

**TRANSFORMING HISTORY EDUCATION WITH ARTIFICIAL  
INTELLIGENCE: OPPORTUNITIES AND CHALLENGES IN TEACHING  
ANCIENT KHWAREZM AND KHWAREZMIAN MATERIALS**

**Rustamova Hilola Xamro qizi**

Lecturer of History of Science in  
Uzbekistan at Alkharizmi university  
+998 93 468 25 07

[h.rustamova@akhu.uz](mailto:h.rustamova@akhu.uz)

<https://orcid.org/0009-0000-8844-5810>

**Rustamov Rahimbergan Hamroyevich**

Master's Student, Urgench State University  
named after Abu Raykhon Beruni,

Software engineering faculty

[rahimbergan121@gmail.com](mailto:rahimbergan121@gmail.com)

+998 94 899 53 00

**Annotatsiya.** Ushbu maqola sun'iy intellekt (AI) ning moslashuvchan o'quv tizimlari, aqlli o'qituvchi tizimlari va o'quv analitikasi orqali qadimiy Xorazmshunoslikdagi qiyinchiliklarni bartaraf etishdagi potensialini o'rganadi. U matnni tiklash va tilni qayta ishlash uchun ChatGPT hamda Ithaca modellari imkoniyatlarini ko'rib chiqadi, UNESCO ramkalariga muvofiq tarafdashlik va maxfiylik kabi axloqiy muammolarni baholaydi hamda raqamli epigrafiya uchun mas'uliyatli joriy etishni tavsiya qiladi.

**Abstract.** This paper examines AI's potential through adaptive learning systems, intelligent tutoring systems, and learning analytics to overcome challenges in ancient Khwarezmian studies. It reviews ChatGPT and Ithaca for text restoration and language processing, assesses ethical concerns like bias and privacy per UNESCO frameworks, and recommends responsible implementation for digital epigraphy.

**Аннотация.** Данная статья исследует потенциал искусственного интеллекта (ИИ) посредством адаптивных систем обучения, интеллектуальных обучающих систем и аналитики обучения для преодоления вызовов в древнехорезмийских исследованиях. Она рассматривает ChatGPT и Ithaca для восстановления текстов и обработки языка, оценивает этические проблемы, такие как предвзятость и конфиденциальность, в соответствии с рамками ЮНЕСКО и рекомендует ответственное внедрение для цифровой эпиграфики.

**Kalit so'zlar:** ta'limdagi sun'iy intellekt, moslashuvchan o'quv tizimlari, aqlli o'qituvchi tizimlari, qadimiy Xorazm, xorazmiy epigrafiya, matnni tiklash, raqamli gumanitar fanlar, tarix pedagogikasi

**Keywords:** artificial intelligence in education, adaptive learning systems, intelligent tutoring systems, ancient Khwarezm, Khwarezmian epigraphy, text restoration, digital humanities, history pedagogy

**Ключевые слова:** искусственный интеллект в образовании, адаптивные системы обучения, интеллектуальные обучающие системы, древний Хорезм, хорезмийская эпиграфика, восстановление текста, цифровые гуманитарные науки, педагогика истории

## **Introduction**

The rapid advancement of artificial intelligence (AI) in education is reshaping higher learning through adaptive learning systems, intelligent tutoring systems (ITS), and learning analytics. These technologies enable personalised, data-driven teaching and learning at scale, allowing educators to tailor content, deliver real-time feedback, and generate actionable insights into student performance. In university settings, AI-driven tools can dynamically adjust instructional materials and enhance both teaching effectiveness and learning outcomes.

Within history education, these developments are particularly significant. University-level history courses serve highly diverse student populations: specialists require deep engagement with primary sources, historiography, and critical analysis, while non-specialists often need support to develop interest, contextual understanding, and connections to contemporary issues. However, the integration of AI into history education also raises important ethical and pedagogical concerns. Issues such as algorithmic bias, data privacy, equity of access, and academic integrity must be addressed proactively. Without appropriate safeguards, AI systems risk reinforcing existing inequalities or undermining the interpretive and critical nature of historical inquiry [Sevnarayan, 2024]. Responsible implementation therefore requires adherence to established ethical frameworks, such as those outlined by UNESCO, which prioritise inclusivity, transparency, and human-centred design [UNESCO, 2025].

## **Methods**

The study of ancient Khwarezm, centred in the historical region of Khwarezm, presents unique pedagogical challenges. The surviving corpus of primary

sources in the Khwarezmian language—primarily inscriptions, administrative documents, and fragmentary manuscripts—is limited, linguistically complex, and often inaccessible to non-specialist students. At the university level, this creates a dual difficulty: history specialists require intensive training in philological analysis and source criticism, while non-specialists frequently struggle with materials that are both linguistically and contextually distant from their prior knowledge. Traditional teaching approaches, constrained by limited resources and time, are frequently inadequate for such diversity.

AI technologies offer a promising pathway to bridge these gaps. Adaptive learning systems can support the acquisition of Khwarezmian language skills by adjusting to individual proficiency levels, while intelligent tutoring systems can guide students through the analysis of primary sources with contextual annotations and interactive feedback. Learning analytics enable instructors to monitor engagement with complex materials and identify areas requiring targeted intervention. In this context, AI not only improves access to rare and difficult sources but also fosters the development of core historical skills, including textual interpretation, comparative analysis, and evidence-based reasoning.

Thousands of inscriptions have survived, yet many are damaged, fragmentary, or displaced from their original locations. Radiocarbon dating is ineffective for most inorganic supports, leaving specialist epigraphers to reconstruct missing text—a labour-intensive process known as text restoration. Epigraphers rely on extensive repositories of textual and contextual parallels, a task that demands considerable time and source study. AI tools are increasingly valuable here, as they can accelerate the identification of parallels while simultaneously supporting the development of students' source-analysis skills [Assael et al., 2022].

## **Results**

Recent evaluations of generative AI tools demonstrate varying levels of proficiency with ancient languages. Most widely used models, including ChatGPT-3.5/4/4o, Claude-2/3, Google Gemini, and Microsoft Copilot, perform at an intermediate level with Ancient Greek and Latin. Since gaining widespread popularity in November 2022, these tools have improved dramatically in their handling of classical languages [Baines and Ross, 2024]. Their capacity to generate accurate recommendations for secondary literature and to suggest relevant sources can significantly reduce the time students and instructors spend searching for materials—often by half—making them valuable supplementary resources for both teaching and research.

However, the performance of these tools with ancient Iranian languages, and specifically ancient Khwarezmian, remains largely unexamined and offers substantial room for improvement. In parallel, new AI architectures for textual restoration and contextual prediction have emerged since the early 2020s. One prominent example is Ithaca, a deep neural network designed to perform simultaneous textual restoration, geographical attribution, and chronological attribution. Trained on a large corpus of ancient Greek inscriptions from the seventh century BCE to the fifth century CE, Ithaca leverages the variability and digitised availability of Greek epigraphic data to achieve strong results in language processing tasks [Assael et al., 2022].

## **Discussion**

The development and deployment of AI tools tailored to ancient Khwarezmian studies represent a promising future direction for history, digital humanities, and epigraphy. Such tools could address chronic shortages of financing and specialised human resources in these fields by democratising access to complex primary sources and accelerating philological training. By combining adaptive learning pathways with advanced text-restoration capabilities, AI has the potential to transform how both specialist and non-specialist students engage with Khwarezmian material.

Nevertheless, several shortcomings and limitations must be acknowledged. Current generative AI models remain heavily dependent on well-resourced languages with extensive digitised corpora; ancient Khwarezmian, with its sparse and fragmented sources, lacks the training data necessary for high-accuracy performance. This data scarcity risks producing unreliable restorations or biased interpretations that could mislead learners. Additionally, while AI excels at pattern recognition and source recommendation, it cannot yet replicate the nuanced human judgement required for historical contextualisation, cultural interpretation, or ethical source criticism. Over-reliance on AI could inadvertently diminish students' development of independent critical thinking.

Ethical concerns further complicate implementation. Algorithmic bias, privacy risks associated with student data, and unequal access to advanced AI tools may exacerbate existing educational inequalities. Academic integrity issues—particularly regarding AI-generated content—also require clear institutional policies. To mitigate these shortcomings, future initiatives should prioritise the creation of open, high-quality Khwarezmian corpora, adopt transparent and auditable AI systems, and maintain a human-centred approach in line with UNESCO guidelines. Collaborative efforts between historians, linguists, computer scientists, and educators will be essential to realise the full pedagogical potential of AI while safeguarding the interpretive integrity of historical inquiry.

## References

1. Assael, Y., Sommerschild, T., Shillingford, B., Bordbar, M., Pavlopoulos, J., Chatzipanagiotou, M., Androutsopoulos, I., Prag, J. and de Freitas, N. (2022) 'Restoring and attributing ancient texts using deep neural networks', *Nature*, 603(7900), pp. 280–283. doi: 10.1038/s41586-022-04448-z.

2. Baines, J. and Ross, E.A.S. (2024) 'Using generative AI to support ancient language teaching', *CUCD Bulletin*, 53. Available at: <https://cucd.blogs.sas.ac.uk/files/2024/09/BainesRoss-AI.pdf> (Accessed: 8 April 2026).

3. Sevnarayan, K. (2024) 'Exploring the dynamics of ChatGPT: Students and lecturers' perspectives at an open distance e-learning university', *Journal of Pedagogical Research*, 8(2), pp. 212–226. doi: 10.33902/JPR.202426525.

4. UNESCO (2025) *AI and education: protecting the rights of learners*. Paris: UNESCO. Available at: <https://doi.org/10.54675/ROQH4287> (Accessed: 8 April 2026).

5. Garz, A., Eichenberger, N., Liwicki, M. and Ingold, R., 2014. Hisdoc 2.0: Toward computer-assisted paleography. *Manuscript Cultures, Natural Sciences and Technology in Manuscript Studies*, 7. [https://scholar.google.com/scholar\\_lookup?&title=HisDoc%202.0%3A%20toward%20computer-assisted%20paleography&journal=Manuscr.%20Cult.&volume=7&pages=19-28&publication\\_year=2015&author=Garz%2CA&author=Eichenberger%2CN&author=Liwicki%2CM&author=Ingold%2CR](https://scholar.google.com/scholar_lookup?&title=HisDoc%202.0%3A%20toward%20computer-assisted%20paleography&journal=Manuscr.%20Cult.&volume=7&pages=19-28&publication_year=2015&author=Garz%2CA&author=Eichenberger%2CN&author=Liwicki%2CM&author=Ingold%2CR)