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THE IMPACT OF ARTIFICIAL INTELLIGENCE ON THE DEVELOPMENT OF PHILOLOGICAL RESEARCH: OPPORTUNITIES AND LIMITATIONS OF MODERN AI TECHNOLOGIES IN LINGUISTICS

Annotation. The advancement of artificial intelligence is increasingly reshaping the landscape of philological research, offering novel opportunities for the analysis of texts, languages, and cultural traditions. This article examines the outcomes of an interdisciplinary investigation based on 27 projects undertaken at German universities between 2020 and 2024, aimed at integrating AI technologies into philological practice. Through the application of quantitative and qualitative methodologies, case study analysis, and data triangulation, the study highlights both the potential of AI to expedite corpus processing and reveal latent patterns, and the critical risks associated with the erosion of cultural context and the insufficient reflexivity of researchers. Special emphasis is placed on ethical considerations surrounding the use of AI in the humanities, as well as the pivotal role of interdisciplinary collaboration in enhancing the functionality of digital tools. The findings underscore the necessity of maintaining a critical and informed dialogue between humanistic scholarship and technological innovation.

Keywords: philology; artificial intelligence; digital humanities; linguistics; corpus analysis; ethical dimensions of AI; interdisciplinary collaboration; machine learning; cultural context; textual analysis.

Introduction

Contemporary philology is undergoing a profound transformation under the influence of artificial intelligence (AI), offering new opportunities for the analysis of texts, dialects, and cultural patterns. The active integration of AI technologies into linguistics, initiated by the work of international researchers, highlights the potential of a symbiotic relationship between the humanities and technical disciplines. For instance, David Blei and his colleagues pioneered topic modeling (LDA), which has become foundational for the analysis of literary corpora [1], while Christopher Manning significantly advanced natural language processing (NLP) through the development of Stanford CoreNLP, widely applied for syntactic parsing of historical texts [2]. Research by Joachim Schulze in the field of digital German studies underscores the role of AI in the preservation of linguistic heritage [3], whereas Margaret Mitchell critically examines the ethical risks associated with generative models in the humanities [4].

German universities, as demonstrated by cases from 2020 to 2024, have served as experimental grounds for testing hybrid methodologies that combine machine learning techniques with philological expertise. However, the lack of studies that systematically consolidate the outcomes of such interdisciplinary collaborations underscores the relevance of the present research. The primary objective of this article is to identify patterns in the integration of AI into philological research and to assess the effectiveness of interdisciplinary approaches [5]. The methodology is based on the analysis of 27 projects employing a mixed-methods design (quantitative-qualitative), data triangulation, and comparative case studies.

Materials and types of research

The present study is based on a comprehensive analysis of 27 interdisciplinary projects carried out at German universities between 2020 and 2024. Three types of materials formed the empirical foundation for this research. First, text corpora were utilized, comprising historical manuscripts (notably, fragments of medieval codices), dialect recordings from regional archives, and contemporary literary works, with a cumulative volume of approximately 15 million tokens. Second, technological datasets were analyzed, including AI system log files that recorded neural network training processes, NLP model performance metrics (F1-score, accuracy, perplexity), as well as the results of A/B testing that compared the effectiveness of "pure" AI-based analysis against expert-machine collaborative approaches. Third, a corpus of expert interviews was examined, consisting of 45 in-depth interviews with philologists and 22 structured interviews with AI developers from leading German universities; all transcripts underwent anonymization and thematic coding procedures.

The methodological design of the study employed a mixed-methods approach, combining quantitative and qualitative strategies, with a particular emphasis on case study methodology and comparative analysis. For processing textual data, methods of corpus linguistics and machine learning were applied, while the interpretation of findings was guided by hermeneutic analysis and phenomenological inquiry. This synthesis enabled the identification of statistical patterns while preserving the cultural and historical context of the studied materials.

Justification for the chosen methods:

1. Case studies were employed to explore the unique experiences of specific projects in detail (e.g., the AI-assisted reconstruction of fragments from the Nibelungenlied).
2. Comparative analysis was used to identify patterns in different universities' approaches to AI integration.
3. Data triangulation was applied to cross-validate findings by correlating technological metrics, expert assessments, and traditional philological analysis.

Such a methodological framework ensured a balance between the breadth of data coverage and the depth of interpretation, which is particularly crucial for research situated at the intersection of the humanities and technical sciences.

Research questions

1. How do AI technologies impact the accuracy and depth of philological analysis compared to traditional research methods?
2. What ethical and methodological risks emerge in the integration of AI into linguistic studies?
3. How does interdisciplinary collaboration between philology and computer science enhance the development of specialized AI tools?

Participants

The study encompassed two principal groups of specialists. The first group comprised 68 philologists from German universities, including professors, associate professors, and doctoral researchers, each with a minimum of five years of professional experience in linguistics, textual studies, and digital humanities. The second group included 34 AI developers directly engaged in the design and implementation of technological tools for philological applications. To strengthen the validity of the findings, a control group of 20 researchers—who intentionally refrain from incorporating AI technologies into their academic practices—was also involved. Participant selection adhered to rigorous criteria: all individuals were required to have published in peer-reviewed journals on topics related to digital linguistics within the past three years. This sampling strategy ensured both the representativeness of the data and the ability to conduct a meaningful comparison between traditional and technology-driven research approaches.

Tools

A range of specialized technological solutions was employed in the study. For automatic text analysis, enhanced versions of BERT models were used, adapted to recognize archaic vocabulary. These models achieved an accuracy rate of 87% in identifying historical forms of the German language. Dialect transcription was conducted using modified versions of the Whisper ASR system, which demonstrated 78% accuracy in transcribing Low German dialects [6]. A particular point of interest was the hybrid tool “Text+Context,” which combined statistical methods (TF-IDF, clustering) with manual expert annotation. To work with multimodal data (audio, video, text), a unique platform was developed to synchronize linguistic analysis with cultural context [7].

Procedure

The study was structured as a multi-stage process. At the first stage, interdisciplinary teams of 3 to 5 members were formed, with each participant responsible for a specific aspect of the work—from digitizing manuscripts to algorithm configuration. Subsequently, the materials were pre-processed: medieval manuscripts were scanned, orthography in dialect texts was normalized, and audio recordings of oral speech were segmented. Special attention was given to “blind” testing: both AI analysis and traditional expert review were conducted in parallel to exclude mutual influence on the results. At the final stage, independent reviewers (who had not participated in the project) compared the conclusions, documenting both the matches and significant discrepancies between the machine and humanities-based methods.

Data analysis

The quantitative methods involved comparing accuracy metrics— for instance, the F1-score for literary genre classification was 0.91 for AI, compared to 0.89 for experts. Cluster analysis of semantic fields using the DBSCAN algorithm revealed patterns that were not immediately apparent during manual processing. The qualitative component relied on thematic coding of interviews in NVivo 12, identifying 17 recurring themes, ranging from “loss of cultural context in automated analysis” to “revolution in lexicography.” Particularly striking were cases where AI errors (such as incorrect dialect attribution) led to a re-examination of established scientific paradigms. Through content analysis, it was found that 68% of philologists consider it essential to visually highlight AI-generated fragments in scholarly works.

Research results

The practical findings of the study revealed mixed results. On the one hand, AI tools reduced the manuscript processing time by 60%, but they required 35% expert revision—particularly in cases involving polysemy and historical allusions. When analyzing metaphors, algorithms achieved 74% accuracy compared to 92% by human experts, but they identified 12% of patterns previously overlooked. Ethical risks were observed in 23% of the projects, where researchers uncritically accepted AI outputs as the ultimate truth. The most successful outcomes emerged from hybrid methodologies: in the medieval text reconstruction project, the combination of machine learning and paleographic expertise yielded results that were unattainable using either method independently.

Discussion

The data obtained confirms the dual nature of AI in philology. The technologies dramatically expand possibilities—ranging from analyzing millions of texts in hours to uncovering hidden linguistic patterns. However, they also introduce new challenges: the risk of "optimizing" complex humanities tasks into binary classifications and the temptation to replace interpretation with raw data. The German experience demonstrates that breakthroughs are not achieved through a race for automation, but through the fine-tuning of the interaction between algorithms and researchers. For instance, the creation of "culturally sensitive" models required a fundamentally new approach—philologists literally "translated" their expert knowledge into neural network architecture, teaching AI to work with context as a living bearer of language.

Research Question 1: How do AI technologies impact the accuracy and depth of philological analysis compared to traditional research methods?

AI demonstrates superiority in processing large datasets but still requires expert oversight. A hybrid approach, combining machine speed with human interpretative depth, reduces the error rate from 22% to 7%.

Research Question 2. What ethical and methodological risks emerge in the integration of AI into linguistic studies?

The primary danger lies in replacing critical scholarly reflection with a technocratic approach. The solution requires institutional changes, including a three-tiered validation system for results and a revision of academic writing standards to accommodate the specifics of AI-assisted research.

Research Question 3: How does interdisciplinary collaboration between philology and computer science enhance the development of specialized AI tools?

The synthesis of philological and computational expertise has led to the creation of fundamentally new instruments. One example is a semantic analyzer in which linguistic theories of metaphorical transfer are implemented as mathematical functions that preserve the cultural context.

Conclusion

Thus, the conducted research allows us to assert that artificial intelligence, while serving as a powerful tool for the analysis and processing of linguistic data, does not negate the necessity of humanistic expertise; on the contrary, it highlights and reinforces its significance. In the context of rapid digitalization, the formation of interdisciplinary collaborations becomes particularly crucial, fostering a deeper consideration of cultural and linguistic particularities in the development of AI solutions.

Consequently, a priority direction should be the establishment of ethical standards for the use of artificial intelligence in academic research, the protection of intellectual property rights, and the creation of open digital resources to support endangered languages and dialects. In this regard, the implementation of hybrid methodologies that combine the quantitative capabilities of AI with the qualitative depth of philological interpretation appears especially pertinent.

Moreover, special attention should be given to the modernization of educational programs to prepare specialists capable of effectively employing AI tools in scholarly research. Technological advancements aimed at developing specialized AI platforms for philological tasks, in conjunction with the international standardization of linguistic data, open new horizons for the integration of digital and traditional methods.

In conclusion, it should be emphasized that successful interaction between artificial intelligence and philology is possible only under the condition of maintaining the active role of the researcher, who guides and supervises the operation of digital systems, thus ensuring the preservation of the core values of humanistic knowledge in an era of technological transformation.

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ЖАСАНДЫ ИНТЕЛЛЕКТТІҢ ФИЛОЛОГИЯЛЫҚ ЗЕРТТЕУЛЕРДІҢ ДАМУЫНА ЫҚПАЛЫ: ТІЛ БІЛІМІНДЕГІ ҚАЗІРГІ ЗАМАНҒЫ ЖИ ТЕХНОЛОГИЯЛАРЫНЫҢ МҮМКІНДІКТЕРІ МЕН ШЕКТЕУЛЕРІ

Аңдатпа. Жасанды интеллектінің дамуы филологиялық зерттеулердің әдіснамасына жаңа серпін беріп, мәтіндерді, тілдерді және мәдени дәстүрлерді талдаудың тың мүмкіндіктерін ашуда. Осы мақалада 2020–2024 жылдары Германия университеттерінде жүзеге асырылған 27 жобаның негізінде жүргізілген пәнаралық зерттеудің нәтижелері ұсынылады. Зерттеуде сандық және сапалық әдістер, кейс-стади және деректерді триангуляциялау тәсілдері қолданылды. Автор жасанды интеллектінің мәтін корпустарын өңдеуді жеделдету және жасырын тілдік заңдылықтарды анықтау әлеуетін анықтай отырып, сонымен бірге мәдени контекстің бұрмалануы және зерттеушілердің сыни рефлексиясының жеткіліксіздігі секілді тәуекелдерге назар аударады. Мақалада жасанды интеллектіні гуманитарлық ғылымдарда қолдану этикасы және пәнаралық ынтымақтастықтың цифрлық құралдарды жетілдірудегі рөлі жан-жақты талданады. Зерттеу нәтижелері гуманитарлық білім мен технологиялар арасындағы саналы және сыни өзара әрекеттестіктің маңыздылығын дәлелдейді.

Кілт сөздер: филология; жасанды интеллект; сандық гуманитаристика; лингвистика; корпусқа негізделген талдау; жасанды интеллектінің этикалық аспектілері; пәнаралық зерттеулер; машинамен оқыту; мәдени контекст; мәтіндерді талдау.

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ВЛИЯНИЕ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА НА РАЗВИТИЕ ФИЛОЛОГИЧЕСКИХ ИССЛЕДОВАНИЙ: ВОЗМОЖНОСТИ И ОГРАНИЧЕНИЯ СОВРЕМЕННЫХ ИИ-ТЕХНОЛОГИЙ В ЛИНГВИСТИКЕ

Аннотация. Развитие искусственного интеллекта оказывает всё более заметное влияние на филологические исследования, открывая новые перспективы для анализа текстов, языков и культурных традиций. В статье рассматриваются результаты междисциплинарного исследования, проведённого на базе 27 проектов немецких университетов в 2020–2024 гг., посвящённых интеграции ИИ в филологическую практику. Используя методы количественного и качественного анализа, кейс-стади и триангуляцию данных, автор выявляет как потенциал ИИ для ускорения обработки текстовых корпусов и выявления скрытых закономерностей, так и существующие риски, связанные с утратой культурного контекста и недостаточной рефлексией исследователей. Отдельное внимание уделено этическим вопросам применения ИИ в гуманитарных науках и роли междисциплинарного сотрудничества в оптимизации цифровых инструментов. Работа подчёркивает необходимость критического подхода и осознанного взаимодействия между гуманитарным знанием и технологиями.

Ключевые слова: филология; искусственный интеллект; цифровая гуманитаристика; лингвистика; корпусный анализ; этические аспекты ИИ; междисциплинарные исследования; машинное обучение; культурный контекст; анализ текстов.