceptions of AI's usefulness.

To address this aim, the study seeks to answer the following research questions: 1) How do students perceive the usefulness of AI tools for academic tasks such as organizing ideas,

correcting grammar, and summarizing information?; 2) How frequently do students use AI tools for different academic purposes?; 3) Do factors such as gender and age influence students' usage patterns and perceptions of AI tools?
By meeting these objectives, the study hopes to give useful information about how AI can be used well in academic settings.

Literature Review

The integration of artificial intelligence (AI) tools into academic writing has generated substantial debate regarding their pedagogical value and cognitive impacts. While initial concerns focused on potential threats to academic integrity and authentic learning, emerging research reveals that when implemented strategically, AI writing assistants can serve as powerful scaffolds for developing critical thinking skills in essay composition.

To begin with, Malik et al. (2023) examine Indonesian students' perspectives on AI in academic essay writing. Their research underscores a generally positive reception, with students recognizing the advantages of AI for grammar correction, plagiarism detection, and content organization. However, concerns about the impact on creativity and critical thinking persist. Malik et al. argue for a balanced AI integration approach, where human authorship remains central. The study also identifies AI tools' potential to democratize learning by providing personalized feedback and overcoming linguistic barriers, fostering inclusivity and multilingualism. Despite these benefits, the authors stress the importance of AI literacy and ethical considerations, noting that students must be educated on appropriate AI usage to uphold academic standards. The research points to the need for comprehensive AI education that promotes both technical skills and ethical awareness, ensuring students can harness AI responsibly without compromising originality or critical analysis.

Expanding on the theme of AI's cognitive role in language learning, the foundational work of Mizumoto et al. (2024) established important baseline findings about AI's dual nature in English as a Foreign Language contexts. Their rigorous linguistic analysis using natural language processing techniques revealed distinct differences between human and AI-generated texts, particularly in the nuanced markers of original authorship that demonstrate authentic critical thinking. While confirming AI's capacity to produce structurally coherent essays, this research importantly identified gaps in AI's ability to replicate the complex cognitive processes underlying human thought. However, rather than viewing these limitations as deficiencies, subsequent studies have demonstrated they can be transformed into pedagogical opportunities when AI is positioned as a critical thinking partner rather than writing substitute.

Building on these insights, Lund and Ting's (2023) groundbreaking "dialogic AI" approach represents a paradigm shift in leveraging AI for cognitive development. Their carefully controlled study with 300 participants established that iterative, reflective exchanges between students and AI systems about developing arguments produced 29% stronger arguments and 35% better counterargument integration compared to traditional writing methods. These significant improvements stem from AI's unique capacity to provide immediate, targeted challenges to student thinking - prompting continuous justification of claims and consideration of alternative perspectives at a scale and frequency that would be impractical for even the most dedicated instructors to maintain. Importantly, this research demonstrates that the value of AI lies not in its ability to generate content, but in its capacity to stimulate and extend student thinking through sustained dialogue.

The method of using AI dialogue partners to increase conceptual precision in students' essays through iterative, AI-facilitated dialogues that challenge reasoning and prompt deeper reflection is described in research such as that by Angulo et al. (2024). Their study outlines a transdisciplinary approach where AI-driven dialogue tools engage students in real-time exchanges designed to stimulate critical thinking, challenge assumptions, and guide the

construction of well-supported arguments across various subjects, including philosophy. This interactive dialogue model involves a structured prompt-response-feedback cycle, enabling iterative learning and cognitive growth by simulating critical interlocutors that help students refine ideas and anticipate counterarguments.

Similarly, Zhang et al. (2023) developed an innovative Socratic questioning system embedded in the Socratic Playground for Learning (SPL), which uses GPT-4-based dialogue to foster critical thinking through iterative, adaptive questioning. Their randomized controlled trial demonstrated a 22% increase in higher-order thinking components in student essays, particularly improving skills in evidence evaluation and synthesis. The system notably enhanced students' abilities to identify underlying assumptions and develop nuanced conclusions, which are crucial for academic writing. This was achieved by the SPL's dynamic feedback mechanisms that guide learners to reflect, critique, and synthesize information through a structured Socratic dialogue process, promoting deeper reasoning rather than rote answers.

Moreover, discipline-specific applications reveal even more nuanced benefits. For instance, Hwang et al. (2023) investigated the impact of AI-generated alternative conclusions on STEM students' critical thinking. Their study found that when students were presented with AI-generated alternative conclusions to their work, they identified 40% more logical gaps compared to students who did not receive such AI support. This intervention helped students critically evaluate their reasoning and improve the rigor of their scientific arguments.

These findings align with Donahue's (2024) Cognitive Scaffolding Theory, which argues that AI tools most effectively enhance critical thinking when they provide discipline-appropriate challenges. These challenges include: 1) probing questions tailored to the subject matter; 2) relevant counter examples that highlight potential flaws; 3) alternative interpretation frameworks that broaden students' perspectives. Together, these mechanisms scaffold learners' cognitive processes, fostering deeper analysis and reasoning.

Beyond direct improvements to argument quality and logical reasoning, research indicates that AI writing tools, when used reflectively, can significantly enhance students' metacognitive skills. Zheng's (2024) "AI-Think-Aloud" protocol requires students to document and reflect on their use of AI throughout the writing process. This intervention led to a 47% increase in metacognitive awareness compared to control groups. Students using this protocol developed stronger abilities to monitor their thought processes, critically evaluate the strength of their arguments, and make deliberate writing decisions.

The integration of AI writing tools in education offers significant cognitive and metacognitive benefits, such as enhancing critical thinking, argument quality, and metacognitive awareness. However, these advantages come with serious challenges related to academic integrity and authentic learning that institutions must address thoughtfully. Alkamel and Alwagieh (2024) investigate the impact of ChatGPT on Yemeni EFL learners. Their findings suggest that students perceive AI tools positively, noting improvements in writing fluency, accuracy, and overall quality. ChatGPT was particularly beneficial for grammar correction and proofreading. However, challenges like academic integrity concerns and the risk of over-reliance on AI were also evident. The study calls for using ChatGPT as a supplementary tool to improve writing skills while promoting critical thinking and ethical usage. Another study by Dergaa et al. (2023) delves into the ethical challenges posed by ChatGPT in academic writing, focusing on the potential for generating false or biased information. The authors discuss the importance of fostering AI literacy among students and recommend that institutions create comprehensive policies to guide ethical AI use. A study by Khalifa and Albadawy (2024) presents a systematic review of literature exploring the integration of AI in academic writing and research. Drawing from 24 studies published since 2019, the authors identify six key domains where AI significantly contributes: idea generation

and research design, content improvement and structuring, literature review and synthesis, data management and analysis, editing and publishing support, and communication and ethical compliance. Tools like ChatGPT are highlighted for their potential to streamline these processes. However, the review also emphasizes the importance of ethical use, academic integrity, and the need for balanced human oversight. The authors recommend broader integration of AI tools in research workflows, supported by training and ongoing evaluation to address emerging challenges.

Smerdon (2024) explores AI's impact on student performance in essay-based assessments, focusing on undergraduate economics students. Despite fears about AI promoting academic dishonesty, Smerdon's findings indicate a neutral overall impact of AI usage on academic performance. While higher-performing students tended to adopt AI tools for idea generation, grammar checks, and literature review, the research did not establish a statistically significant effect on grades. The qualitative aspect of the study identifies key themes in AI use, such as improving writing quality and efficiency, but it also underscores the need for responsible integration to avoid over-reliance on technology. The findings suggest that AI tools can be beneficial educational resources, provided they are used to supplement rather than replace students' academic efforts. Consequently, the study advocates for the thoughtful integration of AI into writing curricula, balancing its potential benefits against the risks of diminishing cognitive engagement.

The disciplinary variations in AI's cognitive impacts, as highlighted by Zhang and Park (2024) and Cotton and Wilson (2023), underscore the importance of context-sensitive implementation strategies. Their research reveals that AI is particularly effective in enhancing logical reasoning skills in fields like philosophy and STEM, where structured argumentation and analytical thinking are central. In contrast, AI's role in creative writing and culturally-specific composition demands more nuanced scaffolding to ensure that students' authentic voice and stylistic diversity are preserved, preventing homogenization of expression.

Further supporting this tailored approach, Huang et al. (2024) found that AI's ability to reduce cognitive load can be especially beneficial for students with learning differences. When AI tools focus on fostering critical thinking development rather than merely generating finished products, they help level the educational playing field by enabling these students to engage more deeply with complex reasoning tasks without being overwhelmed.

Collectively, these studies illustrate the potential of AI tools like ChatGPT to enhance academic writing by offering personalized support and improving language use. However, they also underscore the need for careful management to prevent academic dishonesty and encourage meaningful learning. These insights align with the present study's aim to explore how demographic factors, such as gender and age, influence students' perceptions and experiences with AI tools, as well as to examine the balance between AI benefits and the importance of maintaining academic integrity.

Based on the reviewed literature, the study proposes the following hypotheses: 1) Students' demographic characteristics (such as age and gender) influence how they perceive and use AI tools in academic writing**;** 2) There is a positive correlation between the use of AI for summarizing content and organizing ideas.

Research Methods

Data Collection

This study employed a quantitative approach and convenience sampling to explore the perceived impact of AI tools on students' academic essay writing. The research was conducted at a university in Kazakhstan, where undergraduate students were invited to participate in an online survey. The purpose of the survey was to gather insights into how students use AI tools

in academic contexts and to examine the effects of these tools on key elements of writing performance such as idea organization, grammar and spelling, summarization, paraphrasing, clarity, and critical thinking. The questionnaire began by collecting basic demographic information, including gender, age, and academic major. Following this, participants were asked to respond to a series of self-reported statements using a Likert scale to indicate their level of agreement. These statements explored various aspects of AI-assisted writing, such as the use of AI-generated essay outlines to organize ideas before writing, the role of AI tools in identifying and correcting grammar and spelling errors, and the effectiveness of AI-generated summaries in helping students understand complex research articles. Additional items assessed whether AI tools enhanced the ability to extract key arguments from texts, improved clarity and coherence in writing, and supported the development of self-editing skills. The questionnaire also investigated whether AI-based research assistants helped students gather relevant information to strengthen their arguments, and whether paraphrasing tools aided in restating information in their own words for better comprehension. Finally, the survey included statements that gauged students' overall perceptions of the impact of AI technologies on their writing abilities, including both positive and negative effects on academic writing and critical thinking skills.

Prior to data collection, all ethical considerations were strictly followed. Participation in this study was entirely voluntary, and informed consent was obtained digitally. At the beginning of the survey, participants were presented with an information sheet outlining the aim of the research, their right to withdraw at any time, and assurances of anonymity and confidentiality. They were then asked to tick a box indicating that they understood the information provided and consented to participate in the study. No personal identifiers were collected, and all responses were stored securely for research purposes only.

A total of 91 undergraduate students completed the survey. Among the participants, 69% identified as male and 31% as female (Figure 1).

In terms of age, the respondents were grouped into three categories: 16–18 years, 19–21 years, and older than 22. The majority belonged to the 19–21 age group, which aligns with the typical undergraduate demographic, while a smaller number were either younger or older (Figure 2).

Figure 1

Gender of participants.

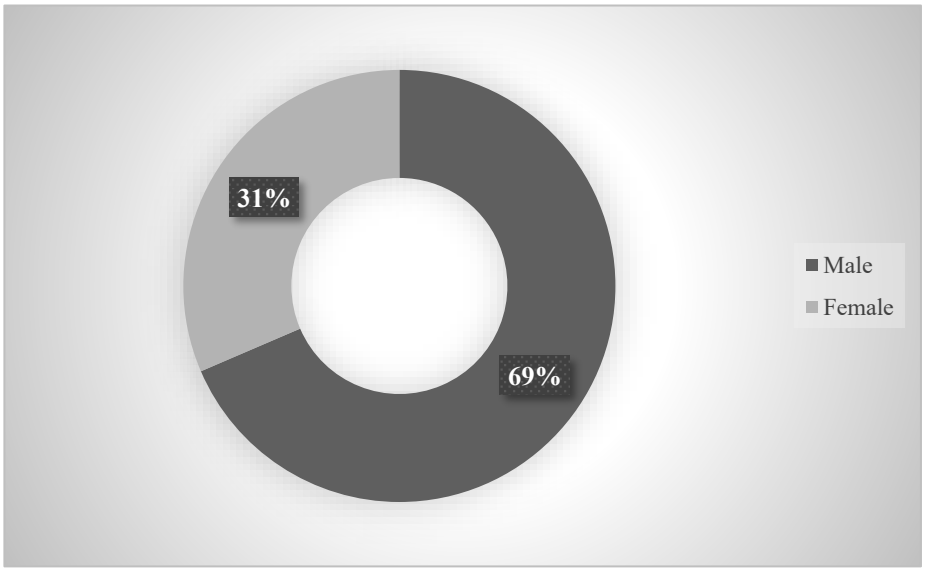
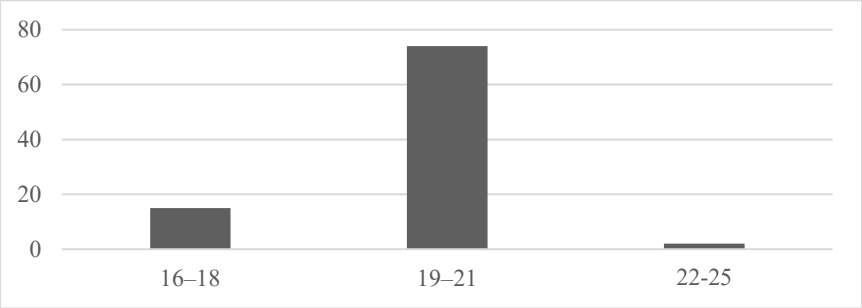


Figure 2
Age range of participants



Participants also represented a range of academic fields in IT. However, the sample was predominantly composed of students majoring in software engineering (70%), followed by cybersecurity (20%), and media technologies (10%). This distribution reflects the university's specialization in digital and technical disciplines and provides a relevant context for analyzing AI tool usage among students who are more likely to engage with emerging technologies.

Results and Discussion

The data were analyzed using descriptive statistics, comparisons by gender and age, and correlation analysis.

Firstly, to provide an overview of participants' perceptions regarding the use of AI tools in academic writing, descriptive statistics—specifically, the mean and standard deviation—were calculated for each Likert-scale item in the questionnaire. Each item was rated on a 5-point Likert scale ranging from 1 ("Strongly disagree") to 5 ("Strongly agree").

The mean was computed by summing all participant responses for a given item and dividing by the total number of respondents (N=91). This measure reflects the central tendency of responses. The standard deviation (SD), which indicates the variability or spread of responses around the mean, was calculated using the formula: $SD = \sqrt{[\Sigma (xi - \mu)^2 / n - 1]}$.

The descriptive results suggest a generally positive perception of AI tools in supporting academic writing. All mean scores exceeded 3.40, indicating overall agreement with the effectiveness of AI across various writing-related tasks (see Table 1).

Participants rated the use of AI for enhancing writing clarity highest (M=3.75, SD=1.06), followed closely by paraphrasing and synthesis (M=3.74, SD=1.12), and summarizing research articles (M=3.71, SD = 1.09). These findings indicate that students perceived AI as particularly effective in improving the clarity of their writing and in assisting with understanding and rephrasing complex academic content.

The use of AI for correcting grammar and spelling also received a favorable evaluation (M=3.66, SD = 1.19). However, the relatively larger standard deviation suggests more variability in students' responses, potentially due to individual differences in writing proficiency or prior exposure to language-enhancing tools.

The lowest mean was recorded for the item concerning AI's role in organizing ideas (M=3.42, SD=1.03), although the value still reflects a generally positive trend. This may suggest that while students acknowledge AI's usefulness in helping to structure essays, they might still rely on traditional methods or prefer to take more control in the pre-writing phase.

Table 1
Mean and Standard Deviation of Perceived Impact of AI Tools

Measure	Mean	Standard Deviation
Use of AI for organizing ideas	3.42	1.03
AI helps correct grammar and spelling	3.66	1.19
AI aids in summarizing research articles	3.71	1.09
AI improves paraphrasing and synthesis	3.74	1.12
AI enhances writing clarity	3.75	1.06

The findings of this study closely reflect prevailing trends observed in the literature regarding AI's role in academic writing. As in previous studies, participants displayed generally positive attitudes toward AI tools, particularly for tasks such as organizing ideas, grammar correction, content summarization, paraphrasing, and clarity enhancement—evidenced by mean scores consistently above 3 on a 5-point Likert scale. These observations align with the findings of Imran and Almusharraf (2023), who identified student perceptions that AI tools substantially aid in text rewriting, summarization, and linguistic accuracy.

Following the descriptive analysis, gender-based analysis revealed noteworthy patterns in how male and female undergraduate students perceived the impact of AI tools on their academic writing practices. Table 2 presents the mean scores for each group across five key areas of AI use in writing: organizing ideas, correcting grammar and spelling, summarizing research articles, paraphrasing and synthesis, and enhancing writing clarity.

Overall, male students tended to report greater benefit from AI in structuring and organizing ideas. The mean score for this item among males was 3.51, compared to 3.21 for females. This difference suggests that male students may rely more heavily on AI-generated outlines or planning tools to assist with the initial phases of academic writing. In contrast, female students rated AI tools higher in all remaining categories, particularly in relation to grammar and spelling correction (M=3.89), paraphrasing and synthesis (M=3.89), and writing clarity (M=3.89). These results indicate that female participants may perceive AI as more useful for refining and improving the language and coherence of their written work.

The smallest gender difference was observed in the summarization category. Male students gave a slightly higher mean score (3.76) than females (3.61), suggesting that both groups acknowledged the utility of AI in condensing complex research materials, albeit with minimal variation. Female students consistently evaluated AI more favorably in the stages of writing that involve language quality and conceptual integration, while male students appeared to benefit more from AI in early-stage structuring.

Table 2
Mean Scores by Gender

Measure	Male Mean	Female Mean
Organizing ideas with AI	3.51	3.21
AI helps with grammar and spelling	3.56	3.89
AI helps in summarizing research articles	3.76	3.61
AI improves paraphrasing and synthesis	3.68	3.89
AI enhances writing clarity	3.68	3.89

These gender-based differences suggest that male and female students may engage with AI tools differently depending on the demands of each stage of writing, and possibly on their individual writing strengths and preferences. This finding aligns with Qian's (2025) systematic review, which highlights that students often use AI tools differently depending on their individual learning preferences and the stage of writing. Qian (2025) notes that structural support features of AI are particularly valued by users who prioritize efficiency in the early stages of composition.

Further analysis combining gender and age variables yielded additional insights into how demographic factors influence perceptions of AI in academic writing. The responses became more differentiated when examined across five subgroups: males aged 16–18, females aged 16–18, males aged 19–21, females aged 19–21, and females older than 22. Table 3 displays the mean scores for three selected measures across these subgroups: organizing ideas, grammar and spelling, and critical thinking/originality.

Among the youngest male respondents (16–18 years), the mean score for using AI to organize ideas was the highest (M=4.00), indicating strong reliance on AI tools at the early stages of the writing process. By comparison, females in the same age group rated AI's utility for organizing ideas significantly lower (M = 3.00). Notably, the highest score for AI's role in enhancing critical thinking and originality was reported by females over the age of 22 (M=5.00), suggesting that more mature students viewed AI as a collaborative partner rather than a simple writing assistant.

In terms of grammar and spelling, female students aged 16–18 provided the highest ratings (M=4.14), while females older than 22 reported the lowest (M=2.00). This contrast may indicate that younger students are more dependent on AI for linguistic accuracy, whereas older students may feel more confident in their own writing skills or approach AI tools more critically.

Male responses were relatively consistent across age groups. However, similar to the youngest females, the younger males (1618) tended to rate AI more positively than their older counterparts, particularly regarding the organization of ideas and summarizing research material.

Table 3

Mean Scores by Age and Gender Subgroups

Measure	**16–18 Male**	**16–18 Female**	**19–21 Male**	**19–21 Female**	**>22 Female**
Organizing ideas with AI	4.00	3.00	3.41	3.30	3.00
AI helps with grammar and spelling	3.75	4.14	3.60	3.90	2.00
AI improves critical thinking	3.63	3.00	3.67	4.15	5.00

These results suggest age- and gender-related tendencies in how students interpret the usefulness of AI tools. Younger participants—especially males—appeared to value AI for structuring and technical support, while older students, particularly females, placed greater emphasis on AI's potential to support critical thinking and originality. The data imply that younger users may lean on AI to scaffold the mechanical aspects of writing, whereas more experienced students see AI as a tool to complement and extend cognitive engagement with their work.

Taken together, these gender and age comparisons highlight meaningful variations in how students integrate AI into their writing processes. These patterns provide practical implications for instructors and institutions seeking to develop AI-supported pedagogical strategies tailored to diverse learner profiles.

Finally, to examine the interrelationships among various perceived functions of AI in academic writing, a Pearson product-moment correlation analysis was conducted. This statistical technique measures the strength and direction of the linear relationship between pairs of continuous variables—here, participants' ratings of different AI-assisted writing functions—on a scale from -1 to +1. Positive values indicate that as one variable increases, the other tends to increase as well, while values closer to zero imply little to no linear association. All variables used in this analysis were based on responses to Likert-scale items ranging from 1 ("Strongly disagree") to 5 ("Strongly agree").

The correlation coefficients were calculated using SPSS, where each participant's response for a given pair of AI functions (e.g., organizing ideas and summarizing content) was paired and analyzed across the sample (N=91). This allowed for identifying not only whether two perceived benefits co-occurred but also whether those benefits tended to be reported together across students.

The results of the correlation analysis are presented in Table 4. The analysis revealed a strong positive correlation (r=0.59) between the use of AI for organizing ideas and content summarization, suggesting that students who found AI helpful for summarizing complex texts also tended to find it useful for structuring their own ideas during essay writing. This relationship underscores the likelihood that students use summarization features of AI not only for comprehension but also as a strategy for shaping their own written arguments.

In addition to this strong relationship, moderate positive correlations were identified between the perceived role of AI in improving writing clarity and its usefulness in both organizing ideas (r = 0.43) and summarizing research (r=0.42). These findings suggest that students who found AI helpful for structuring content or understanding source material also perceived improvements in the overall coherence and clarity of their writing.

Another moderate correlation (r=0.43) was found between paraphrasing and synthesis and organizing ideas, indicating that the ability to rephrase or synthesize ideas using AI may contribute to more structured and logically developed academic essays.

Table 4

Correlation Matrix of AI-Assisted Writing Functions

Measure A	Measure B	Pearson Correlation (r)
AI helps organize ideas	AI helps in content summarizing	0.59
AI improves writing clarity	AI helps in summarizing research	0.43
AI enhances paraphrasing and synthesis	AI helps organize ideas	0.43

These associations suggest a pattern in which different AI tools are perceived as mutually reinforcing. Specifically, the findings highlight how AI features used in early stages of writing - such as organizing ideas and summarizing content - may also support later-stage functions like clarity improvement, synthesis, and coherence.

Although these correlations are statistically significant, it is important to note that they do not imply causation. That is, while students who perceive one AI function positively often rate another similarly, the analysis cannot determine whether one function directly influences the other. Moreover, weaker correlations were observed for AI's perceived role in enhancing originality and critical thinking, suggesting that students may view these more cognitively demanding tasks as separate from AI's technical or mechanical assistance. This distinction highlights a potential gap in how AI is perceived: while tools are clearly valued for their structural and linguistic support, their contribution to higher-order thinking processes may still be questioned by students.

In summary, the correlation matrix reveals how students tend to use AI tools in a complementary fashion, particularly in the areas of content summarization, organizing ideas, and improving clarity. These findings emphasize the potential for integrated AI functionalities to support multiple stages of the academic writing process and underscore the importance of designing AI-assisted learning environments that align with students' writing needs. Thus, hypothesis1 was supported: the analysis revealed that students' age and gender were associated with different patterns of AI tool usage and perception. For example, younger students rated AI more useful for organizing ideas, while female students gave higher ratings for grammar correction and writing clarity. Hypothesis 2 was confirmed through a strong correlation ($r = 0.59$) between summarizing and organizing ideas.

Limitations

While this study provides valuable insights, certain limitations should be acknowledged to better understand the scope and generalizability of the findings:

Firstly, the sample size was relatively small ($N = 91$) and drawn from a single university in Kazakhstan, which limits the generalizability of the findings. Future research should include a larger and more diverse sample across multiple institutions and countries to validate these results and explore cultural or institutional influences.

Secondly, the gender distribution in the sample was unbalanced (69% male), potentially skewing the findings. A more balanced gender representation is necessary to confirm whether the observed patterns hold across demographic groups.

Thirdly, the study relied entirely on self-reported data, which can be influenced by social desirability bias or inaccurate self-assessment. Future research should incorporate objective data sources, such as textual analysis of students' writing before and after AI use or academic performance indicators.

Fourthly, this study focused only on students' perceptions and did not examine teachers' views or institutional policies on AI use in academic settings. Future studies should explore how faculty members and academic institutions are adapting to AI technologies in writing education, including how guidelines or assessment practices may evolve.

Finally, while the study identified correlations between certain uses of AI tools (e.g., organizing ideas and summarizing), it did not explore causal relationships or long-term effects. Future research could use longitudinal or experimental designs to evaluate the sustained impact of AI on writing skills and critical thinking development.

To address the limitations identified in this study, future research should aim to expand the sample size and include participants from multiple universities, both within Kazakhstan and internationally, to enhance the generalizability of the findings across diverse educational settings and cultural contexts. A more balanced gender representation is also essential, as the current sample was predominantly male, potentially biasing the results.

In addition, future studies should complement self-reported data with objective measures, such as analyses of writing quality before and after AI tool use, plagiarism detection outcomes, or academic performance metrics, to gain a more reliable understanding of the actual impact of AI tools on student learning.

Conclusion

This study highlights the mixed experiences of undergraduate students in Kazakhstan using AI tools like ChatGPT for academic writing. Overall, students reported positive impacts, such as better organization of ideas, improved grammar and spelling, and clearer writing. However, the study also showed differences in how students view and use these tools based on gender and age. For example, female students found AI more helpful for grammar and clarity,

while younger male students relied more on AI for organizing their essays. Older female students appreciated AI's role in supporting creativity and original thinking.

The primary aim of this study, to investigate students' perceptions of AI tools in academic writing and how these perceptions vary across age and gender, was successfully achieved. The research objectives were met through the analysis of self-reported data collected from 91 undergraduate students. The hypotheses regarding demographic differences in AI tool usage were supported: the analysis showed that students found AI tools especially helpful for tasks such as enhancing writing clarity, paraphrasing, and summarizing complex materials. Strong correlations between functions such as between summarization and organizing ideas ($r=0.59$) suggest that students perceive these tools as interconnected aids in the writing process. Moreover, the study revealed important demographic differences: males were more inclined to use AI for organizing ideas ($M=4.00$), whereas females particularly those aged over 22 perceived AI as an effective partner in developing originality and even critical thinking ($M=5.00$). Furthermore, the results confirmed that AI is perceived as a beneficial writing aid, although concerns remain regarding its influence on critical thinking.

Beyond descriptive trends, the study contributes to the literature by offering insights from a geographically underrepresented context. As much of the existing literature stems from Western or East Asian institutions, the inclusion of data from Central Asia enhances the geographic diversity of scholarly perspectives on AI tool integration in academic writing. Furthermore, the gender- and age-based comparisons presented here offer further originality. By highlighting how students from different demographic backgrounds perceive and utilize AI differently, the study reinforces the necessity for inclusive and adaptive instructional approaches.

The findings are consistent with prior work by Mizumoto et al. (2024) and Malik et al. (2023), confirming that students generally appreciate AI's utility for grammar, paraphrasing, and summarization, while remaining cautious about its potential to reduce original thought if used inappropriately. Moreover, aligning with Smerdon (2024), this study reinforces the role of demographic variables such as age and gender in shaping students' engagement with AI tools. These parallels highlight the broader relevance of the current findings and support emerging calls for ethical, balanced, and pedagogically grounded AI integration in higher education.

In conclusion, while AI tools can significantly support students' academic writing processes, it is essential to maintain a human-centered, educational approach that emphasizes critical engagement and ethical use. Educators and institutions must play a key role in guiding students to harness AI responsibly, ensuring that technological advancement complements rather than compromises the core goals of higher education.

Conflict of Interest Statement

The authors declare no potential conflicts of interest regarding the research, authorship, or publication of this article.

Author Contributions

Guldana Zhumagaliyeva–Validation, Writing – Original Draft, Formal analysis; Tleshova Zhibek – Supervision, Writing – Original Draft, Project administration; Moldir Amanzhol - Formal analysis, Investigation, Writing – Original Draft; Moldir Smagulova - Writing – Original Draft, Visualization, Formal analysis.

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MECHANISMS FOR THE INTEGRATION OF SOFT SKILLS, VOLUNTEERING, AND STUDENTS' SOCIAL GPA AT THE UNIVERSITY

Abstract: The article examines the mechanisms for integrating soft skills, volunteering, and university students' social GPA. The authors analyze specific features of each concepts and based on identifying their interrelation, propose recommendations for implementing the research results into practical application of social GPA in Kazakhstan universities. They suppose that the findings of the study could be used to improve legal and regulatory framework for scaling up the pilot project on assessing student achievements, taking into account the Integrated GPA (IGPA).

The article's aim is to identify the mechanisms for integrating soft skills, volunteering, and students' social GPA. To achieve this goal, following objectives were solved: 1) to establish the correlation between the concepts of "soft skills" and "volunteering" and their interrelation; 2) to determine the role of soft skills within the criteria system of students' social GPA; 3) to propose recommendations to the scientific and academic community of Kazakhstan regarding the integration of three phenomena under consideration.

The results obtained in the course of solving the objectives allowed authors to conclude that students' volunteering acts as a socio-pedagogical platform for soft skills development, the combination of which has a significant impact on social GPA level, thereby contributing to students' personal development.

Keywords: soft skills, assessment and evaluation of soft skills, student volunteering, social GPA, integrated GPA.

Introduction

At one of the meetings of the Republican Educational and Methodological Council, as a consultative and advisory working body that provides general guidance for the activities of educational and methodological associations in various areas of professional training, one of the highly relevant issues the measurability of university students' personal competencies within the framework of the professional standards of the Republic of Kazakhstan, particularly the professional standard for the "Educator" was discussed. A well-reasoned opinion was expressed that the descriptors of the professional standard in the section on "Personal Competencies" correlate with soft skills. It has been demonstrated that the accompaniment of soft skills ("soft skills include personality traits, sociability, language fluency and personal habits" (Whitmore, 1972)) with hard skills (hard skills include specific competencies or technical skills that can be measured and often validated (Whitmore & Fry, 1974)) benefits many occupational outcomes (Lamri & Lubart, 2023). In their previous research, the authors of this article established that in university-level professional training, there is a clear trend toward a balanced integration of "soft" and "hard" skills. This balance serves as a central concept for the implementation of an integrated student GPA system in Kazakhstan universities, where student volunteering acts as a key criterion within the social GPA component. In connection with the above, this article aims to identify and analyze the

mechanisms for integrating soft skills, volunteering, and the social GPA of university students. To achieve the stated goal, we considered it relevant to solve the following objectives:

to establish the correlation between the concepts of “soft skills” and “volunteering” and their interrelation;

to determine the role of “soft skills” within the criteria system of students' social GPA;

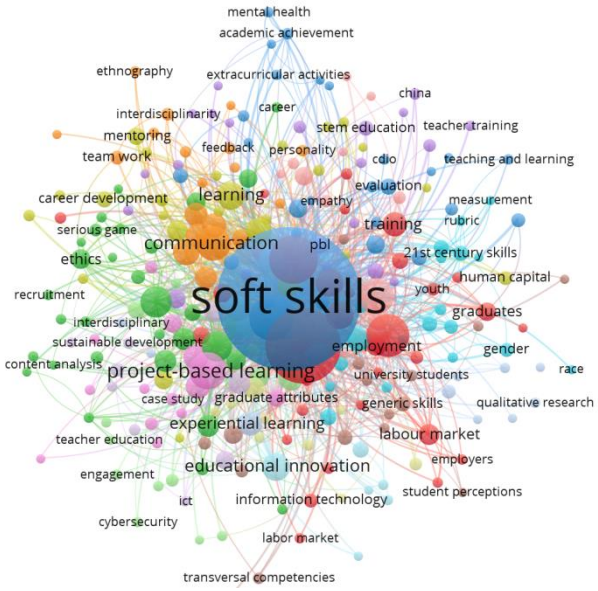
to propose recommendations for the integration of the three examined phenomena to the scientific and academic community of Kazakhstan.

Methods and organization of research

To solve the first objective, methods of theoretical analysis of scientific literature and mapping techniques were applied using the VOSviewer program, which is able to systematize and group key terms into semantic clusters reflecting interest in a specific issue over a selected period of time (Gavrikov & Kosova, 2020), and to provide visualizations of bibliometric networks (Van Eck, 2017). The research was conducted based on the international reference database Scopus using the method of “co-occurrence”, which formed thematic clusters. The program identified five major clusters, which we have conventionally labeled as follows: "Soft Skills" (blue cluster), "Communication" (yellow cluster), "Employment" (red cluster), "Project-Based Learning" (purple cluster), and "Interdisciplinarity" (green cluster). This suggests that the issue of soft skills is associated with a very wide range of scientific research, with the leading direction being education for employment (Figure 1). The bibliometric analysis also showed that researchers showed the greatest interest in this issue in 2020 (Figure 2).

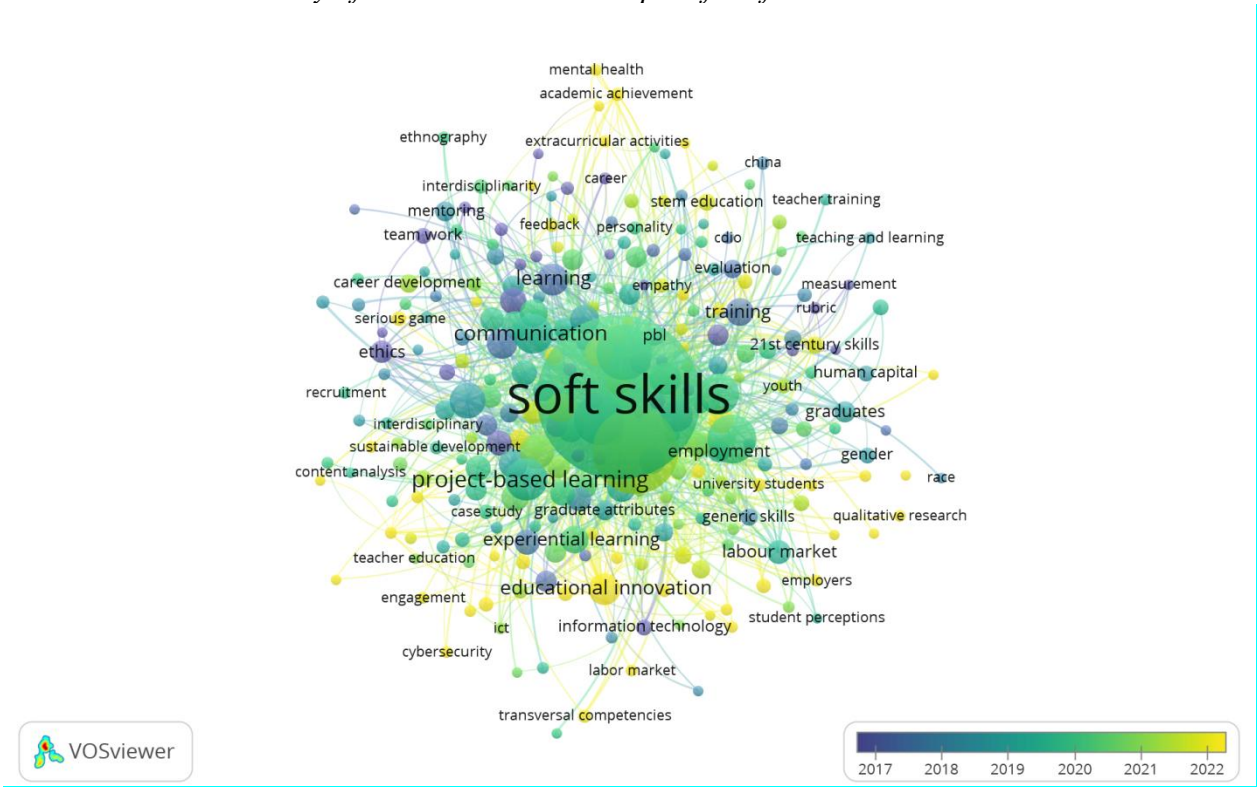
Figure 1

Thematic clusters based on the keyword "soft skills"



Source: VOSviewer

Figure 2
Publication activity of researchers on the topic of "soft skills"



The study of scientific works from available sources indicates that the origin of the term “soft skills” dates back to 1972 and was recorded in reports by the U.S. Army. In this context, the term entered scientific discourse from military and behavioral psychology, as well as military pedagogy. In practical terms, it was actively used in personnel management during the 1980s and 1990s. Since the 2000s, it has been included as a recommended skill set for 21st-century workplaces (OECD – Education 2030; The World Economic Forum, 2020). There is no individual author of the term, but it was presented at the CONARC Conference on Soft Skills Training (1972, Texas), where Paul G. Whitmore delivered a report defining this term as “…important profession-related skills that involve little or no interaction with machines and whose application in the workplace is quite general…” (Whitmore, 1972). Later, he provided a more comprehensive description of the concept in a work co-authored with Fry, J. P. (Whitmore & Fry, 1974). The evolution of the term shows that its introduction into military practice was linked to the implementation of the "System Engineering of Training" doctrine by the U.S. Continental Army Command (U.S. Army, 1968). Despite the absence of a precise scientific definition, the essence of the term is consistently revealed by various authors in a unified manner: the ability of an individual to successfully interact with others (Yan et al., 2019; Talin, n.d.; The World Economic Forum, 2020; Rao et al., 2007; Noah & Aziz, 2020; Morgan, 2024; Abbadia, 2023).

It is also quite interesting that the following concept, as stated in the title of our study “volunteering” also originated within military pedagogy. In particular, in the French language, the term emerged in the 16th century to denote a “volunteer in the army.” Derived from the Latin word voluntarius, it means “voluntary” or “carried out by one's own will.” Today, the term has acquired social and civic connotations and is widely used in sociology, social philosophy, and law. The concept of "volunteering" gained official international recognition through the UN and UNESCO in the 1970s, when the need for civic engagement in the form of voluntary public service was formally declared.

A key role in the institutional recognition of volunteering as a component of civil society was the establishment of the UN Volunteers Program in 1970 (United Nations Volunteers, n.d.). A similar initiative had been launched earlier in 1961 by the U.S. Peace Corps. It is noted that in 2001, the UN proclaimed the International Year of Volunteers, which marked global acknowledgment of the significance of social and civic volunteerism.

While the use of the term volunteering in practice raises no particular disagreements or controversies, this phenomenon has been studied in science from various perspectives. For example, issues of motivation and the outcomes of volunteering have been examined by J. Wilson (Wilson, 2000) and R. A. Musick (Musick & Wilson, 2008). E. I. Kholostova examined volunteering in the context of social work (Kholostova, 2020), while L. M. Drobizheva studied its social and civic dimensions (Drobizheva, 2014). In general, student volunteering is understood as voluntary social engagement by students, which may include activities such as environmental patrols, support for vulnerable groups, social startups, educational initiatives, and more.

If soft skills are understood as a person's ability to interact effectively with others that is, possessing communication abilities, empathy, emotional intelligence, and stress resilience then volunteering acts as a favorable and natural environment for the development and strengthening of these skills. It provides opportunities for the practical application of soft skills, informal learning (learning-by-doing), and the accumulation of experience in civic and social responsibility.

To solve the second research objective, in addition to theoretical analysis of academic literature, the method of examining official documents was also employed.

In fact, one of these documents became the conceptual impetus for our study. It concerns the third concept (social GPA), which at first glance suggests an internal unity among the phenomena we are examining. In this context, we have identified two key regulatory documents that govern the implementation of IGPA in the higher education system of the Republic of Kazakhstan:"

1) Regulations on the pilot mode implementation of the integrated GPA (including the Social GPA), approved by the Order of the Minister of Education and Science of the Republic of Kazakhstan dated June 20, 2022, No. 288.

2) Methodological recommendations for the assessment of student achievements considering the IGPA, approved by the Order of the Minister of Science and Higher Education of the Republic of Kazakhstan dated January 4, 2024, No. 2.

The second document is conceptually based on the provisions of the first and further develops the proposed model. Specifically, Section 1, Paragraph 5 of the Methodological Recommendations emphasizes the importance of the Integrated GPA as a tool that reflects the development not only of professional (hard) skills but also of "soft" skills:

"Education that develops 'soft skills' along with professional skills (hard skills) is aimed at the realization of all missions of the university…" (Methodological Recommendations, 2023).

Furthermore, Section 2, Paragraph 6 it is emphasized that the Methodological Recommendations establish "the procedure and organization for the assessment of students' research and social competencies through the Integrated GPA".

In addition, the document provides a list of criteria for assessing SSCI which includes:

- participation in peer-assisted learning;
- development of communication skills;
- demonstration of creativity;
- participation in sports and wellness activities;
- stimulation of intellectual growth;
- participation in public speaking.

Despite its broad scope, the presented list focuses primarily on aspects of social activity, correlating only partially with the concept of soft skills. It is worth noting that throughout the text of the document, up to the approximate scoring breakdown, the emphasis was placed on social competencies. We believe that such terminological looseness has led to the structural vagueness of the criteria mentioned above. Indeed, these concepts are not interchangeable, as social activity is an indicator of the development of certain social competencies manifested externally and observable in a person's actions, deeds, and behavior. Also, in our view, the criteria such as "demonstration of creativity," "development of communication skills," and "stimulation of intellectual growth" are somewhat debatable, as they serve as a foundational basis for the first, fourth, and sixth criteria. For example, creativity can significantly enhance the indicators of participation in both sports and wellness activities as well as public speaking, and so on.

We believe that the revision of the specified criteria should be aimed at structurally integrating them with soft skills, since soft skills can be appropriately interpreted as social competencies and are directly linked to social GPA (SSCI in terms of the document analyzed). Therefore, in our strong conviction, the criteria framework should include skills such as teamwork, mediation abilities, leadership qualities, stress resistance, empathy, emotional intelligence, and others. This would establish a methodological foundation for the appropriate assessment of students' social competencies, which, in turn, would ensure the selection and development of reliable assessment tools.

If we consider the officially accepted interpretation of the integrated GPA (IGPA) as a comprehensive evaluation encompassing academic performance (GPA), research skills (iROS) and social competencies (SSCI), we believe that evaluating social competencies in actual higher education practice in the country poses the greatest challenge. Altering the evaluation criteria for these competencies will necessitate a simultaneous revision of the assessment methodologies. In this regard, it can be confidently stated that pedagogical and psychological sciences possess a sufficiently rich arsenal of diagnostic methods.

The scale-up of the pilot initiative to implement an Integrated GPA, planned by the authorized body for science and higher education in Kazakhstan, may lead to a significant decline in student achievement metrics. Therefore, the concerns of many university academic service leaders regarding this initiative can be considered justified provided that a proper system encompassing all three key indicators is absent, from assessment tools to systematic documentation of results. It should be noted that the Kazakh scientific and educational community possesses considerable experience in evaluating academic achievements and equally strong skills in monitoring students' research practices. The situation is entirely different when it comes to social skills. Evidence of this was revealed in a rapid online survey of instructors from four Kazakh universities participating in the "Foreign Language: Two Foreign Languages" educational programs (Online survey "Soft Skills"). The results of this survey, along with their analysis and synthesis, are presented in a separate article prepared for open-access publication. In the present article, we will very briefly outline the consolidated findings, which are as follows:

–among the 94 respondents, an overwhelming majority (91.5%) confirm that "soft skills" are included in their educational programs;

–likewise, a large majority (90.4%) report that they assess these skills;

–responses to the third question indicate that teaching staff employ a variety of methods (e.g., essays, compositions, presentations, etc.).

However, based on the authors' experience (all of whom have extensive backgrounds in higher education) and individual interviews and discussions with colleagues, it has been found that the assessment of "soft skills" is not documented. In other words, there is a practical

foundation for evaluating social competencies within the integrated GPA framework, but it is fragmented and lacks a systematic approach.

A similar situation exists concerning student volunteering (a separate article is also being prepared based on a survey among students from several Kazakhstani universities): approximately half (41.8%) of respondents are unaware of or have only a general understanding of volunteering; an equal number (44.8%) are unaware of the volunteer movement at their university; and the overwhelming majority (82.1%) do not participate in the volunteer movement (Online survey "Student Volunteering").

To address the third objective, the following methods were applied: 1) mapping and visualization of bibliometric analysis results using VOSviewer software and data from the Scopus international abstract and citation database; 2) synthesis and systematization of findings from the first two research tasks, specifically: the relationship between the concepts of "soft skills" and "volunteering", their mutual influence, the interpretation of the term "integrated GPA," its components, and assessment methodologies with a focus on "social competencies" (SSCI); 3) analysis of the current situation based on rapid surveys with a representative sample, practical experience of the authors in the educational process, and brief interviews with university representatives (administration and faculty); 4) designing recommended mechanisms for integrating student volunteering, soft skills, and social competencies within the integrated GPA framework, based on the authors' interpretation and initiatives for structuring assessment criteria and SSCI.

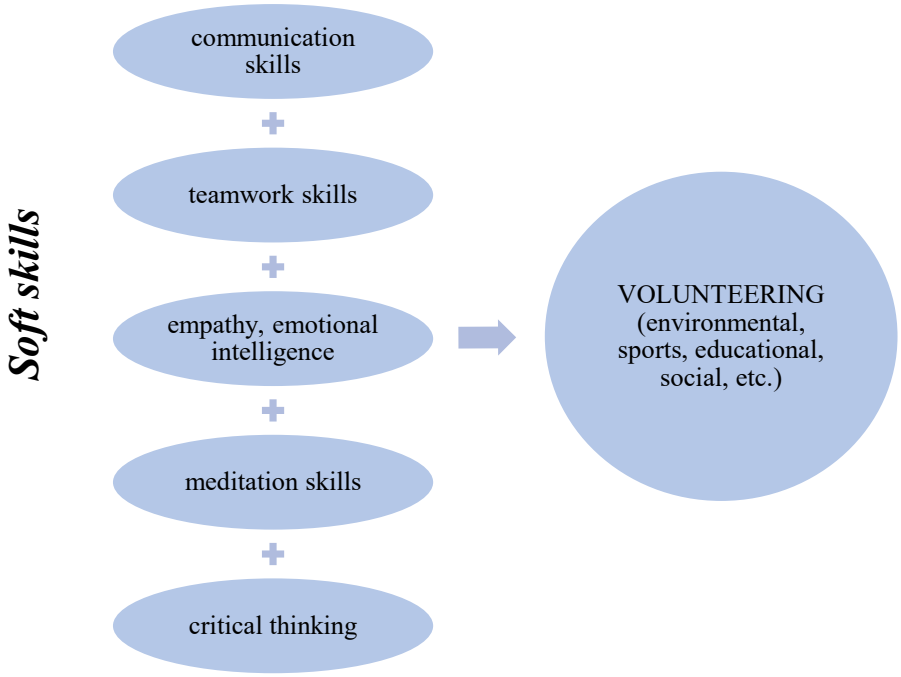
The entire research material obtained through the applied methods allows us to affirm the relevance of the issue under consideration, as well as the importance and significance of scientific efforts aimed at developing soft skills of students and promoting the principles of volunteering in higher education institutions of Kazakhstan.

Research results and discussion

Result one. The correlation between the concepts of "soft skills" and "volunteering" is determined by the fact that the latter is a kind of environmental tool for the development and strengthening of the first phenomenon. At the same time, the set of soft skills components is quantitatively broader and qualitatively more specific. In other words, to promote the values and principles of volunteering within the student community, it is imperative to first cultivate soft skills. These include: communication skills – the ability to establish constructive interactions in the majority of life situations, thereby serving as the foundation for effective teamwork; teamwork skills – achieving common goals both short-term and long-termthrough the fulfillment of individual responsibilities, which are determined by one's position (vertical: management subordination) and role (horizontal: equivalent and necessary functions); empathy and emotional intelligence – the capacity to understand the psycho-emotional state of communicants, allowing for temporary concessions in contentious situations and strict adherence to ethical standards in relationships; mediative skills – the ability to manage conflicts of varying levels, complexities, and types (both intrapersonal and interpersonal) that inevitably arise; critical thinking – the process of seeking information, conducting comprehensive analyses, and drawing well-founded, reasoned conclusions, accompanied by a healthy skepticism regarding the credibility of any information and the validity of one's own beliefs and positions.

Thus, the relationship between soft skills and volunteering can be visually represented as follows: all soft skills though varying in degree collectively form the foundation necessary for effective volunteer work (see Figure 1). Furthermore, participation in voluntary assistance requires additional personally and socially significant attributes, including interests and motivations, awareness, passion, activity, and both terminal and instrumental values, among others.

Figure 1
Soft skills as factors of successful volunteering



Such an approach, within the context of social GPA, provides a structure for its criteria that differs somewhat from that proposed in the aforementioned Methodological Guidelines for the implementation of integrated GPA.

On this basis, we propose the following criteria for assessing social GPA:

1) Participation in volunteer and social projects:
– number of hours engaged in volunteer activities;
– diversity of volunteer activity types;
– level of involvement (role type: participant, organizer, leader, coordinator);
2) Demonstration of soft skills:
– communication skills;
– teamwork skills;
– empathy and emotional intelligence;
– mediation skills;
– critical thinking;
3) Initiative and leadership:
– initiating one's own project (social, entrepreneurial, cultural);
– leading a group/initiative.
– presenting in student communities;
4) Public recognition and achievements:
– medals, diplomas, awards (creative and sports competitions, championships, tournaments, olympiads, accelerators, etc.);
– articles in mass media, posts in social networks, reports at public events.

Thus, we propose four criteria for evaluating the Social GPA (SSCI). All criteria align with the following principle:

Relevance and appropriateness. This means that all the criteria have been selected to serve the main goal of introducing the Social GPA in universities of Kazakhstan, namely:

"…preparing graduates for service to society by fostering active civic engagement, promoting the ideas of patriotism and labor for the benefit of the country, and involving youth in addressing socially significant issues…" (Drobizheva, 2014, p. 10). This also determines the relevance of implementing the Social GPA, which is aimed at monitoring students' contributions to the development of both their university and society as a whole.

Measurability. The first criterion is assessed using two quantitative and one qualitative indicator, all of which can be fully supported by factual materials (for example, a volunteer's diary/book with relevant records of participation in events; diplomas/certificates from competitive selection processes or expert evaluations of both volunteer and social projects, indicating the role performed, etc.). The second criterion requires a more complex evaluation system. Here, a triangulation method is necessary, i.e., the same indicator is measured using at least three different methods to independently confirm the results (Online survey "Student Volunteering"; Morgan, 2024). This method ensures the objectification of subjective opinions/assessments: self-assessment, feedback from the academic advisor and two or three faculty members who have taught the student over several semesters, psychological diagnostics, evaluations from internship supervisors at partner organizations, and peer opinions. Naturally, this requires formal documentation based on evaluation sheets. Thus, a psychological-pedagogical monitoring system is formed, the ongoing implementation of which becomes the responsibility of a designated structural unit within the university. Ultimately, this ensures an objective and informative (digital) student profile (Kostina et al., 2024; Zhetpisbayeva et al., 2022). As for the third and fourth criteria, their assessment procedures are largely similar to those used for the first criterion. The principle of measurability, if properly followed for all these criteria, eliminates ambiguous interpretations and ensures the objectivity of the evaluation.

Achievability. The alignment of the proposed criteria with this principle is reflected in their indicators and they can be achieved within the given timeframe, available resources, and existing conditions. Moreover, all indicators are already present in the real-life educational practices of modern universities in Kazakhstan. It is also worth noting that this principle is closely related to the principle of measurability.

Flexibility. This principle implies that the proposed criteria are not exhaustive; in other words, they can be regularly updated in terms of indicators, evaluation procedures, and assessment tools depending on social policies and the development priorities of both individual universities and the higher education system of the country as a whole.

Encouragement and motivation. All the proposed criteria, when applied in practice through the implementation of an integrated GPA, will undoubtedly contribute to increasing students' motivation not only for academic excellence but also for the development of their social competencies.

Overall, all the specified criteria are, to some extent, a priori, as they represent classical principles of the theory and practice of pedagogical measurement. These principles, though interpreted with a certain degree of authorial perspective, are logically and consistently relied upon by contemporary researchers and experts (Kosherbayeva & Kasymoyova, 2020; Kosherbayeva & Begimbetova, 2024; Gordienko, 2024).

Similarly, the criteria reflect fundamental pedagogical assessment principles that are consistently referenced albeit with individual interpretation by modern scholars and practitioners (Morgan, 2024; Kostina et al., 2024; Zhetpisbayeva et al., 2022).Thus, the assessment of the first, third, and fourth criteria (volunteering, initiative and leadership, public recognition and achievements) requires factual evidence (such as a volunteer's logbook or passbook, project reviews, presentation protocols, medals, certificates of merit, diplomas, or certificates). The second criterion, soft skills, requires the use of psychological testing tools

(for both self-assessment and peer review), independent references, or feedback from mentors and development trackers, as well as psycho-pedagogical observation.

To document this process, it is proposed to introduce assessment sheets, which at the initial stages of the expected large-scale implementation of the Integral GPA (IGPA) should be maintained by university teaching staff responsible for general education courses (History of Kazakhstan, Philosophy, Physical Education, Foreign Language, Kazakh/Russian Language, Cultural Studies, Sociology, Psychology, Political Science). At later stages, this process should involve the entire teaching faculty, including invited practitioners. We believe this approach will ensure not only the successful implementation of the IGPA system but also the promotion and support of initiatives aimed at engaging students with universal and national values.

All evaluations, in our opinion, can and should be analyzed in terms of the influence of the social GPA on students' academic and research achievements.

This proposal relates specifically to the assessment of the second criterion "Demonstration of Soft Skills." The remaining three criteria would be more effectively assessed by dedicated university services (academic, research, and social units) that support the core macro-processes of university education.

Furthermore, all evaluations should be integrated into platforms such as the AIS "Platonus." This automated information system, used by many universities in Kazakhstan, offers the necessary tools and capabilities to create a digital student profile with access for external stakeholders (such as employers and other relevant parties). The digital profile itself can include metrics for all components of the Integral GPA (IGPA).

Undoubtedly, all results should be recorded in quantitative terms (points, coefficients), which each university may define independently. These results should be officially documented in a student's individual portfolio at regular intervals (e.g., during midterm assessments at the end of each semester/trimester).

Conclusion

The research presented in this article allows for several key conclusions. Student volunteering is as a socio-pedagogical platform for the development of soft skills, and the integration of these elements has a direct impact on students' social GPA, thereby enhancing indicators of personal progress. The debate regarding the measurability of students' soft skills lacks strong justification, as contemporary science offers a broad array of psychological and pedagogical tools for effective assessment.

The results of the conducted research based on the results of the public discussion can be fully implemented in the practice of applying the social GPA in universities in Kazakhstan and serve to improve the regulatory framework for scaling the results of a pilot project to assess student achievements through the Integrated GPA (IGPA) model.

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Conflict of Interest Statement

The authors declare no potential conflicts of interest regarding the research, authorship, or publication of this article.

Author Contributions

Lyailya Syrymbetova: Writing - preparation of original project, Author supervision, Reviewing and editing, Project administration; Albina Garipova: Research, Conceptualization, Methodology, Resources; Aidana Shaimerdenova: Validation, Formal Analysis. Darya Khramykina: Data Collection, Visualization.

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