



Article

Artificial Intelligence Methods in Assessing Teacher's Professional Competencies

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Abstract: The article analyzes the methods of artificial intelligence for their application in the higher education system in order to assess the professional competencies of teachers. Generated a model for developing and evaluating professional competencies using artificial intelligence has been created. As a result of the study, it was concluded that the methods and tools of artificial intelligence can contribute to the continuous development a professional competencies of teachers, minimize subjectivity, and improve the effectiveness of assessing teacher's professional competencies. The prospects for using AI technologies in the higher education system of the Republic of Uzbekistan.

Keywords: Competence, Education, Artificial Intelligence, Model, Method, Machine Learning, Natural Language, Multimodal

1. Introduction

AI helps schools identify and develop teachers with strong professional competencies has revolutionized modern classrooms in a short period. AI is generally referred to as a group of computational techniques that imitate the thought process of humans to address challenging problems. The incorporation of artificial intelligence technologies in higher education is consistent with global trends toward digitalization and data-driven decision-making. Theoretical underpinnings for the use of AI to infer teaching effectiveness include concepts such as competence-based education, learning analytics, and intelligent systems [1]. These methods focus on more objectivity, scalability, and lifelong learning and development for the people involved.

Machine learning, natural language processing, and multimodal AI are becoming increasingly utilized in contemporary written assessment. Predictive analysis of teaching outcomes is made possible by machine learning, while the communication and instructional quality can be evaluated with the help of textual data through natural language processing (NLP). Multimodal models take this a step further and combine video, audio, and behavioral data into a more complete description of affect. Yet, the literature is revealing a major gap: a lack of national education system-specific models of the best practices, especially in contexts in the developing world. Different from differentiated methods, which are the focus of previous studies, we posit a framework that combines not only corpus design, development and movement to advanced language capabilities, but also complementary languages, ethical principles and data access programs.

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The study is theoretical and analytical, focusing on AI methods, and providing a macro model for measuring teacher professional competencies [2]. Combining multiple artificial intelligence approaches is expected to aggregate the benefits of assessing plagiarism, provide less subjective assessment solutions, and continue to help in designs for personalized professional development. The results intend to show the usefulness of hybrid AI systems and their relevance to higher education. These findings have significant implications for standards and capacities in relation to evaluation, informing policy development, and setting out priorities to reform education systems digitally.

There is various AI methods currently used in various fields and areas of human activity, as shown in the figure below [3] (Figure 1).

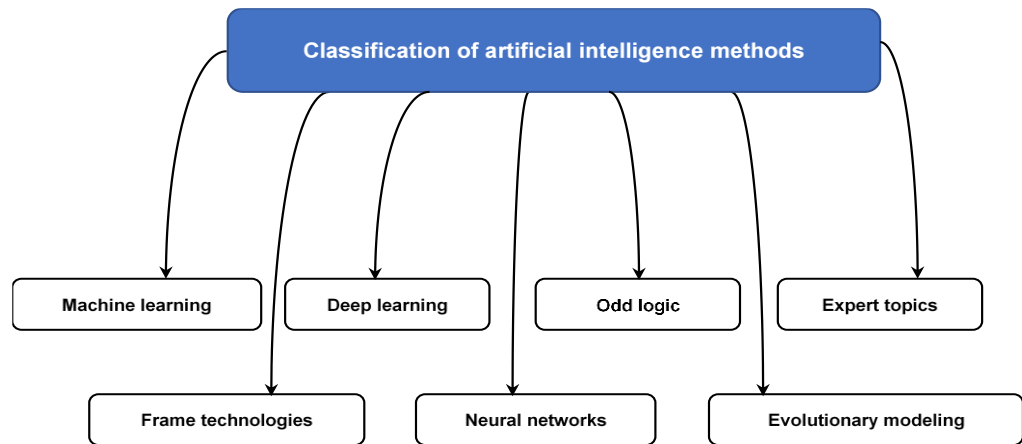


Figure 1. Classification of Artificial Intelligence Methods

2. Methodology

This research uses a qualitative analytic and modeling approach to identify how some of the artificial intelligence methods can be used to evaluate the professional competence of teachers in a higher education setting. This methodology rests on a systematic review and synthesis of literature from theoretical sources, empirical finds and related practices of artificial intelligence (AI) in education. The study explores core AI methods (machine learning, natural language processing, and multimodal artificial intelligence) as analytical methods for handling a variety of education data (student performance metrics, learning management system data, learning resources, and other audiovisual data). This research synthesizes these methods into a single conceptual framework in order to assess their functional characteristics, strengths, and weaknesses for competency assessment.

Lastly, the approach is operationalized in the form of a structural model comprising four consecutive stages: diagnostic, development, evaluation, and rectification [4]. AI tools work with quantitative data and qualitative data to identify competency level during the diagnostic stage. Generative AI systems generate individualized recommendations and pedagogical content for educators during the design phase. During the evaluation phase, analytics are automated to assess progress and provide feedback, and the adjustment phase provides a data-driven continuous improvement cycle of continual adjustments to improve performance. A comparative analysis serves to evaluate the performance of each AI method (individual and hybrid) against specific criteria, including accuracy, objectivity, scalability, and reduction of bias.

The methodological framework also includes contextual influences unique to the higher education system, such as multilingual contexts, compliance with data protection regulations, and information technology architecture [5]. Specifically, this combined perspective allows for a thorough assessment of AI-based proficiency measurement

systems and aids their translation into educational practice, guaranteeing theoretical robustness as well as application-oriented validation.

3. Results and Discussion

Currently, the leadership of the Republic of Uzbekistan is taking effective measures to introduce AI methods into the country's education system. Artificial intelligence methods are widely used to assess the professional competencies of teachers in higher educational institutions, taking into account the specific features of the higher education sector in the Republic of Uzbekistan.

Let's consider some specific methods of artificial intelligence for their possible use in assessing the professional competencies of teachers at higher educational institutions.

In the education system of advanced countries, machine learning is widely used to assess teacher's professional competencies. Machine learning, as a method of artificial intelligence, involves the use of algorithms that are trained on available data to identify patterns and predict outcomes without direct programming. In terms of assessing the professional competencies of higher education institution teachers, machine learning is used to analyze large amounts of data on teaching activities, such as student test results, engagement metrics (e.g., the time students spend viewing educational and reference materials), and individual teacher reports. Machine learning algorithms, including neural networks and random clustering algorithms, allow for the classification of professional competencies into levels (low, medium, high) and the generation of personalized development recommendations (Figure 2).

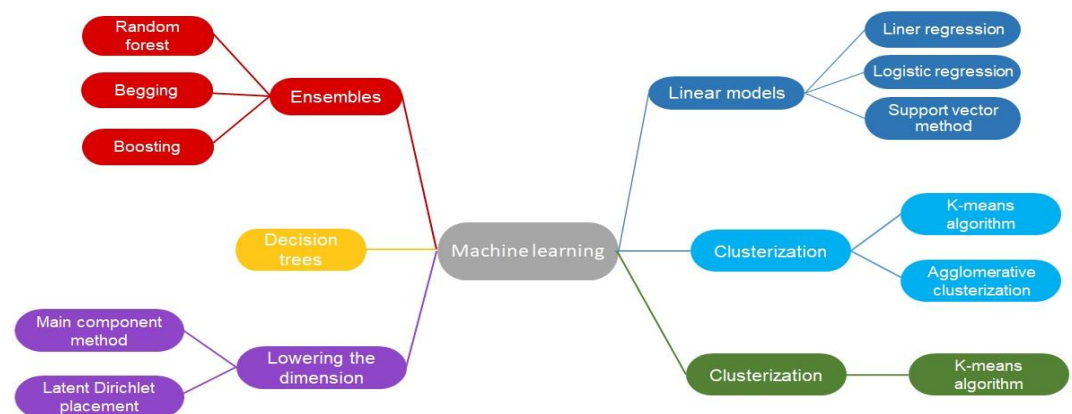


Figure 2. Structural and logical diagram of machine learning

In higher education institutions of the Republic of Uzbekistan, machine learning can be integrated through AI modules into platforms such as HEMIS (Higher education management information system). At the same time, the system will expand the possibilities for high-quality and quick assessment of the activities of both students and teachers. For example, the system will be able to analyze performance data: if a teacher updates a course on a discipline less frequently than the average for a higher education institution, machine learning will identify a lack of professional competencies in "adaptability to digital innovations" and suggest taking online courses in pedagogy. According to a study on teacher readiness for the era of artificial intelligence, machine learning promotes a balance between technological skills and socio-cultural aspects, improving assessment accuracy by 40-60%. The SmartED project, launched in the Republic of Uzbekistan in 2025, focused on implementing modern teaching methods, developing relevant educational programs, and enhancing the practical component of education. As part of this project, machine learning is used to monitor a teacher's professional

competencies by analyzing data on their professional development, which allows for automated certification and identification of skill gaps, such as the use of AI tools in teaching. The advantages of machine learning include scalability and objectivity, but the challenges include the need for large datasets and data protection, which is especially important for higher education institutions in the Republic of Uzbekistan, given the national standards for information security [6].

Another artificial intelligence method used in the assessment of professional competencies is natural language processing (NLP). This method focuses on the analysis and generation of human language, including speech recognition, semantic analysis, and key content extraction. When evaluating teacher's professional competencies, NLP is used to process text data, such as lesson plans, essays, student feedback, and research publications. NLP algorithms, such as transformers (e.g., BERT or GPT models), evaluate the quality of the presentation, the level of terminology proficiency, and the level of communication, assigning scores to the professional competencies of "communicative competence" or "methodological literacy" [7][8] (Figure 3).

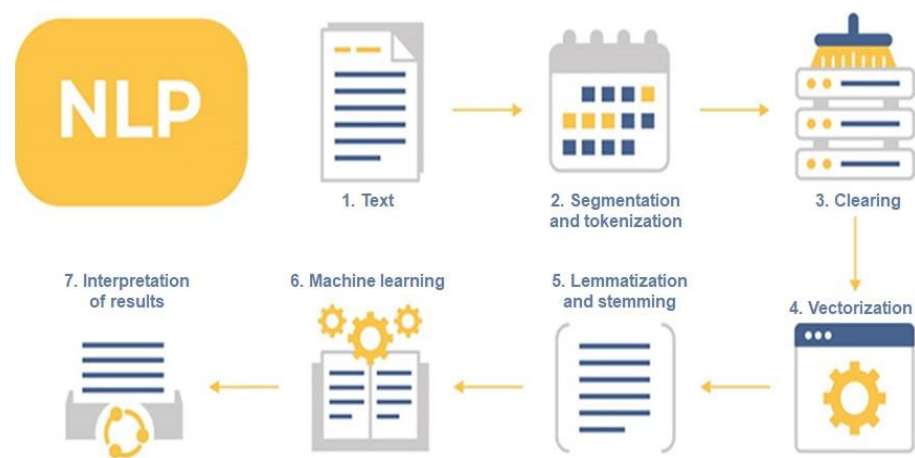


Figure 3. Structural and logical diagram of the natural language processing (NLP) method

In the context of the Republic of Uzbekistan, NLP tools can be adapted to a multilingual environment (uzbek, karakalpak, russian, and english) by integrating them into systems like GigaChat or local alternatives. For example, NLP can analyze student feedback in questionnaires, identifying patterns such as "effectiveness of explanations" or "innovative approaches" and correlate them with a teacher's self-assessment. A study on the application of NLP in language teaching emphasizes that NLP improves feedback, contributing to the continuous development of a teacher's professional competencies. In higher educational institutions of the Republic of Uzbekistan, NLP tools can be used to assess communicative professional competencies by analyzing lecture texts and generating recommendations for their improvement. The advantages include the automation of routine text analysis, but this method also has some limitations, such as the need to consider local dialects and ethical considerations, as well as the potential for bias in the models [9] (Figure 4).

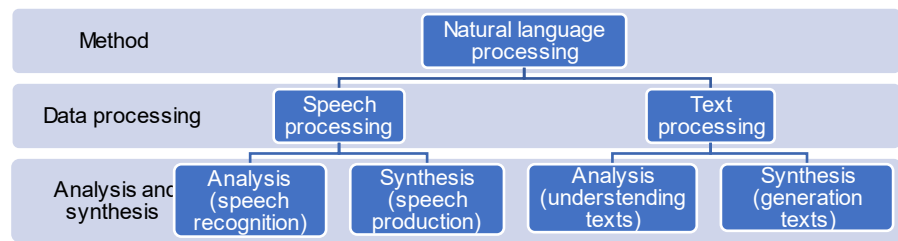


Figure 4. Block diagram of the natural language processing (NLP) method

Next, we will consider a multimodal artificial intelligence model as a tool for assessing professional competencies. Multimodal artificial intelligence combines multiple types of data (text, images, videos, audio, and sensor data) for comprehensive analysis using models like CLIP or multimodal transformers. In the assessment of professional competencies, this method allows for the integration of diverse sources: video tutorials for analyzing gestures and intonation, audio recordings for evaluating speech, and slide images for checking visual presentation. Multimodal analysis identifies complex professional competencies, such as “motivation skills” (based on video) or “multimedia integration” (based on data combination) [10] (Figure 5).

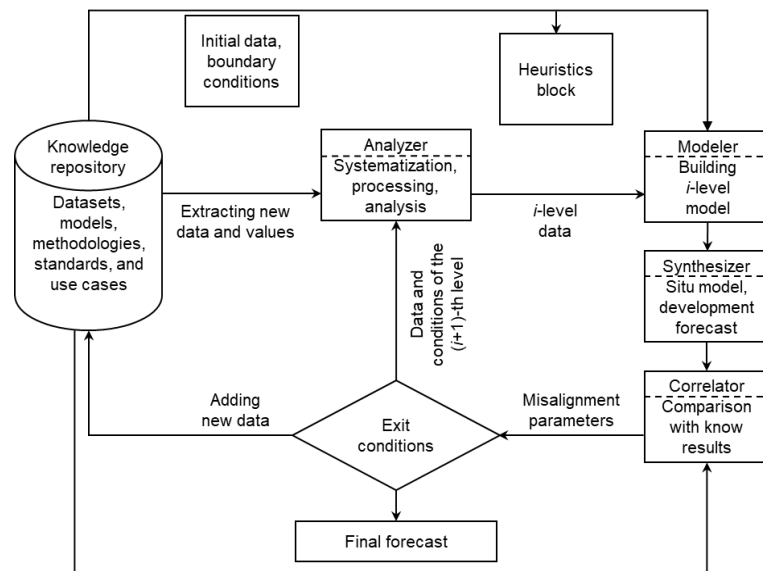


Figure 5. Structural and logical diagram of the multimodal AI method

Multimodal artificial intelligence can be used in projects like AI-powered multimedia studios to assess a teacher’s professional competencies by analyzing lesson recordings. For example, the system can process a video of a lecture, extracting data about interaction (gestures, pauses), and correlating it with the text of the lecture notes to assess its “pedagogical effectiveness”. When using a multimodal artificial intelligence model to assess the professional competencies of teachers in the era of artificial intelligence, it is necessary to maintain a balance between technological and socio-cultural skills. This model can be used to train foreign language and information technology teachers by evaluating their professional competencies through a combined analysis. The advantages are a holistic (integrated, holistic) approach that increases accuracy by 30-50%. It should be noted that the use of this model presents several challenges, such as data integration and privacy concerns, especially when considering GPS and other geodata systems. In general, multimodal artificial intelligence can contribute to the formation of a universal portfolio of professional competencies for modern teachers, adapted to the process of digitalization of education in the Republic of Uzbekistan [11]. The comparison of the above

methods (models) in terms of their effectiveness is shown in table 1.

Table 1. Development and evaluation of a model for the professional competencies of a teacher using artificial intelligence

Method	Key performance indicators	Limitations
Machine learning	Accuracy of performance prediction: 82-87% (based on academic performance and LMS data). - Reduction of analysis time by 50-65%.	Dependence on the quality of input data; risk of bias due to insufficient sample size.
NLP	Text analysis accuracy: 85-88%. - Identification of hidden problems in methods (sensitivity 80%).	Limited ability to consider contextual nuances (sarcastic remarks, cultural specifics).
Multimodal AI	Correlation with expert assessments: $r = 0.75-0.81$. - 40% reduction in subjectivity in assessing engagement.	Ethical risks (biometric data); high requirements for IT infrastructure.
Hybrid systems	Increased consistency of ratings ($\kappa = 0.68$ vs 0.41). - Reduced gender bias by 31%.	The need for constant expert participation; high organizational costs.

In the context of the digitalization of higher education in the Republic of Uzbekistan, which is taking place in accordance with Presidential Decree No. UP-5847 dated 08.10.2019 "On Approval of the Concept for the Development of the Higher Education System of the Republic of Uzbekistan until 2030", artificial intelligence is becoming a key tool for assessing and developing professional competencies [12].

Multimodal artificial intelligence is a technology that integrates multiple types of data (text, images, audio, video, and sensor data) for comprehensive content analysis and generation. It differs from traditional large language models (LLMs), such as GPT-3, in its ability to handle diverse modalities, allowing for the identification of complex relationships between them [13].

Benefits of using multimodal artificial intelligence:

Increased engagement: models like Gemini (Google) or GPT-4 (OpenAI) generate interactive content that combines text and visuals, promoting the development of creative professional competencies in educators.

Assessment of professional competencies: CLIP-type systems analyze images and text to evaluate educational materials, identifying inconsistencies and suggesting improvements.

Self-development: free models such as LLaMA 3.2 (Meta) or Pixtral 12B (Mistral AI) allow educators to experiment with content generation, developing their technological competence [13].

In the Republic of Uzbekistan, the digitalization of higher education is provided for in the Innovative Development Strategy for 2022-2026, approved by Presidential Decree No. UP-165 dated July 6, 2022. Therefore, multimodal artificial intelligence can be used to assess professional competencies by analyzing lectures (video + text), as in the GigaChat system, which generates lesson plans and visual content [11]. Table 2 compares traditional LLMs and multimodal AI.

Table 2. Difference between LLMs and multimodal AI

Aspect	Traditional LLMs (e.g., GPT-3)	Multimodal artificial intelligence (e.g., GPT-4)
Data processing	Text only	Text, images, audio, video
Computational complexity	Average	High (requires GPU)
Application in education	Text generation	Personalized lessons with visuals
Advantages for the teacher	Automating time-consuming work	Developing creativity and appreciation

Generative artificial intelligence is a technology that creates new content based on big data, contributing to the development of high-tech sectors in various fields. In education, generative artificial intelligence is a driver of innovation, helping educators create materials and assess themselves.

Based on the analysis conducted, we can identify key areas for the possible application of generative artificial intelligence in the Republic of Uzbekistan for the development of professional competencies of a higher education institution teacher:

Content generation: models like DALL-E create images for lessons, developing creative competence [13];

Assessment automation: GigaChat-like systems analyze student responses, freeing up time for the teacher's self-development [11];

Overcoming barriers: in the context of possible sanctions, a national model of generative artificial intelligence, similar to YandexGPT, will ensure technological sovereignty [11];

Risks: dependence on technology, ethical issues (such as plagiarism), and the need for digital literacy. According to surveys conducted in the Russian Federation in 2023, 40% of teachers use generative artificial intelligence for training, while 12% of students abuse it for cheating [15].

The advantages and risks of generative artificial intelligence in assessing professional competencies are listed in table 3.

Table 3. The advantages and risks of generative artificial intelligence in assessing

Advantages	Risks
Reducing the time spent on solving time-consuming tasks	Dependence on technology
Personalization of assessment	Ethical issues (deepfakes)
Access to knowledge	Lack of communication
Adaptability	Slow skill development

The proposed model for developing and evaluating professional competencies using AI in the higher education system of the Republic of Uzbekistan.

The model includes stages:

Diagnostic: AI-analyzes data (tests, video tutorials) to identify the level of professional competencies (multimodal analysis).

Development: generation of personalized tasks (generative artificial intelligence, similar to GigaChat).

Evaluation: automated feedback with recommendations.

Adjustment: Data-based self-regulation.

To achieve the intended goals and increase the efficiency and objectivity of assessing a teacher's professional qualities at various stages, it is necessary to use certain artificial intelligence tools, which are listed in table 4.

Table 4. Usage of different AI tool in different stages for different goals

Stage	AI tools	Goal
Diagnostics	CLIP, GPT-4	Identifying gaps
Development	DALL-E, GigaChat	Generation of materials
Evaluation	IBM Watson	Analysis of the results
Adjustment	Pixtral	Personal recommendations

However, the implementation of artificial intelligence models in the system for assessing a teacher's professional competencies requires consideration of existing issues. All current artificial intelligence models do not support the Uzbek language at an expert or analytical level. Given the rapid changes in the geopolitical situation in the world and the lack of a national AI model, there is a risk of bans and restrictions on the use of existing AI models.

4. Conclusion

Based on the above and the results of the analysis, the following conclusions can be drawn:

artificial intelligence methods and tools (Google Vertex AI, ChatGPT, etc.) can contribute to the continuous development of teacher's professional competencies;

the use of artificial intelligence methods and models in assessing a teacher's professional competencies helps to minimize subjectivity;

the use of artificial intelligence methods and models in assessing teacher's professional competencies will increase the effectiveness of assessment in the context of digital transformation of education in the Republic of Uzbekistan.

As a result of the conducted research, a model for applying artificial intelligence in the higher education system of the Republic of Uzbekistan has been developed, which can contribute to the implementation of the Higher Education Development Concept until 2030. The developed model can ensure the self-development of teachers in the context of ongoing digitalization. As recommendations, it is proposed to pilot the implementation of the developed model of using artificial intelligence to assess the professional competencies of a teacher at a higher educational institution in the Republic of Uzbekistan, with consistent monitoring of its effectiveness.

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