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# Artificial Intelligence in the humanities: Between innovation and challenges

Nurali Chelebiyev*[1]
[1]Azerbaijan State Pedagogical University, Sheki Branch, Sheki, Azerbaijan

**Abstract.** The purpose of the study was to determine the boundaries and possibilities of using artificial intelligence technologies in the examination of literary and historical sources. The methodological strategy combined critical analysis of published findings, systematisation of tools, evaluation of representative practices in the digital humanities, and integration of these observations within a unified analytical framework that links technical procedures with interpretative conclusions. Particular attention was paid to case studies that illustrate the capacity of algorithms to reconstruct latent narratives and intertextual networks. The obtained findings demonstrate that topic modelling combined with clustering reliably identifies latent themes and their temporal dynamics in large text collections; contextual neural architectures provide consistent identification of persons, toponyms, and genre features across dispersed corpora; stylometric approaches, together with tools for detecting textual correspondences, enable localisation of shifts in authorial signal and reconstruction of borrowing chain. The study established that tools of geographical annotation allow the reconstruction of spatial trajectories of characters, correspondence, and routes. The analysis also indicated sensitivity of results to the quality of digitisation: errors in the recognition of printed and handwritten text altered thematic distributions and affected attribution accuracy, which required prior cleaning and normalisation. The study noted that generative systems are appropriately considered instruments of co-creation at three levels: operational (variation of formulations), procedural (structural organisation and iterative support), and conceptual (semantic integration and interpretative framing), while decisive responsibility remains with the human researcher. The ethical dimension confirmed the presence of risks related to bias in training collections, threats to confidentiality, and potential distortion of cultural meanings; requirements for transparency, documentation of the role of automated tools, and the involvement of domain expertise were outlined. The practical value of the study lies in the fact that the proposed framework provides researchers with a clear sequence of actions for reproducible analysis of textual corpora, ensures accurate attribution and interpretative validity, and offers instrumentally grounded guidelines for the secure integration of technologies into humanities projects

**Keywords:** topic modelling; intertextual connections; authorship attribution; discursive features; handwritten texts; variation of formulations

## INTRODUCTION

Research on the interaction between AI (Artificial Intelligence) and the humanities acquires particular significance in connection with the expanding use of algorithms for the analysis of cultural texts, historical sources, and artistic practices. The need to examine this issue arises from the duality of technological impact: on the one hand, such systems introduce new instruments for reconstruction, attribution, and interpretation; on the other, they raise questions concerning the reliability of results, their compliance with the methodological standards of the humanities, and the ethical implications of integrating algorithms into the research process.

The limitations and potential of algorithmic approaches were examined in detail by W. Duch (2024), who emphasised that AI technologies could substantially enhance the analytical tools of humanities researchers, yet do not fully reproduce the contextual depth and value-based multidimensionality of humanistic knowledge. The researcher

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*Corresponding author (chelebiyevnurali@gmail.com)

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noted that the effectiveness of machine methods is constrained by the absence of interpretative capacity within such systems. The academic field increasingly regards intelligent systems as a key driver of the development of digital humanities. E. Frontoni *et al.* (2024) stressed that these technologies open a new horizon for digital humanities practices, combining rapid processing of large corpora with the integration of complex models for reconstructing intertextual and spatial connections. The researchers maintained that the potential of these tools derives from their capacity for multi-level analytics, although they remain dependent on human interpretation and oversight.

An important line of inquiry concerns the transformation of authorship in the era of algorithmic systems. S. Colella (2025) observed that texts generated with the assistance of language models enter into a complex relationship with conventional conceptions of authorship, since their form and structure could reproduce features of human creativity, whereas the absence of authorial intention and responsibility places them within a grey zone of cultural practice. The researcher observed that such texts alter the understanding of the performativity of the authorial act and raise questions regarding the boundaries of authentic writing. Research on the use of algorithms in the preservation and interpretation of cultural heritage also proved significant. E.D. Hannaford *et al.* (2024) demonstrated that the application of AI tools to digital collections supports the development of infrastructures for community archives and connected local histories with broader narratives. The researchers concluded that machine learning systems effectively support classification and retrieval processes in archives, yet require community oversight to prevent distortion and preserve the authenticity of cultural data.

Several studies emphasise the need for changes in training systems for humanities research. J. Chun & K. Elkins (2023) proposed a curriculum model grounded in the principle of humanities-oriented AI, which aims not only at technical instruction in working with algorithms but also at cultivating critical thinking capable of assessing the limits and risks of such systems. The researchers concluded that researcher training requires integration of technical literacy and ethical reflection. K. Lavidas *et al.* (2024) showed that the readiness of students in the humanities and social sciences to use AI for academic purposes is shaped by a range of factors, from technical awareness to individual expectations and prior experience with digital tools. The researchers established that integration of such tools into educational processes is feasible only when educational and cultural contexts are carefully considered, which underscores the relevance of implementing these technologies in the humanities not only at the level of research but also of education.

A considerable contribution to the discussion of the dual character of intelligent systems in the digital humanities was made by H. Zhao (2023). The researcher argued that the use of algorithms generates serious challenges while opening new possibilities: such systems could accelerate analysis and expand access to large corpora, yet risk reproducing bias and distorting outcomes. The debate also addressed the transformative potential of algorithms in education and research. A. Shahid *et al.* (2024) emphasised that AI has the capacity to reshape educational practices in the humanities by enabling personalisation, automation of routine tasks, and broader access to resources. The researchers noted that these developments exert a long-term influence on the structure of educational programmes and the organisation of scholarly knowledge.

Despite the substantial body of existing studies, gaps requiring further examination remain. The relationship between algorithmic efficiency and interpretative validity remains insufficiently clarified. The ways in which authorship and creativity are transformed under the influence of generative systems within academic and cultural practices also remain underexplored. Ethical dimensions require further specification, including risks of bias, issues of confidentiality, and challenges of cultural representation. In response to these identified issues, the purpose of the study was to evaluate the effectiveness of algorithmic approaches in the examination of literary and cultural sources and to delineate the limits of their use for formulating academically grounded conclusions. The objectives of the study were as follows: to identify which machine learning algorithms are applied most effectively to the analysis of literary and historical texts; to examine the transformation of authorship and creativity in the digital age under the influence of generative systems; and to analyse ethical challenges related to bias, confidentiality, and cultural representation.

## MATERIALS AND METHODS

The study employed a comprehensive methodology combining critical analysis of publications, evaluation of digital tools, and systematisation of practices in digital humanities research. The study unfolded in several sequential stages. The first stage identified algorithmic approaches of central importance for the analysis of corpora of literary and historical texts. The next stage examined examples of practical application of these approaches in specialised projects. A separate section addressed tools for analysing spatial and intertextual dimensions of texts, along with instruments for processing manuscript and digitised sources. The subsequent stage focused on questions of authorship and creativity arising from the spread of generative systems. The theoretical framework was strengthened through engagement with the cultural concepts of J. Lotman (semiosphere) (Bankov, 2020), Z. Bauman (liquid modernity) (Doyle & Conboy, 2020), and A. Appadurai (cultural flows) (Linares, 2025), which enabled interpretation of the analytical results not merely as technical outcomes but as elements of broader cultural processes. Tools and case studies were grouped by thematic direction in tables (Table 1).

**Table 1.** Methods, tools, and cases of AI application in digital humanities research

| Method/tool | Task/function | Example of application | Source |
|---|---|---|---|
| **Algorithms for text corpus analysis** | | | |
| Latent Dirichl*et al*location (LDA) | Topic modelling, identification of latent topics | Classification of genre-thematic configurations in large corpora | U. Chauhan & A. Shah (2021) |
| Stylometry (R stylo, Δ-metrics) | Authorship attribution, style analysis | Detection of changes in authorial signal within a single work | T. Merriam (2021) |
| Transformers (BERT – Bidirectional Encoder Representations from Transformers; Longformer, BigBird) | Named entity recognition, classification of discursive features | Analysis of long texts (novels, periodicals) | A.H. Mohammed & A.H. Ali (2021); H. Miao *et al.* (2024) |
| **Tools for intertextuality and spatial dimensions** | | | |
| Recogito | Geographic reconstruction, working with toponyms | Mapping routes in texts | Pelagios Network (n.d.) |
| textreuse (R), passim | Detection of repetitions and borrowings | KITAB (Knowledge, Information Technology, and the Arabic Book), analysis of Arabic corpora | M. Romanello & S. Hengchen (2021) |
| Tesserae | Search for allusions and intertextual links | Latin and Ancient Greek corpora | Tesserae (n.d.) |
| **Platforms for working with manuscripts and digital archives** | | | |
| Transkribus | Handwritten text recognition (HTR – Handwritten Text Recognition) | Manuscripts of J. Bentham | Project Update… (2018) |
| ECCO (Eighteenth Century Collections Online) | Assessment of OCR/HTR noise (OCR – Optical Character Recognition; HTR – Handwritten Text Recognition) | Analysis of 18th-century corpus | A. Liimatta (2024) |
| HathiTrust Research Center (HTRC) | Large-scale non-consumptive corpus analysis | Development of worksets from thousands of volumes | HathiTrust (n.d.); HathiTrust Research Center Analytics (n.d.) |
| **Practical application** | | | |
| Mining the Dispatch | Topic modelling of press corpus | Reconstruction of Civil War discourses in the United States | J. Longstreet (2024) |
| The Viral Texts Project | Detection of networked text circulation | 19th-century newspaper republications | The Viral Texts Project (n.d.) |
| KITAB | Detection of borrowings in classical texts | Arabic-language corpora | KITAB (n.d.) |
| ReRites | Co-creation experiments | Text generation and daily editing by the author | ReRites (n.d.) |

**Source:** compiled by the author

The final methodological section addressed ethical considerations. This stage assessed risks of bias in training corpora, potential threats to the confidentiality of archival and personal materials, and issues concerning the representation of cultural heritage. The positions of the Committee on Publication Ethics (COPE) (n.d.) and the International Committee of Medical Journal Editors (ICMJE) (n.d.) were considered, particularly their stance that algorithms cannot be recognised as full authors and that a transparent declaration of their contribution is required.

## RESULTS

### Application of machine learning algorithms to the analysis of literary and historical texts

The application of topic modelling and clustering identifies latent narratives in large text corpora that remain outside the scope of conventional literary and historical interpretation. In nineteenth-century press corpora, researchers identified stable thematic patterns reflecting not only official discourses but also everyday social practices previously documented only fragmentarily (Chauhan & Shah, 2021). Analysis of gender markers in prose fiction demonstrates long-term shifts in the representation of social roles, which correlate with broader historical changes in culture (Casadei *et al.*, 2023). Work with extensive library collections confirms the potential to trace the dynamics of genre forms and their prestige across historical periods, contributing to the development of quantitative literary studies. The use of diachronic vector spaces enables tracing changes in word meaning and usage across extended historical periods, which is particularly valuable for analysing texts characterised by evolving orthography and semantics (Miao *et al.*, 2024). Geographical reconstruction of texts shows that literary and epistolary sources contain distinct cartographic markers permitting analysis of cultural mobility and network structures. Visualisation of the routes of travellers and correspondents illustrates individual trajectories and broader spatial patterns of cultural circulation. This approach supports reconstruction of regional and transregional centres where cultural contacts concentrate and through which texts and knowledge circulate (del Rio Riande & Vitale, 2020). Spatial mapping indicates that

intertextual connections frequently overlap with geographical trajectories, forming cultural "centres of gravity" where diverse traditions intersect.

Research on repetitions and textual borrowings reveals patterns in the circulation of cultural motifs and the stability of specific textual formulations over extended periods. Analysis of Arabic-language corpora reconstructs chains of text transmission, confirming the persistence of traditions of knowledge preservation and transformation across generations (KITAB, n.d.; Romanello & Hengchen, 2021). In nineteenth-century European periodicals, identification of widespread republication describes mechanisms of cultural diffusion and the development of collective media discourses (The Viral Texts Project, n.d.). In classical Latin and Greek corpora, automatic detection of allusions documents interdependencies that remain imperceptible even to experienced philologists, expanding the interpretative potential of conventional scholarship (Riemenschneider & Frank, 2023). Analysis of manuscript sources confirms that algorithmic recognition constitutes an effective tool for producing transcriptions, although its quality depends on the condition of originals and digitisation parameters (Transkribus, n.d.). Instances of substantial errors show that automatic transcriptions without verification can distort corpus analysis. Research on OCR/HTR noise demonstrates that data quality determines the accuracy of topic modelling and authorship attribution (Liimatta, 2024). Analysis of the ECCO collection indicates that textual distortions can alter both topic distributions and attribution results, necessitating systematic verification.

The application of algorithms in interdisciplinary projects confirms their capacity to uncover new aspects of cultural history. In the Richmond Daily Dispatch corpus, hidden narratives of home-front life during the US Civil War were reconstructed, including themes of labour mobilisation, resource scarcity, and disciplinary practices that had remained outside conventional historiography (Mining the Dispatch, n.d.; Longstreet, 2024). Studies of nineteenth-century newspaper republications reveal mechanisms of media circulation explaining the development of national cultural codes (The Viral Texts Project, n.d.). In the Arabic KITAB and OpenITI corpora, researchers demonstrated the persistence of text transmission traditions across historical periods (Open Islamicate Texts Initiative, n.d.). In classical Latin and Greek studies, intertextual analysis tools confirm that digital algorithms allow detailed mapping of literary allusions, providing empirical support for classical philology (Tesserae, n.d.). Spatial analysis using cartographic tools demonstrates the relationship between textual and geographic networks, reflecting a more comprehensive picture of cultural circulation (Pelagios Network, n.d.; GeoNames, n.d.). For summarising results and improving the visualisation of the impact of algorithmic methods on the analysis of literary and historical corpora, the material is presented in Table 2.

**Table 2.** Summary of the results of applying digital methods

| Direction | Identified results | Cultural and interpretative effects |
|---|---|---|
| Thematic modelling and clustering | Latent topics in press and literature, gender patterns, genre dynamics | Reconstruction of social discourses, changes in cultural perceptions, analysis of genre prestige (Chauhan & Shah, 2021; Casadei *et al*., 2023; Miao *et al*., 2024) |
| Geographical reconstruction | Routes of travellers and correspondents, mapping textual movements | Reconstruction of cultural networks, centres of cultural circulation (Pelagios Network, n.d.; del Rio Riande & Vitale, 2020) |
| Intertextual analysis | Detection of borrowings, repetitions, allusions, networked connections | Understanding mechanisms of knowledge transmission and cultural diffusion (The Viral Texts Project, n.d.; Romanello & Hengchen, 2021; Riemenschneider & Frank, 2023) |
| Work with manuscripts | Automated transcriptions, impact of OCR/HTR noise | Confirmation of the need for corpus verification, critical engagement with data (Transkribus, n.d.; Liimatta, 2024) |
| Practical applications | Recovery of hidden narratives, media processes, inter-epochal connections | New approaches to the interpretation of history and literature (Mining the Dispatch, n.d.; Open Islamicate Texts Initiative, n.d.; Longstreet, 2024) |

**Source:** compiled by the author

Contemporary digital technologies demonstrate several advantages and limitations in research application (Fig. 1). Advantages include speed and scale: platforms such as HTRC allow investigation of tens of thousands of texts simultaneously without requiring dedicated infrastructure (HathiTrust, n.d.; Project Update…, 2018). Comprehensive analysis is also significant: the combination of topic modelling, transformers for Named Entity Recognition (NER) and classification, and textual comparison algorithms produces multi-layered analysis corroborated from multiple perspectives. Novel opportunities arise from diachronic embeddings, which track changes in word semantics over time and enhance the interpretation of long-term cultural processes. Limitations persist, notably the heterogeneity of corpora and digitisation quality, which directly affect outcomes. Low optical character recognition (OCR) quality, caused by archaic orthography, scanning defects, or errors in automatic transcription, distorts topic distributions and reduces the accuracy of stylometric analyses and authorship attribution, making preliminary cleaning and corpus normalisation critically important. Another challenge is language specificity: even the most advanced NER models, trained on modern corpora, lose accuracy on historical texts. The HIPE (Identifying Historical People, Places, and other Entities, n.d.) series demonstrated that specially

annotated data and adaptation of metrics to historical variation are required. Long documents present further limitations: basic transformers have restricted context windows, necessitating fragmentation of texts, which can result in loss of discursive dependencies (Mohammed & Ali, 2021). Interpretation of results remains challenging: LDA topics or stylometric clusters require external verification and independent sampling. For clarity, the results are summarised in a SWOT analysis (Table 3), which allows strengths and weaknesses of digital methods to be compared with potential applications and risks affecting the interpretation of humanities data.

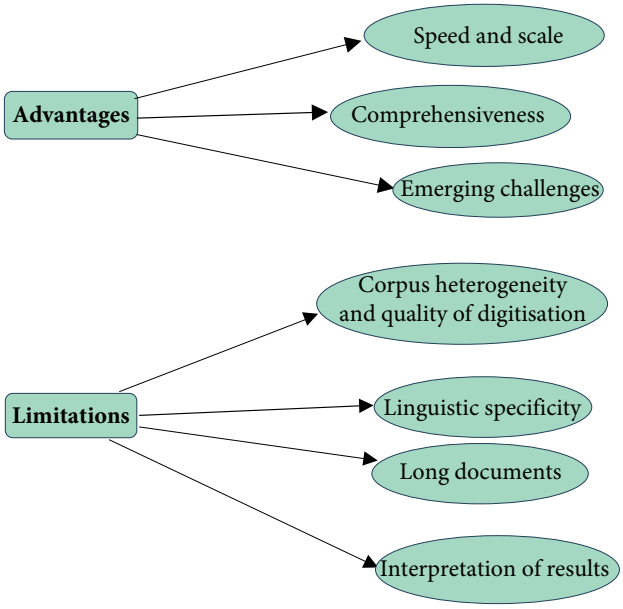


**Figure 1.** Key opportunities and challenges of applying digital technologies in humanities research
**Source:** developed by the author

**Table 3.** SWOT analysis of digital technologies in humanities research

| Strengths | Weaknesses | Opportunities | Threats |
|---|---|---|---|
| Speed and scale of corpus analysis (HTRC allows work with thousands of texts without proprietary infrastructure) | Heterogeneity of corpora and low quality of digitisation, which distort results | Diachronic embeddings, which allow tracking semantic changes over time | Data distortion due to OCR/HTR noise, affecting result reliability |
| Methodological comprehensiveness (combination of thematic modelling, transformers, stylometry) | Dependence on linguistic specificity: loss of accuracy with historical texts | Expansion of cultural process analysis through integration of geographical and intertextual methods | Limited context of base transformers, complicating work with long texts |
| Possibility of multi-level validation of results (different methods corroborate findings) | Requirement for large-scale corpus cleaning and normalisation | In-depth study of cultural contacts using geographical reconstruction tools (Recogito) | Risk of formal interpretations of clusters and topics without external verification |

**Source:** compiled by the author

Strengths of these technologies include scale and comprehensiveness, opening new perspectives for the study of cultural processes. Opportunities include diachronic methods that trace transformations of meanings and cultural codes over time. Weaknesses stem from low-quality source data, multilingual challenges, and the substantial effort required for corpus normalisation. Key threats include the risk of distorted interpretation due to OCR/HTR noise, limitations of transformer models with long documents, and the potential for formalist approaches to clusters and topics without further verification. This analysis clarifies the limits of digital tools while outlining directions for further methodological development in the humanities.

Thus, the combination of topic modelling, transformers, and textual comparison algorithms opens new approaches to the analysis of large historical and literary corpora. Platforms and tools such as HTRC and Recogito standardise workflows and make digital methods accessible to a broad range of researchers. Nevertheless, digitisation quality, lack of annotated corpora for under-resourced languages, need for long-context models, and requirements for interpretative validation remain key challenges. Effective strategies include preliminary corpus cleaning and

normalisation, use of domain-adapted models, verification of results against independent data, and transparency in annotation procedures. These measures ensure reproducibility of results and pave the way for more thorough and precise research in the humanities.

**Authorship and creativity in the digital age**

Discussion of authorship in the context of generative systems arises from the capacity of models to produce texts that readers frequently perceive as human-created. Research demonstrates that non-expert audiences do not consistently distinguish between human and machine-generated poetry; in a large sample, participants identified the origin of poems with approximately fifty per cent accuracy, and assessments of rhythm and aesthetic quality for machine-generated texts were sometimes higher, complicating intuitive recognition of authorship (Porter & Machery, 2024). This observation directly prompts a reconsideration of conventional criteria for attributing texts to specific authors and a reassessment of the role of formal features as indicators of human labour. Normative frameworks in publishing and copyright practice establish a minimum requirement of human contribution. A policy statement and guidance from the United States Copyright Office clearly state that registration applies only to portions of a work with human creative input; sections generated by an algorithm without editorial creativity are not protected and must be declared during submission (Statement of Policy of the United States Copyright Office, 2023). Updated materials from the copyright office and public documents, including the continuation of the Report of the United States Copyright Office (2025), confirm the consistency of this approach, and an appellate decision concerning an image entirely created by a system without human input upheld the position that copyright cannot be obtained without human authorship. Collectively, these documents establish legal consensus: a machine system cannot independently hold copyright and therefore cannot constitute an author.

Editorial standards in academic publishing align with this logic. Committee on Publication Ethics (n.d.) explicitly states that language model tools cannot be listed as authors; responsibility for content and the capacity to assume obligations are incompatible with the nature of such systems (COPE Council, 2023). International Committee of Medical Journal Editors (n.d.) updated guidance requiring transparent declaration of the use of generative tools, prohibiting their listing as co-authors, and emphasising full human responsibility for verification of accuracy and mitigation of errors and plagiarism (Recommendations for the Conduct…, 2025). In the humanities, this implies clear delineation: technical assistance from a model must be disclosed in relevant sections, but the author remains the human who formulates the prompt, selects, edits, and interprets the output.

In practice, a co-creativity model emerges, viewing generative systems as partners in content creation, but not as autonomous agents. Review and empirical studies propose conceptual frameworks that grade algorithmic involvement from instrumental assistance to collaborative creation, consistently assigning the central role to human oversight: task formulation, iterative selection of outputs, and stylistic editing (Liu, 2025). Empirical evidence from co-writing studies indicates that model involvement can enhance productivity during idea generation and structuring stages, but requires clearly defined roles and procedures to ensure attribution (Haase & Pokutta, 2024). A canonical example of co-creative poetics is the ReRites (n.d.) project, in which machine-generated material was edited daily by the author; the output was published as a twelve-book series of essays on processuality and the distribution of roles between human and model. Authorial materials emphasise rhythmic discipline, rewriting, and reprogramming of authorship through human editing of machine-generated text (Erslev, 2023). The project demonstrates that without intensive human curation, the machine's "raw" output does not attain aesthetic completion. For electronic literature studies, this case defines parameters of a hybrid genre: texts in which the algorithm's contribution is documented, but the final form depends on editorial work.

Another notable case is the novella "Death of an Author" (Aidan Marchine, 2023), produced with substantial generative tool involvement. Publisher materials and author interviews describe the process as a multi-stage assembly: models generated textual variants, while the human acted as scenario planner, editor, and compiler. The "rules of the game" method (quotas of machine-generated text, constraints on genre and composition) renders the experiment methodologically reproducible: the boundary between machine contribution and authorial selection can be traced through the protocol (Buleu, 2024). In copyright terms, the work remains human-authored due to the described editing, despite the machine origin of most of the text; this illustrates the distinction between generation and authorship. In literary and cultural studies, original experiments in poetry and drama employ models as sources of variation and combinatorial potential. Synthesised conclusions from poetry research indicate that ease of rhythm and readability metrics may positively influence non-expert perception of algorithmic texts, but such advantages do not guarantee interpretative depth; aesthetic evaluation criteria should therefore be clearly differentiated according to audience and analytical objectives (Porter & Machery, 2024). Overestimating the immutability of distinctions between human and machine texts is methodologically risky: empirical criteria should rely on independent test sets and prior disclosure of editorial procedures.

The shift towards co-creativity also affects creativity. Researchers move from a model of a single authorial act to understanding creativity as a process, in which iterative cycles of "task formulation – generation – selection – interpretation" are distributed between human and model. Procedural phases described in the literature, such as idea generation, elaboration, and realisation, formalise points where algorithmic prompts are useful, and where

exclusively human competence is required – stylistic integration, intertextual anchoring, adherence to genre and historiographical norms (Wan *et al*., 2024). This delineation prevents erroneous attribution of creativity to the model as a capacity for responsibility; it concerns the statistical generation of variants, which only becomes a work through human selection and editorial intervention. New genres at the intersection of literature, media art, and "history-making" use generative tools as stages in a research or artistic workflow. In literature, these are hybrid collections where initial machine narratives undergo rigorous editing; in digital history, experiments with "narrative drafts" are treated as auxiliary material for further processing, rather than as final academic products. Professional communities of historians formulate guidelines for teaching and research, emphasising transparency of procedures and separation of automated generation from scholarly conclusions (American Historical Association, 2025). This reduces the risks of erroneous attribution and enhances reliability. Concerning "synthetic historiography", it remains crucial to maintain methodological barriers between machine drafts and scholarly narratives. Special issues and research projects in digital history underscore the need to verify the instrumental role of models: from prior inventory of plots to semantic annotation of sources, with mandatory quality control, prompt documentation, and validation against independent corpora (Jones, 2023). In practice, this translates into usage protocols: modular accounting of machine-generated suggestions, versioning of iterations, and clear references to stages where human intervention is decisive.

Returning to authorship, legal and ethical consensus does not oppose intensive use of generative tools, but establishes three requirements. First, transparency: disclosure of model use in submissions or methods. Second, responsibility: final verification for factual accuracy, absence of plagiarism, and compliance with citation and copyright standards. Third, attribution: models cannot be listed as co-authors, and technical contribution must be distinguished from creative editing. This applies to academic publications and literary editions; in the latter, paratexts such as afterwords or technical notes are required to document workflow and parameters (COPE Council, 2023). In applied practice, co-writing experiments demonstrate effects on novelty and usefulness of ideas during text preparation, but also reveal risks of stylistic homogenisation: without strict editorial frameworks, outputs may become overly predictable (Wan *et al*., 2024). This supports the use of models for general stages – brainstorming, variant formulation, note synthesis – followed by human integration for style, rhetoric, and intertextuality.

Creativity can be distinguished at three levels (Table 4**).** The creative potential of models functions as a multi-level process. At the first level, they perform an auxiliary role, offering diverse linguistic variations that expand the field for subsequent selection. The next level concerns the organisation of material: algorithms assist in constructing logical flows, suggesting possible structural solutions and transitions. The highest level involves semantic work, where the defining tasks and interpretations are formulated by the researcher, alongside alignment with academic norms and source material (Haase & Pokutta, 2024). Only the combination of these levels justifies speaking of co-creation, while independent generation without authorial selection remains raw material, regardless of perception by non-expert audiences. For cultural and historical research, the co-creation perspective entails institutionalising transparent practices. Professional associations of historians propose pedagogical and research guidelines: focus on methodological compliance, documentation of automation boundaries, and clear communication to students and readers where technical assistance ends, and interpretative work begins (Jones, 2023). These principles serve as a safeguard against the mechanical transfer of machine-generated texts into scholarly conclusions while encouraging careful use of models in corpus preparation, indexing, preliminary summarisation, and heuristic analysis.

**Table 4.** Authorship and cultural representation in the era of AI

| Level of creativity | Characterisation | Role of AI | Role of human | Examples of application | Potential risks |
|---|---|---|---|---|---|
| Operational | Provides variation in formulations, thematic moves, lexical choices | Generates alternative formulations, stylistic options, lexical combinations | Selects the most appropriate variants, verifies accuracy and contextual fit | Text rephrasing, creation of alternative titles or thesis formulations | Overload of options; risk of uncritical copying of machine suggestions |
| Procedural | Supports iterative structuring of text or research | Proposes plan, structure, transitions between sections, possible presentation schemes | Determines final logic of presentation, edits structure according to purpose and standards | Article plan generation, options for argumentative transitions, assistance in building logical blocks | Formal correctness without deep alignment to topic; risk of losing originality of authorial intent |
| Conceptual | Shapes the content framework and semantic substance of research | Can suggest associative ideas or alternative interpretations | Defines cognitive frameworks, works with sources, ensures compliance with disciplinary and methodological standards | Choice of research paradigm, definition of theoretical approach, interpretation of results | Distortion of content through superficial generation; risk of substituting scientific interpretation with machine simulation |

**Source:** developed based on COPE Council (2023); C.R. Buleu (2024)

In the age of generative systems, authorship is less about "who wrote the text?" and more about describing the production process: who formulated the task, which tools were applied, where editing occurred, and which parts were verified and validated by humans. Legal and editorial positions (guidance from the United States Copyright Office, COPE, and ICMJE policies) standardise the requirement for substantial human contribution and transparency. Research and artistic cases, such as ReRites and Death of an Author, serve as sites for clarifying the boundaries of co-creativity. For the humanities, this means generative models can support stages of idea creation, variant formulation, and initial drafting, but co-author status remains with the human who defines the concept, assumes responsibility, and ensures interpretative validity.

**Ethical challenges in the use of AI in cultural research**

The use of AI systems in cultural research generates several ethical challenges, encompassing bias, privacy, and cultural representation. The primary issue is bias. Training data typically originate from archives, museum and library collections, often created within specific historical periods dominated by certain cultural narratives. This reproduces the same imbalances in automated systems. Bias can be present in cultural heritage collections and their digital replicas, and the AI pipeline can amplify these distortions (Foka & Griffin, 2024). Researchers should apply bias mitigation techniques at each stage of the process: from data collection to annotation and modelling. Research on practical experience with AI systems in the cultural sector highlights the challenge of the "black box", which limits transparency (Gîrbacia, 2024). This complicates the assessment of why a model produces a given result and how it may reproduce structural biases present in source data. In this context, the concept of the cultural semiosphere by J. Lotman (Bankov, 2020) is relevant, emphasising that each culture functions as an integrated semiotic system with its own centres and peripheries. Use of corpora formed around dominant cultural narratives means AI models reproduce and reinforce these dominants, marginalising peripheral voices. This renders bias not only a technical issue, but also a semiotic-cultural one, as automated algorithms participate in the redistribution of meaning within the semiosphere.

Another aspect concerns privacy and data protection. Archival and personal texts, which may contain personal data or be subject to copyright restrictions, are used to train models. In the context of cultural heritage, this raises questions of accessibility and transparency, since some systems operate as closed platforms without explanations of who can access the data or how it is used (Yang *et al*., 2023). This relates to Z. Bauman's idea of liquid modernity (Doyle & Conboy, 2020), according to which social structures and rules constantly change, and stable forms of control are replaced by flexible but less transparent mechanisms. The opacity of algorithmic platforms reproduces this fluidity, creating situations in which conventional cultural memory institutions, such as libraries and archives, lose clear contours and fall under the influence of new, less predictable forms of data governance. Studies addressing intellectual property in the United Kingdom emphasise that model training often relies on copyright-protected texts, which can lead to uncertain legal circumstances: who has access, on what basis the data are used, and whether models have legal rights to train on archival texts (Westenberger & Farmaki, 2025). The result is corrections that create uneven cultural representation and affect research reliability.

A third set of challenges concerns ethical dilemmas in cultural representation. The use of artificial intelligence in the reconstruction or reproduction of cultural heritage can distort authenticity. This occurs due to insufficient understanding of local contexts, misinterpretation of symbols or images by algorithms (Floridi, 2023). More broadly, this aligns with cultural flows articulated by A. Appadurai (Linares, 2025), which describe the movement of ideas, images, and symbols across global cultural spaces. Algorithms involved in heritage reconstruction become instruments of these flows, but risk extracting artefacts from their local contexts and transforming them into universal, yet simplified, cultural signs. Consequently, the use of algorithmic models may transform authentic local meanings into globalised formats, heightening ethical risks in representation. It is necessary to establish boundaries of responsibility, preserve historical integrity, and involve cultural experts in interpretative processes. In terms of academic integrity, there are risks to the originality of texts: when AI generates works, there is a temptation not to declare its contribution, which violates professional standards. Furthermore, lack of transparency, for example, over who generated or edited material, or whether the model had any significant contribution, can lead to plagiarism or incorrect attribution (Gallent-Torres *et al*., 2023). This creates the need for protocols requiring transparent documentation of machine contributions as part of authorship or research processes.

Ethical application of machine learning systems in cultural research therefore requires formalisation of protocols, including minimising bias through quality control of corpora, annotation, and model customisation that accounts for cultural diversity; data protection and transparency, including labelling confidential materials and documenting components of generative models to ensure reliability; preservation of authenticity, separating machine reconstruction from historical context and involving cultural experts in verification; and attribution and integrity, with explicit declaration of AI roles, human responsibility for results, and thorough documentation of processes. Implementation of such protocols is achievable through interdisciplinary collaboration, where experts in the humanities, ethics, law, and technology jointly develop principles that combine methodological rigour with historical and cultural sensitivity. This ensures not only the legality and correctness of AI applications but also ethical accountability towards cultural heritage, audiences, and future researchers.

## DISCUSSION

The results indicate that combining topic modelling, transformer-based approaches to NER/EL (Named Entity Recognition/Entity Linking), stylometry, and tools for identifying textual correspondences produces a coherent picture of genre-thematic configurations, networks of textual borrowing, and variations in authorial signal, while delineating ethical boundaries for AI use in the interpretation of cultural data. The study demonstrates the convergence of multiple methodological lines – LDA/clustering, long-context models, stylo analysis, and passim comparison – in reaching consistent conclusions through independent verification and shows reproducibility across different corpora, including newspapers, Arabic texts, classical corpora, and manuscript transcripts. Analysis of authorship and creativity further indicates that generative models function effectively as co-creation tools at operational and procedural levels, while ultimate significance rests with the human, who ensures conceptual integrity, interpretation, and accountability. Findings concerning ethical challenges emphasise that bias in corpora, privacy risks, and the danger of distorted cultural representation require systematic protocols for labelling, transparency, and expert involvement.

With respect to topic modelling, the results confirm that LDA and related clustering methods are suitable for the stable induction of latent topics in large corpora and for mapping discourse evolution. Comparison with the approach of I.C. Chang *et al.* (2021) shows methodological proximity: their study employed text mining, clustering, and LDA for thematic classification of journals in environmental education, reflecting the practice of using LDA for initial inductive segmentation of the corpus. Similarities include the three-step procedure of preprocessing, clustering, and LDA interpretation, along with the validation of topics using domain-relevant indicators. Differences lie in the corpus domain: I.C. Chang *et al.* examined journals with clearly defined sections, whereas the present study considered newspaper and historiographical corpora, which exhibit greater genre and lexical variability and require diachronic embeddings and more stringent normalisation prior to topic modelling. In authorship attribution, stylometric results confirm the utility of most frequent words, Δ-metrics, and sliding-window stylometry for localising shifts in authorial signal within a single work. Comparison with H. Ilsemann (2023) shows alignment in tools, including the use of the stylo package for R and attention to attribution challenges in complex corpora. Similarities include the evidential basis of stylometric decisions and the need for transparent parameters. Differences concern material and task framing: H. Ilsemann addressed the English-language canon and the authorship question of "Henry V", where textual traditions and editorial layers are well documented, whereas the present study addresses multilingual data, including newspaper OCR/HTR texts and Arabic corpora, which require additional quality filters and post-OCR cleaning prior to stylometry. Passim analysis complements stylo, linking attributional conclusions with networks of repeated use.

Analysis of human + AI co-authorship shows that increased productivity in the ideation stage can coincide with risks of style unification, aligning with findings by K. Medeiros *et al.* (2025), who empirically evaluated creativity dynamics with ChatGPT. Similarities include recognition of novelty and utility gains at the generation and structuring stage, alongside the need for human integration to maintain stylistic coherence. Differences appear in evaluation type: K. Medeiros *et al.* operationalised measures through experimental design, whereas the present study relies on corpus metrics, including topic/cluster consistency and stability of stylometric profiles. Another difference concerns the purpose of co-authorship: in the present study, it supports tasks such as drafting analytical paragraphs and producing annotation variants, whereas K. Medeiros *et al.* (2025) examined AI-assisted creation in the context of general creative activity. From an authorship theory perspective, normative conclusions regarding the primacy of human contribution and the need for paratextual transparency correspond with T. Kamatović (2024), who discussed authorship ambivalence in the AI era through engagement with the Augustinian tradition. Similarities include recognition of the shift from a monolithic authorial "I" to a procedural schema, where decisions about meaning and interpretation are made by humans. Differences concern argumentative grounds: the present study emphasises empirical and legal dimensions, including responsibility, attribution, and the non-representativity of AI as author, whereas T. Kamatović draws on posthumanist frameworks and retrospective theological-philosophical analysis.

In literary theory, A. Gefen (2024) examined the transformation of the author's role under algorithmic mediation. Alignment with the present study occurs in the reduction of the authorial centre and the growing importance of editorial, curatorial, and verification practices, consistent with a procedural co-creation model. Differences concern the scale of generalisation: A. Gefen emphasised cultural-poetological diagnosis, whereas the present study links findings to specific methodological techniques and attribution protocols. Conceptual conclusions about shifts in authorship gain empirical support from data showing the division of the process into operational, procedural, and conceptual levels. Regarding cultural representation, the section on ethical risks in reproducing cultural narratives with generative tools resonates with C. Oztabak (2025), who analysed AI-generated folklore narratives and their cultural relevance. Similarities include recognition of potential for cultural resonance when careful curatorial frameworks and local expertise are present. Differences concern emphasis: the present study prioritises labelling algorithmic reconstructions as interpretations and requires source verification, whereas C. Oztabak focused on bridging tradition and digital storytelling with an applied orientation. This highlights the distinction between institutional scientific validation and project-based practices of cultural engineering.

Concerning linguistic and cultural mediation, the results on shifts in semantic fields and the necessity of human interpretation for cross-linguistic transformations align with B. Wei (2024) on the strengths and weaknesses of AI-mediated creative translation. Similarities include recognition of algorithmic usefulness in variant paraphrasing and stylistic suggestion. Differences concern accuracy requirements: the present study prioritises disciplinary control, including adherence to terminology, source material, and historiographical norms, whereas B. Wei emphasises creative advantages and general technical challenges, such as style preservation and cultural nuance, with less focus on rigorous academic validation. In the domain of algorithmic bias in multimodal systems, observations on cultural distortions align with W. Elsharif *et al.* (2025), who summarised strategies for identifying, evaluating, and mitigating bias in text-to-image models. Similarities include recognition of the systemic nature of cultural skew and the conclusion that the full cycle – from data curation through metrics to interventions – determines outcomes. Differences concern modality: the present results are text-centred, whereas Elsharif *et al.* examine the visual aspect. Both approaches converge on the need for clear protocols for transparency, labelling, and expert involvement to ensure accurate cultural representation.

In summary, integrating algorithmic methods into humanities research proves productive under three conditions: methodological triangulation, infrastructural support, and ethical regulation, including transparency, attribution, and participation of domain experts. Importance lies in demonstrating that technical tools enhance heuristic capacity, while final academic meaning emerges through human interpretation. Alignment with other studies is evident in conclusions concerning the utility of inductive topic methods, the capabilities of stylometry, the constructive yet limited effect of co-authorship, and the delineation of ethical boundaries in cultural representation. Differences stem from corpus domain, data modality, and validation criteria.

## CONCLUSIONS

The study systematically analysed the potential of machine learning algorithms for the analysis of literary and historical texts and identified problematic aspects related to authorship, creativity, and ethical challenges. The obtained findings confirm that combining topic modelling, transformer-based models, stylometric methods, and tools for identifying intertextual links allows not only the processing of large corpora but also the generation of qualitatively new insights into genre dynamics, cultural circulation processes, and transformations of authorial practices. The study established that the use of topic modelling methods, particularly LDA, reliably identifies latent topics in large corpora, traces their temporal dynamics, and recovers hidden narratives.

It was confirmed that neural models based on transformers, including BERT, Longformer, and BigBird, serve as effective instruments for text classification, named entity recognition, and analysis of discursive features. These models achieve accuracy in identifying toponyms, persons, and organisations, and in classifying genre markers. Full engagement with historical corpora, however, requires specially annotated data that account for orthographic and syntactic variability. Results also indicated that infrastructural solutions, such as the HathiTrust Research Center, hold strategic importance for humanities studies.

Concerning authorship and creativity, the study established that generative systems can function at stages of variant formulation, planning, and draft creation, while final conceptual integrity, interpretation, and responsibility remain human. Co-authorship is conceptualised at three levels: operational, concerning variation in formulation; procedural, concerning structuring and support of iterative processes; and conceptual, concerning intention and interpretation. The study demonstrated that generative models constitute effective instruments, but cannot be regarded as autonomous authors. Ethical analysis identifies bias in training corpora, confidentiality risks, and challenges of cultural representation as genuine threats to research using AI.

The study was limited by its reliance on the synthesis of existing academic sources and case examples. Ethical concerns related to confidentiality and representation could not always be fully addressed within the scope of the study. Future studies should expand practices using long-context models, develop infrastructural solutions, and deepen ethical reflection to ensure greater accuracy, transparency, and cultural relevance in research of this kind.

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## CONFLICT OF INTEREST

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# Virtual and augmented reality as tools for cultural reconstruction

Ilze Eklsa*[1]

[1]College of Arts and Creative Enterprises, Zayed University, Abu Dhabi, United Arab Emirates

**Abstract.** The aim of the study was to explore the possibilities of virtual and augmented reality technologies for the reconstruction of cultural heritage and their integration into educational practices. The study employed a comparative and cognitive-cultural approach to analyse digital projects in three areas: reconstruction of lost monuments, museum practices, and educational applications. The methodology focused on examining sources of three-dimensional modelling, methods of integration into virtual environments, and the functional use of digital platforms across different national contexts. The results of the study demonstrated that virtual and augmented reality technologies provided new opportunities for the preservation and transmission of cultural heritage. They enabled the creation of highly detailed digital copies of architectural and cultural monuments, ensuring their long-term archiving and scientific interpretation. The Palmyra reconstruction project and the Virtual Museum of the Kyiv-Mohyla Academy confirmed the effectiveness of these tools in documenting war damage and safeguarding heritage. At the same time, the "Reborn Rome" initiative revealed the potential of reconstructing entire historical environments, highlighting their value for educational purposes. The analysis of museum practices at the Louvre and the British Museum showed transformations in the ways of presenting and experiencing works of art, while case studies from the United States, Japan, and Ukraine demonstrated that immersion in virtual environments improved learning outcomes and contributed to the development of innovative educational models. The results can be applied by museums, cultural institutions, and educational organisations to preserve heritage digitally and enhance learning through immersive technologies

**Keywords:** digital replicas; immersive technologies; museum practices; interactive engagement; educational programmes

## INTRODUCTION

The relevance of the study was determined by the growing importance of digital technologies in the preservation and actualisation of cultural heritage, as well as by the urgent need to integrate these tools into the humanities. In the modern world, cultural monuments face numerous threats caused by armed conflicts, rapid urbanisation, and natural or technogenic disasters, which have already led to the irretrievable loss of significant architectural and artistic heritage. Under such conditions, the creation of digital models and immersive environments has become not only a means of visualisation, but also an effective strategy for preserving memory about cultural objects and ensuring their accessibility to researchers and society. The research problem lay in the contradiction between the rapid development of virtual reality (VR) and augmented reality (AR) technologies, on the one hand, and the insufficient level of their theoretical conceptualisation and practical integration into the processes of cultural memory reconstruction, formation of historical narratives, and educational practices, on the other.

A number of authors have already outlined scientific guidelines in this area. For example, B. Patychuk (2023) demonstrated that the use of the metaverse not only contributed to the preservation of architectural heritage but also created space for the cultural reuse of lost objects, confirming the potential of digital platforms for restoring collective memory. S. Ivanysko *et al.* (2024) showed that cultural heritage in the context of the Russian-Ukrainian war has become a vulnerable target, and the destruction of monuments has reached the scale of a cultural crime,

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*Corresponding author (ilze.eklsa@gmail.com)

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bringing the issue to the level of international humanitarian discussions. K. Pletsan *et al.* (2023) proved that digital transformation in the field of heritage protection has made it possible to create effective mechanisms for restoring monuments using 3D modelling and interactive technologies, which has significantly increased the possibilities for their documentation and popularisation. At the same time, Y. Trach (2020) showed that the experience of Ukrainian VR reconstructions of historical and cultural objects demonstrated the practical applicability of these solutions for scientific and educational purposes, in particular through the creation of virtual copies of lost buildings.

In a broader context, B. Rodriguez-Garcia *et al.* (2024) found that systematic reviews of VR reconstructions of cultural heritage demonstrated the high effectiveness of immersive technologies in ensuring an authentic perception of historical artefacts, confirming their importance in shaping new formats of interaction with culture. Research by P.M. May *et al.* (2020) showed that the use of AR in museum education contributed to an increase in visitors' cognitive activity and created a multidimensional learning environment. In turn, A.A. Kennedy *et al.* (2021) found that AR in museum spaces fostered positive emotions, increased interest, and improved knowledge, proving the psychological effect of immersive practices.

In the field of art education, J. Hutson & T. Olsen (2022) demonstrated that VR, combined with digital humanities methods, created new formats for studying art history that went beyond traditional didactics. An analysis by H. Musiol (2021) found that the integration of VR into digital and environmental humanities projects contributed to the formation of innovative prototypes, where artistic practice was combined with scientific knowledge. S. Muenster (2022) showed that the use of 3D technologies in humanities research and education opened up broad opportunities for reproducing complex cultural phenomena and expanded the range of interdisciplinary approaches.

A review of the literature revealed several important gaps that determined the need for further research. Despite noticeable progress in the development of immersive technologies, the integration of VR and AR into the reconstruction of war-damaged cultural objects remained insufficiently studied, with most existing works focusing primarily on technical rather than conceptual aspects. Moreover, there was no unified or generally accepted methodology for assessing the impact of immersive technologies on the processes of cultural memory reconstruction and the shaping of historical narratives, which limited the ability to compare results across different projects and contexts. In addition, the prospects for applying VR and AR in the humanities education system had been explored only fragmentarily, and most studies provided general observations without a detailed analysis of specific national contexts.

The aim of the study was to determine the potential of VR and AR technologies for the preservation and interpretation of cultural heritage. Accordingly, the tasks included: analysing the current state of digital reconstructions in Ukraine and worldwide; identifying how immersive environments influence the perception of history and art; revealing the educational value of such technologies in the humanities.

## MATERIALS AND METHODS

The study applied an analytical method to VR/AR projects in cultural heritage and education. The cases included virtual museums in Syria and Ukraine (Kyiv), large-scale urban reconstructions in Italy (Rome), museum exhibitions in France (Paris), the United Kingdom (London), and Ukraine (Lviv, Kyiv), as well as educational platforms in the United States (Stanford, MIT), Japan (Tsukuba), and Ukraine (Lviv) (Virtual Museum of Syria, n.d.; National University of "Kyiv-Mohyla Academy" Virtual Museum, n.d.; British Museum, n.d.; Virtual tourism, n.d.; Virtual Human Interactional Lab, n.d.; Reinventing Education, n.d.; Artificial Intelligence Laboratory, n.d.; Lviv's Heritage in 3D, n.d.; Mona Lisa Beyond the Glass…, 2019; Rome Reborn: The Pantheon, 2024).

The selection of materials was based on three criteria: the availability of official digital platforms or programmes, the accessibility of descriptions of the technologies used, and representativeness for three areas: the reconstruction of cultural monuments, museum communication, and educational practices. This allowed to include cases that reflected both the conservation of destroyed objects and the restoration of intact historical spaces and their integration into the educational process. The research methodology included a descriptive and comparative approach. For each case, the data sources on which the reconstruction was based were recorded. These included text and visual sources, as well as modern 3D visualisation technologies. Technical means of integration into VR and AR environments, methods of creating virtual tours, and demonstration formats (online platforms, museum exhibitions, educational lectures) were noted. Particular attention was paid to the cross-country comparison of practices. The Syrian and Ukrainian cases were analysed as examples of recording war damage and its digital preservation. The Italian experience of Rome Reborn represented the reconstruction of a historic city in its heyday. French and British museum initiatives were evaluated through the prism of interpretive potential and impact on the perception of art objects. Educational projects in the United States, Japan, and Ukraine were compared in terms of ways to integrate VR and AR into educational programmes at various levels.

The analytical framework was based on a cognitive-cultural approach. For each example, the cognitive possibilities of virtual reality (VR) and augmented reality (AR) were identified, including the presence effect, multi-channel interaction, and interactive perception, as well as the ways in which cultural and historical contexts were reflected in the virtual environment. This ensured a comprehensive comparison of digital practices across different national and disciplinary settings.

## RESULTS

### Reconstruction of cultural monuments using VR and AR technologies

Virtual and augmented reality have become effective tools for recreating destroyed or lost architectural and historical-cultural objects. The use of three-dimensional modelling, photogrammetry and geospatial data has made it possible to create digital replicas of monuments that are under threat of destruction or have already lost their authentic appearance. Such solutions not only ensured the archiving of information about cultural objects, but also provided interactive access for a wide audience through virtual tours, educational programmes and museum exhibitions. The use of VR and AR in this context was interdisciplinary in nature, combining methods from archaeology, architecture, computer science and cultural studies.

One notable example was the reconstruction of the ancient city of Palmyra in Syria, which suffered extensive damage in 2015. The destruction of architectural complexes affected key cultural heritage sites – the Temple of Bel, columned streets and other monumental structures that had previously been included in the UNESCO World Heritage List (Site of Palmyra…, 2017). In response to the losses, international research and technical teams launched the large-scale Palmyra VR Project (Virtual Museum of Syria, n.d.), which involved the creation of comprehensive three-dimensional models of architectural monuments. The main goal of the project was to preserve information about objects that could not be physically restored in digital format and to provide access to them for the scientific and educational community (Fig. 1).

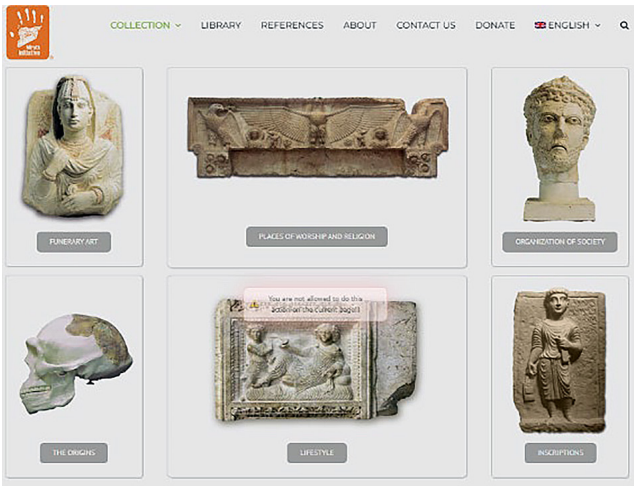


**Figure 1.** Palmyra VR Project interface

**Source:** Virtual Museum of Syria (n.d.)

The digital models were created by combining various data sources: high-resolution photogrammetry, archival drawings and photographs, and satellite images. The use of these materials made it possible to create multi-level virtual reconstructions that took into account both the general proportions of architectural complexes and small decorative elements. The accuracy of the modelling made it possible to reproduce the texture of the stone, the structural organisation of the buildings, and the spatial interaction between different architectural components. The result was digital replicas that not only served as visualisations but also as a scientific source for further architectural analysis. The developed models were integrated into a VR environment, which opened up opportunities for their practical use. Researchers obtained a tool for remote analysis of architectural solutions, comparative studies, and reconstruction of historical contexts that would otherwise have been lost. VR tours were created for a wide audience, allowing them to virtually visit the territory of Palmyra, familiarise themselves with architectural ensembles and obtain multi-level information about their historical function and development. This combination of scientific and educational components contributed to the formation of a new type of interaction with cultural heritage, in which the user was not only a passive observer but also an active participant in the process of cognition. The Palmyra VR Project demonstrated that digital technologies can serve as a compensatory mechanism in the event of the loss of the physical cultural environment. Virtual reconstructions ensured the long-term preservation of material culture in digital form, while making it accessible to researchers, educators and the general public. This example confirmed the effectiveness of VR in the field of cultural heritage, where digital representation can become not only a means of archiving, but also a tool for restoring cultural memory and supporting intercultural dialogue.

The Ukrainian context has seen significant development in the use of VR technologies for the reconstruction and preservation of cultural heritage. One example is the Virtual Museum of Kyiv-Mohyla Academy (National University of "Kyiv-Mohyla Academy" Virtual Museum, n.d.), which was created as a comprehensive

digital platform for representing architectural objects and monuments that are at risk of being lost or have been destroyed as a result of contemporary social and military challenges. The main objective of the project was not only to document cultural artefacts, but also to create an interactive environment in which digital copies could be used in educational, scientific and museum contexts. Three-dimensional models were created based on photogrammetry, archival drawings, historical images and modern visualisation technologies (Fig. 2, 3).

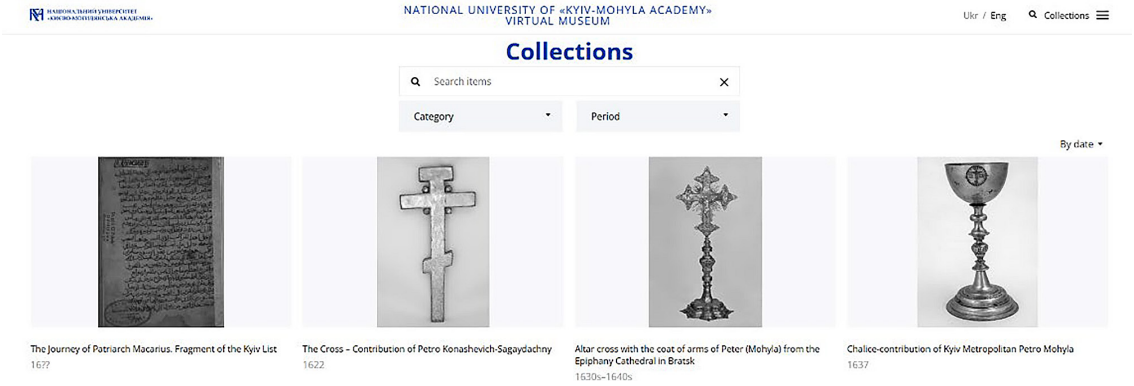


**Figure 2.** Interface of the Virtual Museum of Kyiv-Mohyla Academy
**Source:** National University of "Kyiv-Mohyla Academy" Virtual Museum (n.d.)

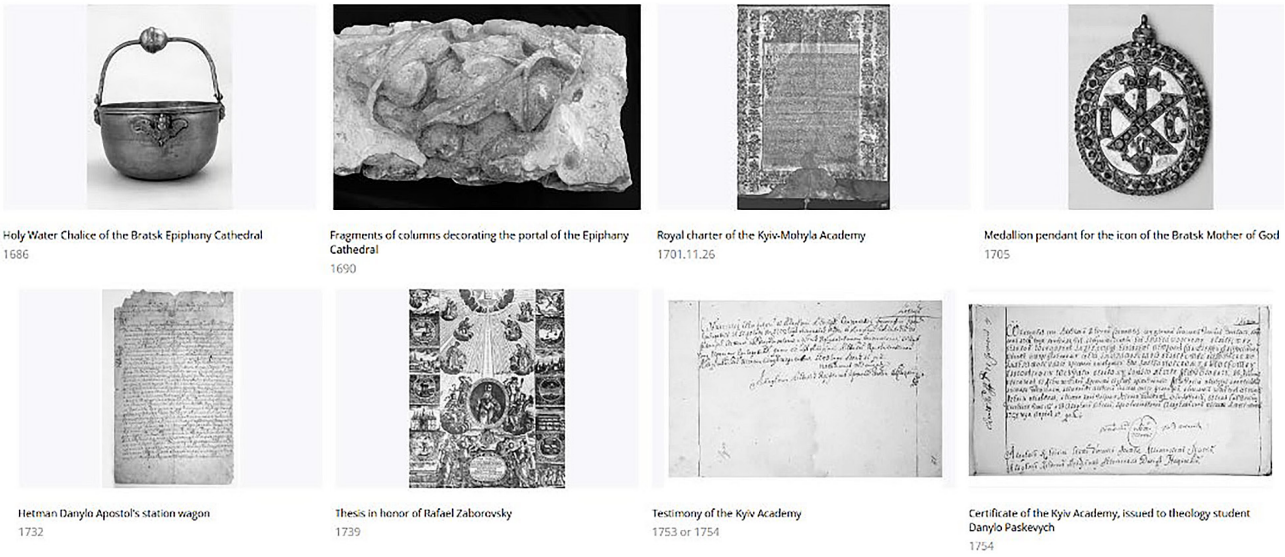


**Figure 3.** Exhibition collections of the Virtual Museum of Kyiv-Mohyla Academy
**Source:** National University of "Kyiv-Mohyla Academy" Virtual Museum (n.d.)

The combination of these sources ensured the accurate reproduction of architectural structures and museum artefacts, including their details, scale and spatial organisation. The result was the creation of 3D copies that were integrated into a VR environment, allowing not only the archiving of cultural heritage, but also providing users with the opportunity to interact with the reproduced objects in the form of lectures, scientific research or virtual exhibition spaces. A significant result of the project was the formation of a concept of digital preservation of cultural heritage, within which the VR platform performed a dual function: on the one hand, an archive with a high level of scientific reliability, and on the other, an educational resource for a wide audience. This made it possible to integrate digital models into courses on cultural history, architecture and art, as well as to use them in interdisciplinary research. The importance of the project went beyond the local level. The Virtual Museum of Kyiv-Mohyla Academy gained international significance as it became a tool for promoting Ukrainian cultural heritage in the global academic and museum environment. This provided new opportunities for cultural diplomacy, expanded the accessibility of Ukrainian heritage to foreign researchers, and at the same time integrated Ukrainian experience into global discussions on digital humanities and cultural memory preservation practices (Marukhovska-Kartunova *et al.*, 2024).

In the European context, a key example was the Rome Reborn: The Pantheon (2019) project, aimed at large-scale

recreation of a virtual image of Ancient Rome in the 4th century AD. The main goal of the initiative was to create a comprehensive three-dimensional model of the city that reflected not only architectural ensembles but also the spatial logic of the urban environment. The project reconstructed the main public buildings, including the Colosseum, the Roman Forum, thermal baths, temples and basilicas, as well as residential quarters with the recreation of their internal structure. A distinctive feature of the project was the combination of historical and archaeological data with high-resolution computer graphics (Fig. 4).


**Figure 4.** Rome Reborn interface
**Source:** Rome Reborn: The Pantheon (2024)

Archaeological drawings, excavation data, textual sources from the ancient period, and the results of modern research on the history of Roman architecture were used to create the models. This ensured a high level of scientific reliability and accuracy of the reconstructions. At the same time, the use of VR tools made the results accessible to a wide audience, who could interact with the digital space in the form of interactive walks. The project allowed users to move through the virtual streets of the city, view architectural objects from different angles, and perceive the recreated space on a scale as close to reality as possible. This created conditions for a new type of immersion in the study of urbanism and architecture, where traditional textual or graphic representations were replaced by a multi-channel and dynamic experience. The significance of Rome Reborn went beyond purely scientific interest. Its results were actively implemented in the educational process of universities, where VR reconstructions were used as a tool for teaching the history of architecture, archaeology, and cultural studies. In addition, digital models became part of museum exhibitions and specialised online platforms, providing broad access to both the academic community and visitors interested in the history of Rome. In this way, the project demonstrated the potential of VR reconstructions for interdisciplinary education, museum practice, and cultural promotion, establishing them as an effective tool in the field of digital humanities (Frischer & Massey, 2022).

A comparison of the above examples revealed several key trends. In the case of Syria, the reconstruction aimed to preserve cultural heritage destroyed by conflict while making it accessible to the international community. Ukrainian initiatives demonstrated a similar approach, but in the more dynamic context of modern warfare, where digital documentation was combined with the task of creating an evidence base for destruction. The Italian project Rome Reborn developed another dimension – it was based not on the conservation of losses, but on the reconstruction of the historic city in its heyday, providing a tool for educational immersion and scientific analysis. Thus, each of the above cases represented different models of VR and AR application: from documenting losses to reconstructing the past in its entirety (Table 1).

**Table 1.** Key results of VR and AR reconstructions of cultural heritage

| Result of VR and AR reconstructions | Content of the result | Examples of application |
|---|---|---|
| New form of archiving | Preservation of architectural and cultural data in the form of digital copies with a high level of detail | 3D scanning of heritage sites, creation of digital replicas of destroyed monuments |
| Interactive interaction | Ability to move within virtual spaces, view objects from different angles, and access supplementary information | Virtual museum tours, VR excursions to historical sites |
| Educational dimension | Use in university programs, museum pedagogy, and cultural diplomacy; overcoming physical and geographical limitations | VR lectures, AR textbooks, international cultural projects |

**Source:** compiled by the author based on N.J. Shih *et al.* (2020), R. Spallone *et al.* (2022), R.G. Boboc *et al.* (2022)

The use of VR and AR in the reconstruction of monuments has proven effective in three areas. First, these technologies have contributed to the preservation of material objects in digital form and minimised losses in the event of destruction. Secondly, they have provided greater access to cultural heritage, enabling researchers and visitors from around the world to interact with restored monuments. Thirdly, VR and AR have become tools for integrating cultural heritage into the educational process, combining academic authenticity and audience engagement. Thus, the review of international and national examples has confirmed the universality and promise of VR and AR reconstructions in the field of cultural heritage preservation. Despite different contexts – from war damage to

archaeological reconstructions of ancient cities – all projects demonstrated the high potential of digital technologies to ensure the accessibility and longevity of cultural memory. Given these results, VR and AR can be considered integral tools of modern cultural policy aimed at preserving and actualising historical and cultural heritage.

**The impact of virtual and augmented reality on the perception of history and art**

Immersive technologies have opened up new opportunities for interpreting historical events and art objects. The use of VR and AR in museum practices has changed the way visitors interact with cultural heritage, expanded the boundaries of perception, and shaped new educational formats. Traditional familiarisation with exhibitions in physical space has been supplemented with interactive tools that provide a sense of presence and expand the cognitive capabilities of the audience. This has made it possible to combine aesthetic perception with analytical consideration, creating a multi-level system of access to cultural content (Trunfio *et al.*, 2022).

The French experience demonstrated the integration of VR in leading museum institutions. The Louvre introduced VR exhibitions that provided visitors with the opportunity to interact directly with individual works of art. In particular, when using the Mona Lisa Beyond the Glass… (2019) app, visitors could view the painting in virtual space, enlarging individual fragments and exploring artistic details that were inaccessible in the physical hall. This form of presentation did not replace the original, but provided an additional tool for its study. The VR exhibition combined visual material with multimedia explanations, which helped to form a holistic view of the art object. Such practices allowed for a combination of emotional and scientific perception, expanding the range of interpretative possibilities (Fig. 5).

**Figure 5.** VR exhibition "Mona Lisa Beyond the Glass"
**Source:** Mona Lisa Beyond the Glass… (2019)

British museums have also been actively using virtual technologies. The British Museum (n.d.) has provided users with the opportunity to take VR tours of the halls containing collections from ancient Egypt and Mesopotamia. The virtual routes were integrated with the museum's databases, allowing users to obtain structured scientific information about the artefacts during their virtual journey. The effect of presence was enhanced by the ability to move freely around the exhibition space and interact with digital copies of the objects. This format created new educational narratives in which history and archaeology were presented through a multidimensional experience that included visual, spatial, and intellectual levels. The use of VR at the British Museum confirmed that technology can combine academic authenticity with accessibility for visitors of all levels of preparation (Fig. 6, 7, 8).

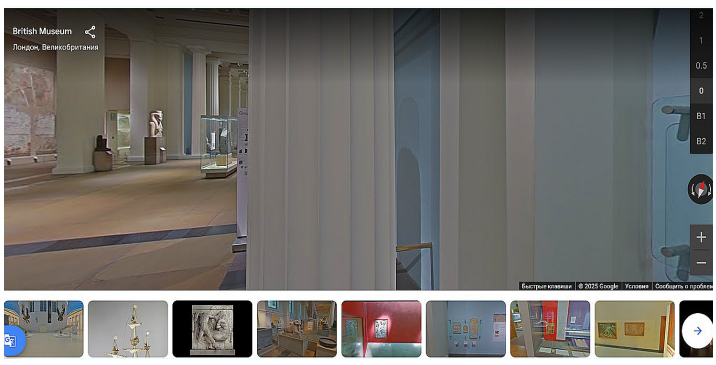


**Figure 6.** Gallery of British Museum in VR tour interface
**Source:** Google Arts & Culture (n.d.)


**Figure 7.** Gallery of British Museum in VR tour interface

**Source:** Google Arts & Culture (n.d.)


**Figure 8.** Icon of Triumph of Orthodoxy

**Source:** Google Arts & Culture (n.d.)

Ukrainian museums were in the process of testing augmented reality in their activities. Experimental AR applications were implemented in Lviv and Kyiv, allowing reconstructions of the original appearance of exhibits to be superimposed on their current state. Such solutions made it possible to visualise fragmented or damaged objects in their restored form, giving visitors an idea of their original shape and function. In practical terms, AR applications were used for interactive lectures and museum demonstrations, where users could compare the real exhibit with its digital reconstruction. This created a new level of perception, in which the authentic object was combined with its virtual reconstruction, forming a comprehensive view of the cultural artefact (Fig. 9).

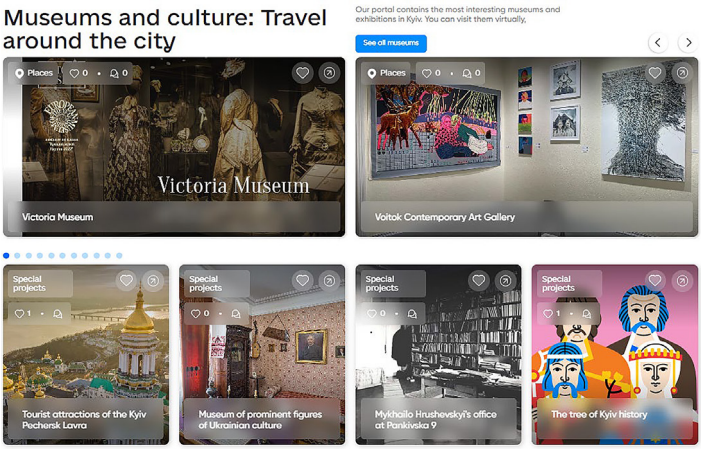


**Figure 9.** Exhibitions of Kyiv Tourism Hub

**Source:** Virtual tourism (n.d.)

A comparative review of these examples demonstrated the diversity of approaches to the application of VR and AR in the field of art and history. French VR exhibitions focused on detailing works of art and expanding the possibilities for their study. The British Museum used VR as a tool for interactive access to large-scale collections,

creating new forms of popular science presentation of history. Ukrainian practices focused on reconstructing the original appearance of exhibits, which allowed them to restore their integrity in the perception of the modern audience. Despite the differences, all examples had one thing in common: the use of immersive technologies made it possible to overcome the limitations of traditional museum space and form new approaches to the presentation of cultural heritage. The use of VR and AR in museum practices has proven its effectiveness in combining several aspects. The technologies expanded the cognitive potential of perceiving history and art through interactive engagement and multi-channel experiences, while also contributing to the creation of innovative educational models that combined academic content with immersion in a virtual environment. In addition, VR and AR have increased the accessibility of cultural heritage for those groups of visitors who were unable to physically visit museums. Taken together, these characteristics have shown that immersive technologies have become an integral part of contemporary museum and educational practices, transforming the ways in which society interacts with cultural heritage.

**Educational applications of virtual and augmented reality technologies**

The use of virtual and augmented reality in education has demonstrated the potential to transform the learning process in the humanities. Immersive technologies have made it possible to combine academic content with visualisation and interactive engagement, which has helped to expand cognitive abilities and increase the engagement of students and pupils. An important feature of VR and AR was the creation of a multi-level learning environment where traditional forms of information presentation were complemented by practical tools for immersion in virtual spaces and reconstructed objects. This shaped a new format of educational activity that combined theoretical knowledge and empirical experience (Valli & Carlomagno, 2024).

The experience of introducing immersive technologies into education demonstrated different models of their application depending on the level of education and national context. Universities in the United States have become one of the leading centres for the integration of VR into educational programmes, particularly in courses on art history and cultural studies. Stanford University offered courses that gave students the opportunity to virtually visit reconstructed ancient monuments and medieval cathedrals (Virtual Human Interactional Lab, n.d.). This allowed them to analyse architectural details, the spatial organisation of objects and the cultural context of their functioning. The use of VR went beyond traditional text materials and illustrations, creating an immersive experience in a restored historical space. Such classes provided a deeper understanding of cultural phenomena and contributed to the development of analytical skills. At the Massachusetts Institute of Technology, VR was actively integrated into interdisciplinary courses, where digital reconstructions were used not only to analyse works of art, but also to study sociocultural processes (Reinventing Education, n.d.). This demonstrated a gradual transition from the narrow professional use of technologies to their application as a universal learning tool capable of combining humanities and technical knowledge. The American experience as a whole showed that VR courses became the basis for the formation of new educational models, where technological innovations were integrated into the academic process.

A similar approach to integrating immersive technologies into the educational process was implemented in Japan, where the main focus was on school education. Unlike in the United States, where VR was used primarily in university courses and combined academic and research practices, Japanese initiatives were aimed at adapting historical material for primary and secondary school students. As part of the collaboration between the Artificial Intelligence Laboratory (n.d) and the University of Tsukuba, a new generation of AR textbooks was developed, allowing historical scenes to be reproduced directly on the pages of printed publications. The use of tablets or smartphones made it possible to activate three-dimensional models of architectural complexes, objects of material culture, or reconstructions of events, creating the effect of immediate presence. This practice provided students with a new format for acquiring knowledge, in which the textual material of the textbook was combined with visual elements and interactive tasks. The educational effect was that schoolchildren could not only familiarise themselves with the facts, but also visualise historical phenomena in their cultural and spatial context. This contributed to the development of spatial thinking, the formation of a comprehensive understanding of historical processes, and increased motivation to learn. In addition, the involvement of university researchers in the development of school materials made it possible to combine academic reliability with modern methods of presenting information, which made AR textbooks both scientifically sound and pedagogically effective tools (Kleftodimos & Evagelou, 2025).

The Ukrainian experience logically complemented the examples given, as it demonstrated the use of VR in higher education in the context of contemporary challenges, in particular the destruction of cultural heritage during the war. Lviv Ivan Franko National University held VR lectures on cultural heritage, during which students worked with three-dimensional models of destroyed architectural objects. This allowed them to familiarise themselves with monuments that could not be visited physically and to form a holistic understanding of their historical and cultural value. Unlike American university practices focused on the reconstruction of world monuments, Ukrainian VR lectures also served to preserve national cultural memory. At the same time, this approach echoed the Japanese one, as both models demonstrated a desire to make cultural heritage accessible to those who were unable to interact with it in physical space (Fig. 10).

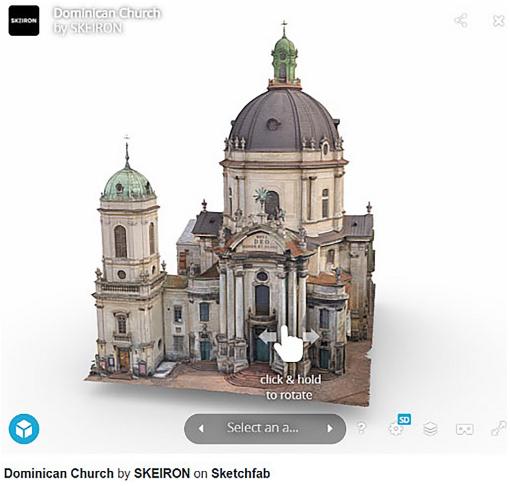


**Figure 10.** 3D visualisation of Dominican Church
**Source:** Lviv's Heritage in 3D (n.d.)

A comparison of practices in the United States, Japan, and Ukraine revealed different approaches to the implementation of VR and AR in education. University programmes in the United States focused on the use of VR for immersion in reconstructed cultural spaces, which contributed to the development of analytical skills and the combination of humanities and technological aspects. Japan demonstrated a focus on school education, where AR textbooks helped to visualise material and shape perceptions of historical events through interactive engagement. Ukrainian universities used VR to restore access to destroyed cultural monuments and create learning environments that combined local and global cultural contexts. All these examples showed that VR and AR not only increased student and pupil engagement, but also shaped new educational models that combined academic rigour with innovative approaches to presenting material. A summary of the results gave reason to conclude that VR and AR have become an important factor in the modernisation of the educational process in the humanities. Immersive technologies opened up access to cultural heritage in conditions of limited resources and destruction, created a multidimensional learning experience, and promoted the development of critical thinking. They ensured versatility of application, as they were effective in school, university, and interdisciplinary education. This confirmed that VR and AR shaped new approaches to teaching cultural heritage, combining traditional academic structure with innovative means of knowledge transfer, which met the modern needs of humanities education.

## DISCUSSION

The results of the reconstruction of cultural monuments using VR and AR in this study were consistent with the conclusions of G. Neglia *et al.* (2024), who emphasised the role of digital tools in preserving heritage during military conflicts. Examples from Palmyra and Ukrainian initiatives demonstrated the universality of this approach. At the same time, the cited works placed greater emphasis on the risks of losing objects and the need for urgent response, while this study also highlighted the long-term function of digital conservation. Thus, the results of this study expanded on the conclusions of its predecessors, as they emphasised not only the defensive but also the educational function of digital replicas.

The recreation of Palmyra in Syria in the Palmyra VR Project echoed the approaches of Y.J. Alkhatib *et al.* (2023), who viewed 3D reconstructions as a way to bring lost heritage back to life. This study showed that such reconstructions not only restored the architectural appearance but also shaped the educational environment. Unlike the authors mentioned above, who focused primarily on technical and visualisation aspects, the results of this work demonstrated the cultural and social dimensions of digital copies. This made it possible to combine scientific reconstruction with the formation of new models of interaction with the past, which complemented the experience of previous studies. An analysis of the use of interactive 360° media in heritage preservation, conducted by R. Dieb *et al.* (2024), confirmed the importance of visual accessibility for an international audience. In this study, a similar emphasis was placed on virtual tours of Palmyra and other sites, which created a sense of presence for users. However, unlike the study by the aforementioned authors, where technology served primarily as a means of popularisation, the results of this work revealed its potential for scientific analysis and the educational process. Thus, the approach of this study complemented existing practices by integrating entertainment, educational and research aspects into a single immersive format.

The study by S. Pouryousefzadeh *et al.* (2021) revealed the potential of innovative technologies for restoring cultural heritage within "smart cities" The results of this study were consistent with their conclusions, as they also showed the possibilities of VR and AR for integrating heritage into modern urban spaces. At the same time, the role of these technologies in preserving cultural memory under conditions of destruction was emphasised, which had not been a central aspect in the work of the aforementioned authors. Thanks to this, the results of this study broadened the context, demonstrating the versatility of VR and AR in combining urban and cultural dimensions. The large-scale virtualisation of Rome in the Rome Reborn project, described by M. Fasolo (2024), emphasised the educational potential of VR reconstructions. These conclusions were confirmed in this study, which also traced the integration of digital models into the educational process. A particular emphasis was placed on distinguishing between the reconstruction of lost objects and the virtualisation of cities in their period of prosperity. Thus, the results of this study expanded on M. Fasolo's conclusions by revealing different strategies for using VR: as a compensatory mechanism and as a tool for educational immersion. This allowed for a more comprehensive outline of the range of possibilities offered by immersive technologies.

The use of AR for the restoration of cultural objects, highlighted by A.O. Sachenko & I.R. Kit (2024), was consistent with the Ukrainian examples considered in this study. The similarity lay in the use of augmented reality to reconstruct fragmented or damaged artefacts. At the same time, the results of this work showed that AR not only visualised the original appearance of objects but also created a new level of museum communication. This differed from the more technical focus in the study by A.O. Sachenko & I.R. Kit and made it possible to highlight the pedagogical and educational potential of AR, which still requires further development. The study by H. Li & I. Hiromu (2021) examined projection mapping technologies as a means of bringing cultural objects to life. The results of this work confirmed the importance of visual immersion in engaging the audience. At the same time, VR and AR were considered more broadly as tools providing not only aesthetic but also cognitive impact. Thus, the results obtained made it possible to specify the conclusions of H. Li & I. Hiromu by demonstrating the integration of visual perception effects with educational and scientific potential. This made it possible to outline the multi-level impact of immersive technologies on society.

The phenomenological approach to museum experience developed by C. Palmer (2023) was found to be relevant for comparison with the obtained results. The author emphasised the interaction of visitors with digital space as a way of understanding cultural content. In this study, a similar idea was implemented through the analysis of VR exhibitions at the Louvre and the British Museum. However, unlike C. Palmer's work, which focused on individual experience, the results of this study also considered the collective dimension – educational programmes, university courses, museum lectures. This made it possible to refine the conclusions of the predecessor, expanding them towards the social integration of VR. The digital replicas of museum artefacts described by G. Patrucco *et al.* (2023) confirmed the importance of three-dimensional models as a scientific source. In this study, a similar emphasis was placed on the analysis of Ukrainian and international projects. At the same time, the results of this work also highlighted the educational and diplomatic potential of digital models, which went beyond purely scientific use. Thanks to this, they refined the conclusions of the aforementioned authors, proving that digital replicas can serve as a means of cultural diplomacy and popularisation of national heritage in the global space.

The combination of 3D imaging with mixed reality, as discussed by V. Barrile *et al.* (2022), highlighted the potential of new technologies in museum activities. In this study, these conclusions were confirmed by the example of Ukrainian AR applications that restored the original appearance of exhibits. However, attention was focused on the integration of such practices into the educational process, which differed from the more technological approach of V. Barrile *et al*. This led to the conclusion that VR and AR are becoming not only tools for museum presentation but also platforms for comprehensive humanities education. The creation of 3D objects for VR and AR applications, described by S. Van Nguyen *et al.* (2022), demonstrated the technical aspects of digital model formation. These findings were further developed in the direction of integrating 3D models into educational courses and museum exhibitions. While the work of the aforementioned authors emphasised technological innovations, the results of this work demonstrated their cultural and educational potential. This made it possible not only to confirm the importance of digital technologies but also to outline new perspectives for their use in humanities practices.

A comparative analysis outlined the common and distinctive features in approaches to the use of virtual and augmented reality in the reconstruction of cultural heritage, museum practices, and educational models. It was shown that, regardless of national contexts and research traditions, VR and AR are universal tools for preserving cultural memory and forming new formats of interaction with the past. A comparison of the results with scientific developments made it possible to not only confirm but also refine previously formulated conclusions, broadening the understanding of the possibilities of immersive technologies in the humanities. Such complexity provides a basis for generalising key trends and formulating the final conclusions of the study.

## CONCLUSIONS

The study showed that VR and AR enable the reconstruction of cultural objects and their integration into education and museum practice. Projects such as Palmyra VR, the Virtual Museum of Kyiv-Mohyla Academy, and Rome Reborn demonstrated the creation of authentic 3D replicas for archiving, research, and public access. Immersive environments reproduced spatial and morphological features of monuments, supporting remote analysis and interpretation. The results confirmed three main outcomes: digital preservation, interactive engagement, and educational integration. Examples from the Louvre, the British Museum, and cases from the United States, Japan, and Ukraine highlighted the cognitive and pedagogical value of these technologies. Altogether, VR and AR proved to be effective tools for preserving heritage and modernising the humanities.

The comparative analysis revealed distinct functional objectives: in contexts of war damage, priority was given to documenting losses and ensuring digital preservation; in historical urbanism projects, emphasis was placed on reconstructing entire urban ensembles for research and education; in museum practice, the focus lay on enhancing accessibility and explanatory value. Effective scaling of such initiatives required cooperation among museums, universities, archives, technology partners, and heritage protection bodies. The study confirmed that VR and AR serve as efficient tools for cultural reconstruction and education, highlighting the need for international standards and collaboration to secure validity, sustainability, and accessibility of digital heritage solutions.

A limitation of the study was that the analysis was based mainly on individual cases and available public

sources, which did not allow for a comprehensive overview of existing VR/AR projects and their technical characteristics. Promising areas for further research were identified as the development of unified standards for digital conservation, the evaluation of the pedagogical effectiveness of VR/AR in different educational contexts, and the integration of artificial intelligence for the automation of cultural object reconstruction processes.

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# Social media as a space of global cultural transformations

Erisela Marko*[1]
[1]European University of Tirana, Tirana, Albania

**Abstract.** The aim of the study was to determine how digital platforms shaped new cultural identities and became a space of global cultural transformations. The methodology was based on a qualitative approach using discourse analysis, case study, and comparative analysis. The research considered examples of digital identity (virtual avatars, memes, biographical practices), the functioning of virtual communities (diaspora groups, open communication platforms, communities of practice), and global cultural trends that emerged on social media. The results established that digital identities were formed through the combination of individual self-presentation and algorithmically generated data, creating multidimensional representations that differed from offline personalities but had social significance. The phenomenon of multicultural hybridity was identified, manifested in the combination of linguistic codes, content stylistics, and symbolic markers from different cultural contexts. It was demonstrated that virtual communities performed the functions of transcultural contact: diaspora groups preserved and adapted traditions, open communication platforms contributed to the creation of collective narratives, and professional and academic networks ensured collective knowledge and cooperation in multicultural environments. It was established that global cultural trends such as That Girl, Italian Brainrot and Aura Farming spread through algorithmic amplification and mass user replication, rapidly transcending local contexts and gaining worldwide circulation. The practical significance of the study was that the results could be used for the development of strategies of digital cultural policy, educational programmes on media literacy and intercultural communication, as well as for further investigation of the long-term effects of digital trends on the processes of identity and cultural memory

**Keywords:** digital identity; hybridity; transcultural interaction; community of practice; replication; cultural diffusion; aspirational identity

## INTRODUCTION

In the twenty-first century, social media became a key driver of global cultural change. They not only transmitted information but also shaped new identity practices, facilitated transcultural contacts, and generated viral trends that spread faster than traditional forms of cultural exchange. The relevance of the study is determined by the fact that digital platforms have turned into environments where local practices merge with global narratives, and new models of cultural identity are formed on an unprecedented scale. The research problem lies in the lack of a holistic understanding of how exactly social media functions as a space of cultural transformation.

Scholars have shown strong interest in the ways social media reshape cultural practices and identities. E. Arya (2024) argued that digital platforms contribute to a shift from collective models of unity to individualised self-expression, offering opportunities to construct identity beyond traditional social structures. Similarly, C.P. Pande & K.B. Asthana (2024) demonstrated that social networks foster hybrid identities that combine local cultural features with global narratives, thus creating conditions for multicultural identity formation. The issue of intercultural interaction is central in the work of F. Helm (2024), who showed that virtual exchange fosters competences of mutual understanding and supports new approaches to cooperation in multicultural environments.

Philosophical perspectives also play a crucial role in the discussion of cultural globalisation. H. Fang (2020) emphasised that expanding global flows inevitably produce hybrid identities, revealing a dialectic between

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*Corresponding author (erisela.marko@uet.edu.al)

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homogenisation and the preservation of difference. He argued that globalisation not only unifies cultural practices but also revives attention to cultural memory as a resource of resistance. A. Rojas (2025) analysed identity formation through the lens of axiological philosophy, suggesting that digital infrastructures create multidimensional identities where individual self-construction intersects with collective value systems. Cultural memory, in this view, is continuously reinterpreted in the digital sphere and becomes a foundation for negotiating identity. Complementing these approaches, R. Bentley *et al*. (2023) conceptualised cultural evolution in digital environments, demonstrating how disinformation and fragmented networks both intensify social divisions and simultaneously enable the emergence of new, digitally mediated identities.

The reviewed studies highlight significant progress in understanding the cultural impact of social media. However, important gaps remain: there is no integrated framework that would simultaneously address the emergence of new cultural identities, transcultural interactions within virtual communities, and the mechanisms underlying global trend formation on digital platforms. These aspects define the focus of this research. The aim of the study was to clarify how social media contribute to the formation of new cultural identities, create spaces for transcultural interaction, and generate global cultural trends. To achieve this aim, the study sets the following objectives: to identify the features of new cultural identities in digital environments, particularly the phenomena of digital identity and multicultural hybridity; to analyse virtual communities as spaces of transcultural contact and mechanisms for preserving cultural memory; and to investigate global cultural trends arising on digital platforms, tracing their dynamics of dissemination and their influence on different cultural contexts.

## MATERIALS AND METHODS

The research was conducted within the framework of cultural and media studies, applying a qualitative methodology aimed at identifying patterns of cultural transformation in the digital environment. The methodological basis combined elements of discourse analysis, case study, and comparative analysis, which made it possible to examine both specific examples of digital content and broader processes of intercultural interaction on social media platforms.

To determine the features of the emergence of new forms of cultural identities in the digital environment, several case studies were selected. The article by E. Petrarca (2018) was used as an empirical foundation for analysing the CGI-influencer Lil Miquela. This source was chosen because it provided a comprehensive account of the construction of a virtual personality that had gained recognition equivalent to real media figures. The analysis of E.G. Ellis (2024) was employed to investigate the Dolly Parton meme, as this example offered clear evidence of how individuals consciously adapted identity presentation to the specific norms of different platforms. The text by L. Hendrickson (2024) was included to conceptualise the dual structure of digital identity (active and passive), providing a theoretical framework for understanding the algorithmic dimension of identity formation. N. Allen (2024) was used to illustrate the role of short biographical descriptions on Twitter, which allowed for the identification of strategies of multidimensional self-presentation. These materials were selected because they represented complementary perspectives: virtual avatars, memes, algorithmic identities, and biographical narratives, thereby covering diverse manifestations of digital identity and multicultural hybridity.

The second stage of the research focused on analysing the functioning of virtual communities as spaces for transcultural contact and mechanisms of preserving cultural memory. The Facebook group Ukrainians in USA (Ukrainian Diaspora in USA, 2025) was selected as an illustrative case of diaspora communities. This case was used to examine the mechanisms through which cultural traditions are transmitted and sustained in digital environments. K. Raouna (2024) provided a typology of online communities, which allowed for the analysis of platforms such as Reddit (n.d.), Discord (n.d.), and Twitch (n.d.) as spaces for global communication and exchange. The website Stack Overflow (Newest Questions Stuck OverFlow, 2025) was studied as a large-scale community of practice, illustrating the role of collective knowledge exchange among programmers worldwide. Finally, ResearchGate (n.d.) was included to represent international academic collaboration in digital environments. These materials were chosen because they reflected different functions of virtual communities: heritage preservation, everyday interaction, professional cooperation, and academic exchange.

The third research stage was devoted to investigating global cultural trends that originated on digital platforms, tracing their dissemination dynamics and their influence on cultural environments. The video of TikTok (n.d.) about morning routine (The ideal morning routine for 2022, 2022) was analysed as the origin of the That Girl trend, which provided insight into the construction of aspirational lifestyles. The source Best brainrot characters (2025) was employed to investigate the Italian Brainrot trend, as it offered a clear example of the use of AI-generated content and the transcultural circulation of humour. The video of Rayyan Arkan Dikha (Aura Farming Rayyan arkan dikha, 2025) was selected to illustrate the Aura Farming trend, which exemplified how local cultural expressions could gain worldwide recognition through replication and algorithmic amplification. These cases were chosen because they reflected different mechanisms of trend formation: lifestyle aesthetics, absurdist creativity, and performative authenticity. The selection of materials was guided by the principle of representativeness, as each case provided an illustrative and widely recognised example within its category. The use of diverse platforms and content types made it possible to examine digital cultural processes from multiple perspectives, covering identity construction, community functioning, and trend dissemination.

## RESULTS

**New forms of cultural identities in the digital environment.** The concept of cultural identity in academic discourse was traditionally associated with the idea of belonging to an ethnic, national, or religious community. In the classical approach, identity was defined through shared values, traditions, language, and social practices that shaped a sense of collective unity. However, with the spread of digital technologies and interactive platforms, the focus shifted: the concept of identity began to be seen as a dynamic construct arising from constant interaction in digital spaces.

The concept of digital identity encompasses a wide range of components that extend beyond traditional notions of personal identity. It integrates unique user markers, socio-cultural aspects of interaction, and algorithmically generated data. These elements jointly construct a complex representation of an individual in the digital environment (Fig. 1).

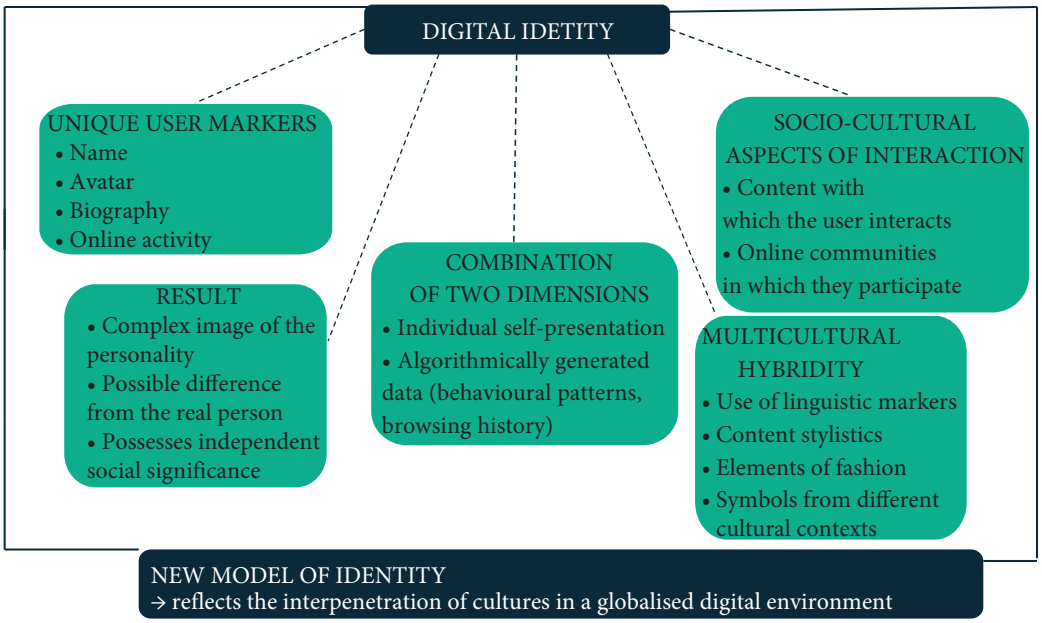


**Figure 1.** Scheme of the coverage of the term "Digital Identity"
**Source:** compiled by the author based on M.M.F. Majeed *et al.* (2020) and M. Robles-Carrillo (2024)

The scheme from Figure 1 demonstrates that digital identity is not confined to explicit user self-presentation but also involves data generated through interaction and algorithmic processing. As a result, digital identity functions as a hybrid construct that merges personal, cultural, and technological dimensions. This complexity enables the emergence of multicultural hybridity and the development of new identity models reflecting the interpenetration of cultures in a globalised digital environment. An example of digital identity was the virtual character Lil Miquela (Miquela Sousa), created as a CGI-influencer on the Instagram platform (Fig. 2).

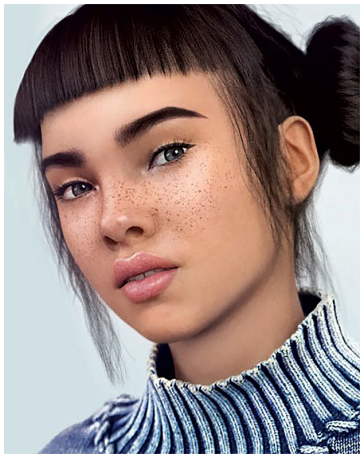

**Figure 2.** Lil Miquela

**Source:** E. Petrarca (2018)

She had more than one million followers and demonstrated activity characteristic of real media figures: publications with fashion brands, music releases, participation in social discussions. This example confirmed that identity could exist independently of a physical person, and its social significance was determined by interaction with the audience. Lil Miquela combined an invented Brazilian-American background with contemporary cultural practices, showing that even virtual constructions were able to represent multicultural hybridity. This phenomenon expanded the boundaries of understanding identity: users interacted with the character as with a real person, confirming that digital presence in social media could acquire the status of a social fact (Petrarca, 2018).

Another evidence of the transformation of cultural identity was the well-known Dolly Parton meme, published in 2020. The singer presented herself in four versions – LinkedIn, Facebook, Instagram (n.d.), and Tinder – each of which corresponded to the specificity of the platform (Ellis, 2024). This example demonstrated that users consciously formed different variants of their own digital identity, adapting it to the norms of a particular social network. On LinkedIn, identity reproduced a professional image, on Facebook – social and family belonging, on Instagram – visual aesthetics, on Tinder – a romantic component. In this way, in the digital environment a multiplicity of identities arose, coexisting in one user but realised in different communicative contexts. This confirmed that social media stimulated the process of differentiation of personality and the simultaneous existence of several models of self-presentation.

Digital identity was not limited only to what the user consciously demonstrated in their profiles. It was also formed algorithmically – through the analysis of browsing history, behavioural patterns, and interaction data. In the article Understanding Your Digital Identity (Hendrickson, 2024), two levels of digital identity were distinguished: active and passive. The active level encompassed profiles, publications, and biographical information provided by the user independently. The passive level was formed on the basis of data on views, likes, and communication. Together, these two levels created a complex image of the personality, which became the basis for targeted content and algorithmic behaviour prediction. This indicated that digital identity was determined not only by the user's self-presentation but also by the result of systematic data analysis carried out by platforms.

An example of multidimensional digital identity was also illustrated in the format of short biographies on Twitter. As examples show, users in their bios simultaneously indicated profession, hobbies, and cultural orientations: "Writer|Sharing thoughts on literature, writing tips, and my journey as an author. Lover of books and coffee" or "Chef | Delicious recipes, cooking tips, and kitchen hacks. Bringing gourmet cooking to your home" (Allen, 2024). Such biographies performed the function of a compact representation of a multifaceted identity, which combined the professional sphere, creative interests, and personal hobbies. In this way, users created a cross-platform image that easily adapted to different digital environments. This underlined that contemporary cultural identity was increasingly defined not by belonging to a single tradition but by the ability to integrate different cultural markers into one's own self-presentation.

All the considered examples confirmed that digital platforms had formed new approaches to the construction of cultural identity. The historical development of the concept indicated a transition from a collective to an individual paradigm, as well as from homogeneity to hybridity. Personalised avatars such as Lil Miquela demonstrated the possibility of identity existing independently of a physical person, the multiplicity of self-presentations in social networks revealed the ability to adapt the image to different communicative environments, and the distinction between active and passive identity emphasised the algorithmic dimension of this process. Examples of Twitter bios showed that even short self-presentations could reproduce the multidimensionality of contemporary identity. The development of the digital environment led to the emergence of models of identity characterised by plasticity, multidimensionality, and openness to cultural interaction. These models reflected a new phase of cultural transformations, in which individuality was defined not only by belonging to a community but also by the ability to integrate different cultural codes into a personal digital image.

**Virtual communities as spaces of transcultural interaction.** The phenomenon of virtual communities emerged in the late twentieth century with the development of digital communication platforms that enabled interaction without geographical proximity. Early forums, mailing lists, and online chats provided the first opportunities for individuals to gather around shared interests. Over time, these forms of communication transformed into complex social ecosystems, where cultural exchange occurred on a global scale. In contemporary scholarship, a virtual community is defined as a network of individuals connected through digital platforms, whose communication is structured around shared practices, values, and goals. Unlike traditional communities limited by physical or cultural boundaries, virtual communities bring together participants from different backgrounds, allowing them to create collective identities beyond territorial borders. These environments are characterised by openness, accessibility, and the possibility of constant interaction, which make them favourable for transcultural contact. The role of such communities is not confined to the exchange of information. They serve as spaces where knowledge is preserved, cultural practices are transmitted, and new hybrid forms of identity are shaped. The emergence of global platforms has amplified these functions, making virtual communities a central element in understanding contemporary cultural transformations.

One of the most illustrative cases of how virtual communities support transcultural exchange is the activity of diaspora groups on Facebook. An example is the group Ukrainians in USA, where members actively share videos of traditional songs, photographs of embroidered shirts, and recipes for national dishes such as "borscht" and "varenyky" (Ukrainian Diaspora in USA, 2025). Such practices are not limited to cultural nostalgia; they create a dynamic channel of cultural continuity, allowing traditions to be preserved and adapted in new environments. Through comments and discussions, older generations transmit knowledge about symbolism, rituals, and traditional techniques, while younger participants integrate these elements into their everyday lives in a foreign context. As a result, diaspora communities form a digital bridge that ensures the survival of cultural practices across borders and fosters interaction between participants with diverse experiences of migration and cultural adaptation.

A similar function is evident in open platforms such as Reddit (n.d.), Discord (n.d.), and Twitch (n.d.), which have become universal spaces for communication across cultural boundaries. Reddit, with its system of thematic subreddits, enables users from various countries to participate in discussions ranging from popular culture to specialised professional topics. The decentralised structure encourages users to present their cultural perspectives, which leads to the formation of collective narratives that transcend national contexts. Discord servers operate as spaces of continuous dialogue, often uniting people around gaming, education, or cultural projects. The format of voice and text channels promotes direct interpersonal contact, where language and cultural barriers are mitigated through shared interests. Twitch, originally a platform for streaming video games, has expanded into a broader cultural medium where live broadcasts create a sense of co-presence. Viewers from different parts of the world simultaneously participate in events, exchange comments, and influence the development of online subcultures (Raouna, 2024). These platforms illustrate how virtual communities facilitate the formation of transcultural practices, transforming entertainment and communication into sources of collective cultural experience.

Virtual communities of practice (VCoP) illustrate a further manifestation of transcultural interaction. These are groups of professionals and enthusiasts who share expertise and develop collective knowledge through constant interaction. Stack Overflow, a global community of programmers, where millions of users exchange advice, problem-solving strategies, and best practices, serves as an illustrative case (Newest Questions Stuck OverFlow, 2025). The specificity of this community lies in the fact that knowledge is created collectively, while norms of communication and problem-solving become elements of a shared professional culture. New participants learn from the experience of more advanced members, and the culture of mutual assistance spreads across national and cultural groups. This confirms that professional identity can be formed in a transcultural context, where competence and contribution outweigh geographical belonging. Another example of a virtual community of practice is ResearchGate (n.d.), an international network of scientists designed for the exchange of articles, research results, and methodological approaches. This platform allows researchers from different countries to communicate directly, comment on each other's work, and establish collaborations. The exchange of knowledge in this context is not only academic but also cultural, as participants bring diverse perspectives, traditions of scientific communication, and methodological approaches. The result is the formation of a global research environment where cultural differences are not obstacles but resources for creating new ideas and practices.

The examples considered demonstrate that virtual communities serve different functions depending on their structure and purpose, but they all contribute to transcultural interaction. Diaspora groups support cultural continuity and adaptation in new contexts; universal communication platforms expand opportunities for exchange in everyday and professional domains; communities of practice create conditions for the collective construction of knowledge. Each of these forms illustrates how digital environments transform communication into a process of cultural integration, fostering the emergence of new hybrid models of identity and collective experience. The development of virtual communities has shown that cultural contact in the digital age is no longer limited by geographical or linguistic boundaries. Social media groups of diasporas demonstrate how traditions can be preserved and transmitted in conditions of global mobility. Platforms such as Reddit, Discord, and Twitch show that shared interests and interactive communication create new cultural forms that go beyond national frameworks. Communities of practice, such as Stack Overflow and ResearchGate, prove that professional and academic collaboration takes place in a transcultural environment, where knowledge is enriched by the diversity of participants. Virtual communities have become key spaces for the formation of transcultural contacts, as they combine preservation of heritage, everyday communication, and professional cooperation. Their functioning confirms that in the globalised digital environment, identity and cultural belonging are constructed not only through individual self-presentation but also through participation in collective practices that integrate diverse cultural codes. This process reflects the transition to a new stage of cultural transformations, where virtual interaction plays a decisive role in shaping global cultural dynamics.

**Global cultural trends emerging on digital platforms.** The phenomenon of cultural trends has long been associated with processes of diffusion, when innovations, styles, or practices spread from one group to another through interaction and imitation. Traditionally, these processes required significant time and relied on physical contact, mass media, or institutional mediation. With the rise of digital platforms, the mechanisms of cultural diffusion acquired

new characteristics. Social media created an environment where cultural patterns could be generated, shared, and transformed within extremely short timeframes. The combination of algorithmic recommendation systems and user-generated content accelerated the speed of dissemination, while the global accessibility of platforms allowed trends to transcend national and linguistic boundaries. The concept of a "global cultural trend" in the digital context refers to practices or aesthetic codes that originate in specific online interactions but rapidly achieve worldwide visibility. Such trends are not limited to entertainment; they influence lifestyle practices, patterns of socialisation, and even economic activities. Platforms such as TikTok (n.d.), Instagram (n.d.), and YouTube (n.d.) have become central in this process due to their technical architecture, which prioritises visual storytelling, brevity of content, and virality. The interaction of these factors results in the emergence of cultural practices that shape not only digital communication but also offline behaviours. The logic of cultural trend formation on digital platforms is based on a triadic mechanism: initial creative impulse, replication by users, and amplification through algorithms. The initial impulse may be a video, meme, or performance. Replication occurs when users adapt the practice to their own contexts, while amplification is ensured by platform algorithms that prioritise popular content. This triadic mechanism explains the rapid transformation of local expressions into global cultural phenomena.

The trend known as That Girl illustrates how a lifestyle practice, initially tied to individual creativity, can turn into a global cultural phenomenon. In January 2021, TikTok user published a video showing her morning routine demonstrated a structured morning routine associated with discipline, productivity, and minimalist aesthetics (The ideal morning routine for 2022, 2022). This format resonated with audiences seeking aspirational content and quickly became viral. The hashtag #ThatGirl accumulated more than two billion views by the summer of 2022. The appeal of the trend lay in its presentation of self-discipline, productivity, and minimalist aesthetics, which were visualised through short, aesthetically structured videos. As the practice spread, it generated multiple derivative variations that adapted the core idea of aspirational self-presentation to diverse cultural codes. Each of these variations adapted the core idea of self-presentation to different cultural codes, which indicates the flexibility of digital trends in accommodating diverse aesthetic traditions. The case of That Girl illustrates the construction of aspirational digital identity, showing how replication and aesthetic standardisation transform individual lifestyle practices into globally recognisable cultural models.

A more recent example, Italian Brainrot, illustrates the role of absurd humour and generative technologies in the creation of transcultural trends. In the summer of 2024, TikTok was flooded with videos showing AI-generated hybrid creatures combining animal forms with human features and pseudo-Italian names (Best brainrot characters, 2025). The most popular figure became Tralalero Tralala, AI-generated hybrid creatures combined animal and human features, accompanied by synthetic voices, exemplifying a form of absurdist humour as symbolic play (Fig. 3)


**Figure 3.** Most popular figure Tralalero Tralala
**Source:** Best brainrot characters (2025)

A single video with this character reached more than twenty million views in one week, initiating a wave of replications and modifications. The dissemination of this trend extended beyond TikTok: Instagram Reels hosted similar videos, Reddit communities produced fan art, and NFT (Non-fungible tokens) collections based on the characters emerged. The case demonstrates how playful absurdity and visual experimentation, supported by artificial intelligence, can achieve global resonance. The integration of Italian linguistic elements, albeit parodic, introduced cultural references that were reinterpreted in diverse contexts. Italian Brainrot demonstrates the hybridity of digital culture, where algorithmic creativity and absurdist humour operate as mechanisms of transcultural symbolic adaptation.

The trend called Aura Farming provides another perspective on the dynamics of digital cultural practices. In August 2024, an eleven-year-old Indonesian boy, Rayyan Arkan Dikha, uploaded a video where he calmly danced on a boat to a popular Indonesian song (Aura Farming Rayyan arkan dikha, 2025). This practice, later labelled as 'aura farming', functioned as a symbolic performance of authenticity and calm confidence, which was replicated and amplified by algorithms and adapted by global celebrities. The video reached millions of views, and the practice was quickly adopted by global celebrities. Jungkook, a member of the Korean band BTS (Bangtan Sonyeondan), recorded a similar video, American football players incorporated the movement into performances on the field, and even the Singapore Navy produced an official clip in this style. The trajectory of Aura Farming demonstrates how local cultural expressions can achieve worldwide diffusion when amplified by algorithms and adapted by influential figures. The trend combined elements of music, dance, and

performative identity, which allowed it to be reinterpreted in multiple contexts without losing recognisability. Aura Farming exemplifies how local cultural expressions can be globalised through replication and algorithmic amplification, confirming that authenticity functions as a transferable symbolic resource in digital environments.

The analysis of these three cases reveals different mechanisms of cultural trend formation. That Girl illustrates how lifestyle practices structured by visual aesthetics and discipline become models of aspirational identity. Italian Brainrot shows the potential of technological creativity and absurd humour to generate shared cultural codes. Aura Farming demonstrates how localised expressions, grounded in everyday performance, can become global through replication by celebrities and institutions. Despite their differences, all three trends share the characteristic of transcultural adaptability: they can be reinterpreted in diverse cultural contexts while retaining their recognisable core. This adaptability explains why digital platforms function as key incubators of global cultural practices. The emergence of global cultural trends on digital platforms reflects a new stage of cultural dynamics, where practices generated by individual creativity acquire global resonance through algorithmic amplification and user replication. Historical analysis demonstrates that while cultural diffusion has always been a feature of human societies, its contemporary form is distinguished by unprecedented speed, scale, and flexibility. The examples of That Girl, Italian Brainrot, and Aura Farming confirm that platforms such as TikTok (n.d.) operate as laboratories of cultural experimentation, where visual aesthetics, humour, and everyday practices are transformed into globally recognised cultural codes. These trends illustrate different dimensions of cultural transformation: the pursuit of aspirational lifestyles, the creation of shared symbolic frameworks through parody and absurdity, and the elevation of local expressions to the status of global phenomena. The study of global cultural trends highlights that digital platforms not only mediate cultural exchange but also actively shape the content, form, and dynamics of contemporary culture. They create conditions for the continuous emergence of hybrid practices that integrate elements from diverse traditions and contexts. As a result, global cultural trends are not merely transient phenomena but indicators of structural transformations in the ways identity, communication, and cultural belonging are constructed in the digital age.

## DISCUSSION

The results of the present study confirmed that social media had become a key environment for the construction of digital identities, the functioning of transcultural communities, and the dissemination of global cultural trends. These findings resonated with, but also extended, the results of earlier research. The conclusion that digital identity was formed through the combination of self-presentation and algorithmically generated data correlated with the broader reflections of I. Levin & D. Mamlok (2021). Their work demonstrated that cultural and social life in the digital era was mediated by technological infrastructures, which reshaped traditional models of belonging. The results of this study specified their findings by illustrating that algorithmic data did not only mediate communication but actively produced new layers of identity. C. Davison (2024), in turn, conceptualised digital self-presentation as a structured practice embedded in everyday life. Compared to her conclusions, the present research added an empirical dimension by demonstrating how these practices manifested in concrete cases such as virtual avatars and memes.

While C. Davison highlighted theoretical aspects of identity construction, this study revealed the mechanisms through which hybrid identities gained social significance in different online environments. At the same time, the results complemented the argument of E. Michalkiewicz-Kadziela & E. Milczarek (2021), who examined the legal boundaries of identity creation. They proved that regulation influenced how identities could be formed or recognised. This research did not focus on legal aspects, but its findings suggested that algorithmic and user-generated elements of identity already functioned as socially acknowledged facts, regardless of legal codification. Thus, the present study extended the perspective by showing how cultural practices outpaced legal definitions. C. Sullivan & S. Tyson (2023) proposed a global framework for digital identity as a universal category. While their results were oriented towards institutional design, the current findings indicated that in practice globalised identity emerged not through top-down models but through everyday self-presentation and replication across platforms. The comparison confirmed that theoretical and institutional perspectives required supplementation by empirical evidence of user practices.

The phenomenon of multicultural hybridity identified in this study was closely linked to the theoretical shift from intercultural to transcultural communication analysed by W. Baker (2022). His results demonstrated that cultural interactions could no longer be understood as dialogue between separate traditions, but as the emergence of fluid hybrid forms. The present study confirmed this by showing that users integrated multiple cultural codes into self-presentation, memes, and biographical practices. However, while author's conclusions remained largely conceptual, this research supplied empirical validation through case studies such as Twitter biographies or the Dolly Parton meme. Similarly, M. Shonfeld *et al.* (2021) highlighted how learning in digital environments demanded cross-cultural alignment. Their results showed that interaction in online education promoted mutual adaptation of practices. The findings of this study broadened their framework: hybridity appeared not only in formal learning but also in informal communication, lifestyle trends, and community participation. A. Hillary (2020) added another dimension by exploring how neurodiversity intersected with intercultural communication. Compared to her work, the present research extended the scope from individual cognitive specificities to collective cultural hybridity, yet both results converged

in demonstrating that online environments expanded the boundaries of participation.

The analysis of virtual communities as spaces of transcultural contact aligned with the results of E. Zolduoarrati *et al.* (2025), who studied how regional cues shaped practices on Stack Overflow. Their findings revealed that global communities of practice were influenced by local cultural elements, which shaped interaction styles and problem-solving norms. The present study confirmed their observations by showing that communities of practice produced hybrid professional cultures in which contributions from diverse participants were integrated into shared norms. At the same time, it demonstrated that such transcultural mechanisms were not confined to professional platforms but also characterised diasporic and leisure-oriented communities. S. Ponzanesi (2020), analysing digital diasporas, underlined the role of affect and postcolonial perspectives in shaping online belonging. The results of this research converged with hers by showing that diaspora groups preserved cultural traditions through digital practices. However, this study expanded the focus beyond affective ties, emphasising that diasporic communities simultaneously performed adaptation and innovation, creating dynamic forms of cultural continuity.

The mechanisms of virality identified in the current study were strongly connected with the works of C. Ling *et al.* (2021). They dissected the factors determining the virality of memes, establishing indicators such as humour, relatability, and visual form. The results of this research confirmed their conclusions by showing that absurd creativity and humour, as in the Italian Brainrot case, became the key to global resonance. Yet this study added nuance by emphasising the role of algorithmic amplification, which C. Ling *et al.* addressed only marginally. A. Siddiqui (2021) analysed viral videos from the perspective of societal impact, stressing that they influenced collective behaviour. The current research supported this claim through the example of Aura Farming, which moved from an individual performance to institutional adoption by celebrities and even official organisations. Thus, the results highlighted that virality was not only a technical or aesthetic phenomenon but also a cultural mechanism of transformation.

The interpretation of digital platforms as cultural artefacts, proposed by S. Vicari & D. Kirby (2023), also found confirmation in this study. Their work showed that platforms themselves shaped cultural practices through technical design. The present research demonstrated how this influence was realised in practice: the architecture of TikTok or Instagram determined the triadic mechanism of trend formation (impulse – replication – amplification). The empirical analysis provided evidence of how socio-technical affordances structured cultural diffusion. G. Jolia & N. Jolia (2022) described digital culture as a global phenomenon of the technological world. Their results provided a broad conceptual background, while the current study clarified the specific forms of cultural transformations – identity, communities, and trends that together defined the structure of digital culture. Similarly, R.N. Chawla & P. Goyal (2022) identified emerging patterns of digital transformation through bibliometric analysis. Their work mapped the field, while the present research gave detailed content to these patterns, demonstrating how transformation unfolded in specific cultural practices.

In summary, the comparison of results showed that the current study both confirmed and advanced existing scholarship. It confirmed theoretical assumptions about hybridity, transculturality, and virality, while advancing them by demonstrating concrete mechanisms and case studies. It diverged from some institutional and normative perspectives by showing that cultural practices often developed independently of legal or policy frameworks. Finally, it integrated dispersed findings into a holistic model of digital cultural transformations. The results thus contributed to the academic discourse by bridging conceptual, empirical, and practical dimensions, and by providing a comprehensive picture of how social media operated as a space of global cultural change.

## CONCLUSIONS

The conducted research demonstrated that the digital environment substantially transformed the processes of identity formation, intercultural communication, and cultural trend dissemination. It was established that the emergence of new cultural identities was characterised by the integration of personal self-presentation with algorithmically generated behavioural data. This interaction produced complex digital identities that could diverge from offline identities yet retained independent social significance. Within these identities, multicultural hybridity manifested through the combination of linguistic codes, visual aesthetics, fashion elements, and symbolic markers originating from diverse cultural traditions. Such hybridity confirmed the shift from collective models of identity towards fluid and multidimensional forms adapted to global digital environments.

The analysis of virtual communities revealed their role as crucial spaces for transcultural contacts. It was shown that diaspora groups in social networks contributed to the preservation and transmission of cultural memory, while simultaneously enabling the adaptation of traditions in new sociocultural contexts. Universal communication platforms such as Reddit, Discord, and Twitch facilitated the creation of transcultural interactions based on shared interests and practices that transcended national and linguistic boundaries. Communities of practice, exemplified by Stack Overflow and ResearchGate, functioned as global spaces of knowledge production, where professional and academic collaboration was enriched by cultural diversity. These findings confirmed that virtual communities operated not only as channels of information exchange but also as mechanisms of collective identity construction and intercultural learning.

The investigation of global cultural trends demonstrated that digital platforms had become incubators of cultural experimentation, where local practices rapidly

acquired global resonance. The case of That Girl illustrated how lifestyle aesthetics structured around discipline and minimalism turned into aspirational identity models. The trend of Italian Brainrot revealed the potential of generative technologies and parody in creating transcultural symbolic frameworks. The diffusion of Aura Farming confirmed that localised cultural expressions could achieve worldwide recognition through replication and algorithmic amplification. Collectively, these examples proved that global cultural trends functioned as indicators of structural cultural transformations, distinguished by unprecedented speed, scale, and adaptability. Overall, the study established that digital platforms shaped cultural processes by generating hybrid identities, supporting transcultural communities, and producing global cultural practices that redefined the parameters of belonging and interaction in the twenty-first century. Further research should be directed towards examining the long-term effects of digital trends on the processes of identity and cultural memory.

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# Social informatics and global "digital inequality": Global strategies for overcoming the information divide

Tanya Vazova*[1]
[1]Plovdiv University "Paisii Hilendarski", Plovdiv, Bulgaria

**Abstract.** The purpose of the study was to identify the characteristics of the digital divide in society and to determine effective strategies for overcoming it, with particular attention to technological, cognitive, and economic aspects. The methodology included the conceptual and analytical method, document analysis, case study analysis, and comparative descriptive analysis of statistical data, which collectively ensure a comprehensive examination of digital inequality and the mechanisms for overcoming it. The findings of the study demonstrated that digital inequality constitutes a multidimensional phenomenon that combines limited access to technologies, different levels of digital skills, and economic barriers. A comparative analysis of the United States, Germany, and Bangladesh established that, in highly developed countries such as the United States and Germany, the level of Internet penetration reaches 94%, mobile connections exceed 100% (125 and 130 per 100 individuals, respectively), and the divide between urban and rural areas remains almost absent. In Bangladesh, which represents countries with lower income levels, 47% of the population uses the Internet, rural areas lag behind urban areas (49% compared with 78%), and gender and social disparities remain substantial. The analysis of case studies from Finland, India, and Kenya indicated that the integration of technological solutions with educational and social programmes contributes to the improvement of digital literacy, the expansion of access to knowledge, and the reduction of information isolation within local communities in Finland, India, and Kenya. International networks and programmes, such as Electronic Information for Libraries, confirm that global partnerships support the expansion of the effects of local initiatives and contribute to the sustainability of digital services. The study outlined data concerning the relationship between the level of economic development of countries and digital inclusion, together with the practical results of the application of digital libraries and archives across different socio-economic contexts. The obtained results emphasise that digital inequality determines the opportunities available to populations for education, participation in the digital environment, and access to information, whereas overcoming this divide requires a comprehensive approach that combines the development of technological infrastructure, education, socio-economic measures, and the provision of equal opportunities for all population groups. The practical value of the study lies in the identification of specific mechanisms of digital inclusion that may be used by governments, educational institutions, and international organisations to reduce the digital divide and improve access to knowledge

**Keywords:** global level; socio-economic contexts; educational resources; digital competencies; population groups

## INTRODUCTION

The rapid digitalisation of society drives the transformation of access to information, education, and social resources, while also intensifying digital inequality as one of the principal barriers to the development of a knowledge society. Research on the digital divide is becoming increasingly relevant because unequal access to information and communication technologies influences social stratification, economic opportunities, and the level of participation of populations within the digital environment.

Academic approaches emphasise the multidimensional character of digital inequality and the necessity for a comprehensive analysis of its manifestations. S. Khan (2024) examined the global dimensions of the digital divide and outlined the principal factors contributing to inequality in

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*Corresponding author (tanyavazova00@gmail.com)

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access to information and technologies. The study analysed socio-economic and infrastructural barriers and proposed approaches for overcoming them through policies of digital inclusion. The problem of access to information and communication technologies on a global scale also attracts the attention of numerous researchers. J. Dey (2022) considered the digital divide as a global phenomenon affecting both developed and developing countries. The study described inequalities in access to ICTs (information and communication technologies) and highlighted the influence of economic and regional factors on the development of digital inequality. Attention also focused on the systematisation of academic approaches to the examination of the digital divide. S. Lythreatis *et al.* (2022) conducted a comprehensive review of the literature on digital inequality and identified the principal areas for further investigation in this field. The researchers analysed key theoretical models of the digital divide and outlined prospects for the development of research within the context of technological transformations.

Questions concerning the reduction of digital inequality through educational and informational strategies also occupy an important place in academic discourse. Y. Abaz & R. Nuredin (2023) examined educational and informational approaches to ensuring digital inclusion within vulnerable communities. The study considered the role of educational programmes and digital tools in expanding access to knowledge and developing digital competencies. Another relevant area concerns the analysis of digital inequality within information systems and policies. P. Vassilakopoulou & E. Hustad (2023) conducted a review of studies in the field of information systems that addressed the reduction of the digital divide. The researchers focused on existing approaches and identified the principal challenges and areas for the development of research on digital inclusion. Digital humanism also conceptualises digital inequality as a social challenge. A. Bon *et al.* (2024) investigated mechanisms for reducing the digital divide in the development of a digital society. The study described the role of social institutions, technologies, and educational initiatives in ensuring equal access to digital resources. Digital inequality also affects the social and medical dimensions of social life. Z. Jafar *et al.* (2024) analysed the relationship between digital inequality and access to medical information. The study examined the role of social media in reducing inequalities and emphasised the necessity of developing digital inclusion for the improvement of public health. Trends in digital divide research also emerge in bibliometric analyses. J.A. Hoyos Muñoz & D. Cardona Valencia (2025) conducted an analysis of academic publications concerning digital inequality and digital inclusion. The study identified principal trends, key research areas, and prospects for the development of this issue within global academic discourse.

Thus, the review of literature indicates growing interest in digital inequality as a complex social phenomenon that requires an interdisciplinary approach. Despite the substantial number of studies, there remains a need to combine theoretical analysis with practical case studies and comparative statistical data, which defines the focus of the study. Academic literature demonstrates insufficient integration of theoretical approaches to digital inequality with empirical comparative data at the global level. The role of public libraries and digital archives as instruments of social inclusion across different socio-economic contexts also receives limited attention. Furthermore, the relationship between different forms of the digital divide and processes of social stratification in the development of a knowledge society remains insufficiently explored.

The purpose of the study was to identify the specific manifestations of digital inequality within society and to outline effective strategies for overcoming it with consideration of technological, cognitive, and economic factors. The objectives of the study were to characterise different forms of digital inequality (technological, cognitive, and economic) under conditions of the development of a global information society; to conduct a comparative statistical analysis of the United States, Germany, and Bangladesh; and to evaluate the role of public libraries and digital archives as instruments of social inclusion in global practice.

## MATERIALS AND METHODS

The study employed a set of complementary methods that ensure a comprehensive analysis of digital inequality within the context of the global information society. During the first stage of the study, the conceptual and analytical method was applied to generalise academic approaches to the interpretation of the digital divide and to distinguish its principal forms, namely technological, cognitive, and economic inequality. This approach helped systematise the theoretical foundations of the issue and clarified its connection to the "knowledge society" and the processes that were transformed access to information in the digital era. In particular, technological inequality was examined through access to the Internet and digital devices, according to World Bank (n.d.), International Telecommunication Union (2017; 2025a; 2025b). Cognitive inequality was examined through the level of digital skills and the capacity for critical thinking described by E. Hargittai (2001), whereas economic inequality was examined through material opportunities and the cost of digital resources discussed in UNESCO (2024).

During the second stage, document analysis was employed for the examination of international strategies aimed at reducing digital inequality and information isolation. The study analysed strategic documents and analytical materials produced by international organisations, particularly the United Nations, UNESCO, and UNICEF, which contributed to the generalisation of approaches to digital inclusion and the reduction of the digital divide. In particular, United Nations (n.d.; 2023), and UNESCO Inclusive Policy Lab (n.d.) focus on principles of equal access to digital resources and basic services. UNICEF (2018), D. Souter & A. van der Spuy (2019) and Internet Universality (R-O-A-M) (Reach, Opportunity, Affordability, Meaningful) outlined approaches to assessing Internet development and shaping policies of digital accessibility.

UNESCO (2015; 2022a), and UNESCO Institute for Information… (2024) identified priorities for the development of inclusive digital education. Practical instruments and areas for the implementation of digital policies were presented in United Nations Digital Transformation Group… (2023) and UNESCO (2019a; 2019b), which contributed to the identification of key measures for the development of digital competencies and infrastructure.

During the third stage, the case study method was applied for the analysis of public libraries and digital archives in Finland, India, and Kenya. These countries were selected as representative examples of states with different levels of digital development and socio-economic conditions, which enabled a comprehensive comparison of models of digital inclusion and the effectiveness of library and information systems within the global context. The criteria for comparison included the country or region, the name of the project or organisation, principal functions, instruments of digital inclusion, and examples of outcomes or effects. The selection was determined by the fact that Finland represents a high level of digital development and mature infrastructure, India represents a medium level characterised by a combination of innovation and structural disparities, whereas Kenya represents countries with a lower level of digitalisation where basic inclusive solutions were actively implemented. This approach enabled the comparison of models within the typology of high, medium, and low levels of digital development. In Finland, the study analysed the activities of the National Digital Library (2016), The Conference of European National Librarians (2025) and National Library of Finland (2025) which integrates the resources of libraries, archives, and museums and forms a unified digital platform for access to cultural heritage. In India, the study examined digital library initiatives (Trivedi, n.d.; Mukherjee & Patra, 2023; Lavania, 2025), which function as educational centres and provide access to learning resources and programmes of digital literacy in urban and rural regions. In Kenya, the study examined the activities of the Kenya National Library Service (n.d.) (KNLS) and grassroots initiatives to promote contemporary African literature The Guardian (2025), which aim to expand access to knowledge, preserve local heritage, and support the development of reading culture among the population.

During the final stage of the study, comparative descriptive analysis of statistical indicators was employed for the examination of the global digital divide through secondary data concerning Internet access, mobile technologies, and household coverage in countries with different levels of economic development (OECD, 2024; Islam, 2025), which contributed to the identification of patterns in the influence of digital inequality on social stratification. Three countries represents different levels of economic development were selected for the comparative statistical analysis of the global digital divide: the United States (high level), Germany (high level), and Bangladesh (low to medium level). This selection enabled comparison of indicators related to Internet access, mobile technologies, and territorial disparities within a unified typology that complements the qualitative analysis of case studies from Finland, India, and Kenya. Educational opportunities and access to knowledge were described with reference to A. Ranjan (2024), International Telecommunication Union (2024) and D. Slotta (2025). The study also identified integrated strategies of digital inclusion that combine the development of technological infrastructure, education, and socio-economic measures through the use of Our World in Data (2023) and World Bank (2025). The combined application of these methods provided a comprehensive research framework and contributed not only to the characterisation of digital inequality but also to the analysis of effective international mechanisms for overcoming it in the development of the knowledge society.

## RESULTS

**Types of digital inequality in the context of the development of the global information society.**

Digital inequality, or the digital divide, was associated with the rapid development of information and communication technologies, which transforms the methods of producing, disseminating, and consuming knowledge, thereby shaping a new form of social organisation known as the knowledge society. These processes, however, were accompanied by unequal access to digital resources, which leads to the emergence of new forms of social stratification. The term "digital inequality" or "digital divide" refers to the gap between different social groups in relation to access to information and communication technologies and the opportunities for their effective use. In its conventional interpretation, this concept encompasses differences in access to the Internet, computer technologies, and digital services. Contemporary research expands this interpretation by incorporating not only physical access, but also the level of digital skills, the capacity for critical thinking, and opportunities for integration into the digital environment. For example, reports issued by the International Telecommunication Union (2025b) emphasise that the digital divide includes both infrastructural and socio-cultural aspects of technology use.

For the systematisation of theoretical approaches to the analysis of digital inequality, it was appropriate to distinguish its principal forms, namely technological, cognitive, and economic inequality. This typology contributes to an understanding of the multidimensional character of this phenomenon and its influence on the development of the knowledge society. Technological digital inequality was primarily associated with access to technical infrastructure. This concerns the presence or absence of Internet access, the speed of connection, and access to devices such as smartphones or computers. According to data provided by the World Bank (n.d.), the proportion of Internet users differs between countries with high and low income levels. This indicates that access to technologies remains unequal and depends on the economic development of regions. Consequently, technological inequality forms the basic

level of the digital divide, which prevents certain population groups from participating in the information space.

Cognitive digital inequality encompasses differences in the level of knowledge, skills, and competencies required for the effective use of digital technologies. Even under conditions of physical access to the Internet, not all users possess the capacity to realise its full potential. This was associated with the level of education, digital literacy, and the ability to evaluate information critically. Academic literature frequently defines this aspect as the "second level of the digital divide", which emphasises its distinction from purely technical barriers (Hargittai, 2001). Thus, cognitive inequality manifests through differing levels of participation in the digital economy, online education, and informational processes. Economic digital inequality reflects the influence of material conditions on access to digital resources and opportunities for their use. The cost of Internet services, digital devices, and educational resources may constitute a barrier for socially vulnerable population groups. Economic inequality also determines opportunities for investment in education, professional development, and the advancement of digital competencies. Reports issued by international organisations highlight that countries with lower income levels possess more limited opportunities for the development of digital infrastructure and the implementation of innovations (International Telecommunication Union, 2017).

The distinction between these three forms of digital inequality enables its examination as a complex social phenomenon that combines technical, educational, and economic dimensions. These levels remain interconnected because the absence of access to technologies restricts opportunities for acquiring digital skills, whereas a low level of skills reduces the effectiveness of the use of available resources. Digital inequality was directly associated with a knowledge society, in which information and knowledge function as key resources for development. Within such a society, access to information determines not only educational opportunities but also economic competitiveness, social mobility, and the level of participation in public life. According to data provided by UNESCO (2024), unequal access to digital resources may contribute to the intensification of social inequality and the marginalisation of particular population groups. The digital era was characterised by the transformation of conventional channels of access to information. Educational resources, public services, the labour market, and communication practices were increasingly shifted into the online environment. This creates new opportunities for development while simultaneously intensifying the risks of exclusion affecting individuals who lack sufficient levels of access or competencies. Thus, digital inequality constitutes one of the principal factors determining the patterns of social stratification worldwide. It influences the distribution of resources, opportunities for self-realisation, and the level of integration into the knowledge society. Analysis of its technological, cognitive, and economic forms contributes to a comprehensive assessment of the scale of the problem and to the identification of principal directions for overcoming it. In summary, digital inequality was a multidimensional phenomenon that reflects socio-economic disparities. Its examination requires an interdisciplinary approach and the application of both theoretical and empirical methods of analysis. For this reason, reference to statistical data produced by international organisations, together with conceptual approaches developed within the theory of the knowledge society, contributes not only to the description of the scale of the digital divide, but also to an understanding of its causes and consequences under conditions of global digital transformation.

**Overcoming information isolation in developing countries.**

The overcoming of information isolation in developing countries was considered a complex process that involves expanding access to digital infrastructure, developing the digital competences of the population, and implementing inclusive educational and social practices. The effectiveness of such strategies was determined by the combination of technological, economic, and institutional factors that support integration into the global information space. United Nations (2023), developed under the auspices of the UN, serves as a foundational document concerning responsible digital development. It establishes framework principles intended to ensure equal access to digital resources, protect users' rights, and promote the sustainable development of the digital economy. Analysis of this document demonstrates that global policies on digital inclusion focus not only on ensuring physical access to technologies, but also on the regulatory and ethical aspects of the use of digital platforms, which directly influences the overcoming of the technological and cognitive levels of digital inequality. The document United Nations (n.d.) outlines specific strategies of the UN for providing equal digital opportunities for all population groups, with particular emphasis on the importance of access to information and communication technologies in education, healthcare, and public services. This strategic document emphasises that inclusion was not limited to access to equipment, but also encompasses the development of digital competences, particularly user training and the creation of open digital resources, which directly influences the reduction of cognitive and economic inequality.

UNESCO proposed Internet universality indicator (Souter & van der Spuy, 2019), which constitutes a system of indicators for evaluating internet universality at national and regional levels. This framework enables the analysis of accessibility, openness, users' rights, and the participation of various stakeholders, which corresponds with the R-O-A-M concept (UNESCO, 2019b). Analysis of the Internet Universality Indicators provides objective data concerning the degree of digital inclusion and the level of access to knowledge in different countries, which forms the basis for comparative and comparative-statistical studies of the digital divide. The concept of Internet Universality (R-O-A-M) specifies the principles upon which digital development

policy should be based, namely the protection of human rights, the openness of technologies, accessibility, and the participation of different stakeholders (UNESCO, n.d.). This approach permits the examination of digital inequality not merely as a technical issue, but as a socio-political phenomenon in which regulatory frameworks, civic participation, and the transparency of information systems play significant roles. UNESCO (2015; 2022a) documents aimed to ensure equal access to education through connectivity and technology. These declarations define state priorities in the creation of inclusive educational environments, the development of digital infrastructure in schools and resource centres, and support for educational programmes directed at population groups that often remain at the periphery of the information society. Analysis of these documents indicated that strategic initiatives related to education and digital infrastructure were central to overcomed cognitive and economic inequality.

United Nations Digital Transformation Group… (2023) presented specific instruments for implementing digital development policies at national and regional levels. This includes methodologies for assessing the digital needs of populations, recommendations concerning infrastructure development, and the creation of open platforms and educational resources. Analysis of this document clarifies how global strategic principles were transformed into practical measures that directly influence the reduction of the digital divide. Alongside strategic documents, the analysis also includes supplementary advisory materials. For example, UNESCO Inclusive Policy Lab (n.d.) provides detailed recommendations concerning the development of digital services for vulnerable population groups, while emphasising the importance of integrating technologies into public services. Similarly, UNICEF (2018) focuses on children's needs regarding internet access, while emphasising the social responsibility of states and organisations in ensuring the digital inclusion of younger generations. UNESCO documents concerning the inclusive development of societies, particularly UNESCO (2022b), highlight the role of digital technologies in the development of resilient and inclusive social structures, while stressing the importance of access to knowledge as a condition for sustainable development (document archive through the Inclusive Policy Lab). Publications such as UNESCO (2019b) outline the prospects for the use of artificial intelligence and other advanced technologies in the knowledge society, together with their potential for overcoming cognitive and economic inequality in access to information.

Practical recommendations concerning the implementation of information and communication technologies in education and social services were presented in the documents Cities Coalition for Digital Rights (n.d.) and UNESCO Institute for Information… (2024). These documents propose specific instruments and methodologies for the development of inclusive digital infrastructure, such as libraries, educational centres, and open resources that provide access to knowledge across different socio-economic contexts. These documents demonstrate how strategic principles were translated into practical programmes that contribute to overcoming the digital divide at national and local levels. In summary, the conducted documentary analysis indicates that international strategies of digital inclusion encompass several interconnected directions, namely the creation of regulatory and legal frameworks for ensuring access to digital resources, the development of infrastructure and educational programmes, the implementation of practical instruments for local communities, and the monitoring and evaluation of the effectiveness of these measures. The use of these documents enables the identification of the complex dimensions of digital inequality and emphasises that its overcoming requires the integration of technical, educational, and socio-economic measures, together with an interdisciplinary approach in academic research and practical policy.

**Role of public libraries and digital archives as instruments of social inclusion in global practice.**
The analysis of public libraries and digital archives was conducted to illustrate practical approaches to overcoming digital inequality across different countries. Table 1 presented data on specific projects and organisations, their core functions, applied instruments of digital inclusion, and achieved outcomes, which allows for the assessment of the effectiveness of integrating technological and socio-educational measures into practice aimed at ensuring equal access to knowledge.

**Table 1.** Analysis of public library and digital archive practices as instruments of social inclusion

| Country / Region | Project / organisation name | Core functions | Digital inclusion instruments | Examples of outcomes / effects |
|---|---|---|---|---|
| Finland | National digital library | Integration of library, archive, and museum resources into a unified digital platform | Online access to collections, open metadata, integration of digital services for all citizens | Increased use of digital resources, improved access to historical and cultural materials, support for digital literacy |
| India | Digital Library Initiatives in India | Development and maintenance of digital libraries in urban and rural regions | Online learning platforms, open electronic resources, library consortia, digital literacy programmes | Improved access to educational materials in remote regions (Agra, Uttar Pradesh), support for local educational projects |

**Table 1.** Continued

| Country / Region | Project / organisation name | Core functions | Digital inclusion instruments | Examples of outcomes / effects |
|---|---|---|---|---|
| Kenya | Kenya National Library Service | National library service, digital services, access to educational and cultural resources | Local digital programmes, open resources, library restoration, community training programmes | Improved digital literacy, expanded access to knowledge in communities, development of local educational initiatives |

**Source:** compiled based on Electronic Information for Libraries (n.d.), K. Trivedi (n.d.), Kenya National Library Service (n.d.), National Digital Library (2016), S. Mukherjee & S.K. Patra (2023), National Library of Finland (2025), Conference of European National Librarians (2025), S. Lavania (2025), The Guardian (2025)

The analysis of public library and digital archive practices across different countries indicated that effective digital inclusion depends on the integration of technological solutions with social and educational programmes. The examination of case studies from Finland, India, and Kenya enables the identification of different approaches to organising access to digital resources across varying levels of economic development and digital literacy. In Finland, the National Library of Finland (2025) ensures universal and equal access to knowledge, supports the dissemination of cultural heritage, and enhances citizens' digital competences. In India, digital libraries function as educational centres in remote regions, providing learning resources for schools and community organisations, which contributes to reducing information isolation in rural areas. Kenyan examples demonstrate that even in countries with limited resources, state library programmes and local digital initiatives increase access to knowledge, forming a basis for community development and improved digital literacy.

In Finland, the National Library of Finland (2025) shows a high level of digital maturity. In 2025, more than 1.7 million loans of e-books and audiobooks and nearly 5 million views of digital journals were recorded, while the number of users exceeded 270,000. The service covers 280 municipalities, approximately 97% of the population, and provides access to more than 12,000 digital publications. Audiobooks were borrowed approximately 1.3 million times in 2025, while e-books were borrowed around 450,000 times, which indicates the dominance of the audio format in digital reading (National Digital Library, 2016). In India, digital libraries serve as a vital tool to reduce educational inequality in low-resource schools, but achieving real impact requires curriculum-aligned, multilingual, and offline-ready resources (iDream, 2025). To turn this access into measurable outcomes, schools must provide continuous support for teachers and monitor real-time usage analytics to prevent digital content from going underutilised.In pilot projects of digital libraries in rural schools, expanded out-of-school access to learning was observed through offline digital platforms that compensate for the absence of internet connectivity and libraries in communities (Yle News, 2025).

In Kenya, the activities of the Kenya National Library Service (n.d.) focus on expanding access to knowledge through digital and mobile services. International reviews of library programmes in East Africa indicate that KNLS digitalisation includes the establishment of local digital access centres and mobile libraries serving communities with limited infrastructure, which expands access to educational resources in remote regions (Conference of European National Librarians, 2025). The comparative analysis of Finland, India, and Kenya shows that the level of digital inclusion depends directly on the development of digital infrastructure and the integration of library services into education systems. All three models demonstrate a common tendency: even under different resource conditions, digital libraries function as an effective instrument for expanding access to knowledge and improving digital literacy. A comparative statistical analysis of three countries with different levels of economic development was conducted to assess the global digital divide. Table 2 presented key indicators of internet access and mobile technologies, household coverage, urbanisation, and gender disparities, which enables the identification of the level of digital inclusion and the characteristics of the digital divide across different socio-economic contexts.

**Table 2.** Comparative statistical analysis of the digital divide: The United States, Germany, Bangladesh

| Indicator | United States | Germany | Bangladesh |
|---|---|---|---|
| Internet users (% of population) | 94% (high-income group ITU 2025) | 94% (high-income group ITU 2025) | 47% (national estimate, ITU/BB 2025) |
| Mobile subscriptions (per 100 people) | 125 | 130 | 119 |
| Households with Internet access | 90%+ | 85%+ | 55% |
| Urban/rural gap | minimal | minimal | urban 78%, rural 49% |
| Mobile internet coverage | almost 100% | almost 100% | 4G ~100%, 3G ~99.8% |
| Overall Internet access level | 94% (high-income group) | 94% (high-income group) | 23-47% (low-/lower-middle income range ITU) |

**Source:** compiled based on Our World in Data (2023), International Telecommunication Union (2024; 2025a), OECD (2024), A. Ranjan (2024), T. Islam (2025), D. Slotta (2025), World Bank (2025)

The comparative statistical analysis presented in Table 2 highlights substantial differences between countries in levels of digital inclusion. The United States and Germany record Internet use of 94%, while Bangladesh records 47%, reflecting an almost twofold gap in access to digital resources. Household Internet access reaches 90%+ in the United States, 85%+ in Germany, and 55% in Bangladesh, indicating differences in the depth of infrastructure penetration in everyday life. The urban-rural gap in the United States and Germany remains minimal, while Bangladesh shows 78% in urban areas and 49% in rural areas, indicating pronounced territorial inequality in digital access. Mobile subscription levels reach 125 in the United States, 130 in Germany, and 119 in Bangladesh per 100 people, exceeding population size and indicating multi-device digital usage across all contexts.

ITU data (2025) confirm the global scale of digital inequality. Average Internet use worldwide stands at 74%, while high-income countries reach 94% and low-income countries 23%. Regionally, Internet use reaches 88-93% in Europe and the Americas, 77% in the Asia-Pacific region, and 36% in Africa. These patterns suggest that the digital divide operates across both inter-country and regional levels and correlates with economic development. Digital inequality in the compared countries appears as a combination of infrastructural (47% versus 94%), territorial (78% versus 49%), and technological (125-130 versus 119 mobile subscriptions) gaps. Thus, digital inclusion depends not only on access to the Internet, but also on the distribution of access across social groups and territories.

Table 2 presented a clear correlation between economic development and access to digital technologies. High-income countries demonstrate high levels of Internet and mobile access, which supports stronger integration into digital environments and knowledge-based society structures. In lower-income countries, the digital divide appears through overall connectivity levels, urban-rural inequality, limited access to educational and informational resources, and social barriers. Internet penetration increases across all countries, yet growth rates differ. High-income countries show stabilisation at high levels, while developing countries demonstrate rapid growth in mobile Internet access alongside persistent structural inequalities. These findings underline the relevance of global and local digital inclusion strategies aimed at reducing informational inequality and ensuring equal access to knowledge across population groups, a key element in the development of knowledge-based societies in the digital era.

The study confirms that digital inequality represented a multidimensional social phenomenon combining technological, cognitive, and economic dimensions that determine access to knowledge and information resources. The digital divide extends beyond physical access to the Internet and devices, encompassing disparities in digital skills and economic constraints that influence participation in knowledge-based society structures. Comparative data demonstrate that in high-income countries, digital infrastructure supports near-equal access across social groups, while in lower-income countries, the digital divide limits educational opportunities, participation in digital environments, and access to information. Analysis of international strategies and policies indicates that reducing digital inequality requires an integrated approach combining technological infrastructure development, education, social measures, and economic support, alongside equal opportunity frameworks. Digital inclusion functions as a key factor in building a fair and sustainable knowledge-based society.

## DISCUSSION

The results of the study on digital inequality in the global information society need to be aligned with existing academic approaches and empirical research in this field. The analysis allows observed trends to be compared with research on the digital divide as a complex socio-economic phenomenon. Attention focuses on linking findings with interpretations of digital inclusion, access to information, and the role of technology in shaping knowledge-based societies. The study indicates that digital inequality functions as a systemic factor of social stratification under conditions of global digitalisation, which was supported by the findings of L.A. Liotta (2023). The researcher examined the impact of digitalisation on social inclusion and inequality in vulnerable communities and analysed mechanisms addressing the digital divide through social and technological tools. The study emphasises that the combination of three types of inequality forms a coherent digital divide rather than isolated factors. The development of a knowledge-based society involves an uneven distribution of access to information resources, which aligns with the results of the study by A. Farooqi *et al.* (2022). The researchers considered the structure of the digital divide in digital environments and identified key factors influencing unequal access to information. Unlike this general approach, the study specifies the structure of the divide through distinct types of digital inequality, enabling clearer identification of underlying mechanisms. The digital divide demonstrates a multidimensional structure including technological, cognitive, and economic components, as also identified by H. Reddy *et al.* (2022). Their study reviewed the global digital divide and its impact across sectors, including healthcare. Physical access to digital technologies remains a necessary but insufficient condition for digital inclusion, a conclusion also supported by M. Lopez-Aguado *et al.* (2022), who investigated the relationship between digital inequality and social exclusion and showed that access alone does not ensure integration. The study confirms this through the identification of cognitive factors as key constraints. Digital competence levels influence the effective use of information resources, as shown by A. Acilar & Ø. Sæbø (2023). The researchers conducted a systematic review of the gender digital divide and emphasised the role of skills in shaping inequality. Economic barriers continue to determine access to digital infrastructure and educational opportunities, as established by R. Reynolds *et al.* (2022). The researchers examined digital inequality in remote education

during the pandemic and analysed resource constraints affecting access to learning. The study identifies economic factors as structurally determining, influencing both access to technologies and skill development.

Digital inequality reflects socio-economic disparities between and within countries, as also shown by N. Barik (2025). The researcher conducted a bibliometric analysis of studies on the digital divide and identified key global trends in the field. Within the study, these disparities were further specified through comparative country analysis, which enables empirical confirmation of the global scope of the digital divide. High-income countries demonstrate high levels of digital inclusion, while developing countries retain structural constraints, as also noted by T.S. Muwani *et al.* (2022). The researchers examined digital transformation and its impact on marginalised communities. The study also highlights internal inequalities between urban and rural territories, which intensify the overall digital divide. The urbanisation factor remains a determinant of differentiated access to digital technologies, as observed by F. Mubarak & R. Suomi (2022). The researchers considered digital exclusion among older people and identified territorial and age-related differences in access to technologies. Gender and social gaps represent additional manifestations of digital inequality at a global level, as conceptualised by R. Heeks (2022). The researcher analysed digital inequality in countries of the Global South and examined structural dimensions of exclusion in the digital economy. The study treats these aspects as part of a broader system of socio-economic barriers rather than as separate autonomous forms of inequality. Mobile internet plays a key role in expanding access to digital environments in lower-income countries, as demonstrated by P.O. Vitalis *et al.* (2025). The researchers analysed the digital divide in Nigeria and analysed the role of media and mobile technologies in access to information. International organisations develop integrated approaches to addressing the digital divide through digital inclusion policies, as indicated by D.O. Okocha & E. Edafewotu (2022). The researchers reviewed strategies for reducing the digital divide and described the role of public policy in this process.

Global strategies focus not only on infrastructure but also on the development of digital skills and regulatory mechanisms, as noted by G. Özcan Alp & T. Baycan (2024). The researchers investigated the digital divide in regional development and assessed the impact of policies on reducing inequality. Education functions as one of the key instruments for addressing cognitive digital inequality, as shown by A. Afzal *et al.* (2023). The researchers explored the use of technologies in education and highlighted the role of educational tools in ensuring access to knowledge. Public libraries and digital archives function as effective institutions for ensuring equal access to knowledge, as reflected by M.H. Laskar (2023). The researcher studied the development of digital society in India and assessed access to resources in urban and rural regions. The integration of technological and socio-educational measures increases the effectiveness of digital inclusion, as confirmed by L. Deineko *et al.* (2022). The researchers assessed the digital divide in Ukraine and its impact on regional sustainable development. Local initiatives combined with global programmes contribute to the sustainable reduction of the information gap, as reported by G.W. Muschert & M. Ragnedda (2024). The researchers considered digital inequality in a regional context and described the role of international and local factors. The study confirms this through comparative analysis of practices in Finland, India, and Kenya, showing that the effectiveness of digital inclusion depends on the combination of local and global approaches. Open digital resources and platforms function as instruments for democratising access to information, as observed by L.M. König *et al.* (2023). The researchers addressed digital inequality in healthcare and evaluated approaches to reducing disparities through interventions. Digital inequality requires an interdisciplinary approach and policy coordination across levels, as noted by E. Sala *et al.* (2022). The researchers explored the age-based digital divide in Europe and identified the need for comprehensive approaches to its reduction. The study confirms this conclusion through the synthesis of three types of digital inequality, demonstrating the need for integrated inclusion policies. Digital inclusion functions as a necessary condition for the development of a fair and sustainable global knowledge-based society, as emphasised by A. Farooqi *et al.* (2022). The researchers highlighted the importance of equal access to information and presented digital inclusion as a foundation for societal development. The findings of the study align with academic approaches that view digital inequality as a multidimensional and dynamic phenomenon combining technological, cognitive, and socio-economic dimensions. Analysis of the literature confirms that reducing the digital divide was possible only through a comprehensive approach that includes infrastructure development, improvement of digital literacy, and implementation of effective digital inclusion policies. Therefore, digital inclusion emerges as a key prerequisite for ensuring equal access to knowledge and for forming a stable and equitable society under conditions of global digital transformation. The synthesis of the findings indicates that digital inequality in the global information society has a complex and multidimensional character and functions as an important factor of social stratification. Unequal access to digital resources, differences in digital competencies, and economic barriers generate persistent disparities between countries and social groups. Physical access to technologies does not ensure full integration into the digital environment without adequate skills and educational support. Effective strategies for addressing information exclusion rely on the combination of infrastructure development, digital education, and institutional regulatory mechanisms. Public libraries, digital platforms, and mobile technologies function as instruments for ensuring access to knowledge and expanding participation in the digital environment. Integration of global and local initiatives contributes to reducing the digital divide.

## CONCLUSIONS

The study conducted a comprehensive analysis of digital inequality as a multidimensional social phenomenon that combines technological, cognitive, and economic aspects. The study established that the digital divide determines the level of public access to information resources, opportunities for participation in the knowledge society, and the effectiveness of learning and professional activity. The technological level of digital inequality was manifested through differences in access to the internet, connection speed, and availability of digital devices, which creates a basic barrier to participation in the digital environment. The cognitive level relates to differences in digital competencies, users' ability to evaluate information, and the application of technologies for learning or professional activity. The economic aspect concerns the capacity to acquire digital devices, access educational resources, and invest in skills development, which directly affects socio-economic mobility and inclusion in the digital society. Documentary analysis of international strategies and programmes of digital inclusion established that effective reduction of the digital divide requires a comprehensive approach combining infrastructure development, digital competencies, and a regulatory environment.

The practical analysis of case studies of public libraries and digital archives in Finland, India, and Kenya demonstrated that effective digital inclusion was achieved through the integration of technological solutions with socio-educational programmes. In Finland, the National digital library recorded more than 1.7 million issues of e-books and audiobooks and nearly 5 million digital journal views in 2025, while the number of users exceeded 270,000, which confirms a high level of digital maturity in society. In India, digital library initiatives in the state of Uttar Pradesh demonstrated an increase in learning outcomes of 32% in English, 34% in natural sciences, and 52% in mathematics among 7,500 female students, which confirms the effectiveness of digital resources in addressing educational inequality in remote regions. In Kenya, the Kenya National Library Service, through the establishment of local digital centres and mobile libraries, expands access to knowledge in communities with limited infrastructure, emphasising that even under constrained resources, it was possible to increase digital inclusion. A comparative statistical analysis of the United States of America, the Federal Republic of Germany, and Bangladesh confirmed a clear correlation between the level of economic development and access to digital technologies. The study also showed that mobile subscription rates exceed 100 per 100 inhabitants in all three countries (ranging from 119 to 130), which indicates the global spread of multi-device consumption regardless of income level. The results emphasise that the urban-rural gap in lower-income countries (Bangladesh) remains critical, while in developed countries it was minimal, indicating the need for targeted infrastructure investment in rural regions.

Based on the conducted study, several practical recommendations can be proposed, including strengthening state support for digital infrastructure and access to educational resources; implementation of programmes for the development of digital competencies among all population groups; promotion of global partnerships and transnational initiatives to scale successful practices; and evaluation of the effectiveness of measures using digital inclusion indicators. The limitation of the study lies in the use of open statistical data, which may not fully reflect all local and specific contexts. Future research could include empirical surveys and field studies to clarify the impact of digital initiatives on different social groups and to identify more precise strategies for addressing the digital divide.

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# Digital archaeological projects and their influence on the perception of cultural identities in different regions

Olena Khomenko*[1]

[1]Department social and humanitarian disciplines, European University, Kyiv, Ukraine

**Abstract.** The digitalisation of archaeological heritage was transforming the methods of storing, visualising, and interpreting archaeological data, whilst also influencing the perception of cultural identities across various regional and institutional contexts. The aim of this study was to determine how the application of computational tools in the study of archaeological heritage alters conceptions of collective memory, historical belonging, and modes of interpreting the past in colonial and postcolonial societies. The research methodology was grounded in a theoretical-analytical approach and encompassed qualitative content analysis, comparison and systematisation, the logical-analytical method, and theoretical generalisation. Data analysis identified the principal forms of digital archaeological projects: three-dimensional documentation of archaeological sites and digital twins; three-dimensional reconstructions; digital archives; integrated research infrastructures; geoinformation projects; virtual museums and interactive exhibitions; and digital repatriation. It was established that digital repositories, three-dimensional models, and integrated research infrastructures broaden access to archaeological materials beyond their physical storage locations. It was determined that three-dimensional reconstructions construct a spatial image of the past but necessitate a demarcation between verified and hypothetical elements. Regional analysis enabled the identification of infrastructural, documentary, landscape-analytical, reconstructive-managerial, and archival-epigraphic models of digital archaeological heritage. Consequently, it was revealed that the decolonisation of the digital archaeological narrative depends on the transparency of object provenance, the participation of source communities in the description of materials, and the possibility of updating metadata. The findings of this research can be utilised by researchers, museum specialists, digital archive developers, and educational institutions when creating digital projects related to archaeological heritage and cultural identity

**Keywords:** three-dimensional documentation; heritage; virtual museums; geoinformation projects; postcolonial rethinking; metadata

## INTRODUCTION

The digital transformation of archaeology was changing the methods of recording, storing, analysing, and publicly presenting archaeological heritage. Three-dimensional (3D) documentation, digital twins, online repositories, geoinformation systems, algorithmic data processing, and virtual forms of exhibition were expanding the formats for working with archaeological materials. In the digital environment, an archaeological object was represented not only as a material artefact or a museum exhibit but also as a dataset, a visual model, an element of a digital collection, or part of an online narrative. In this regard, it was necessary to determine how computational tools participate in shaping conceptions of cultural memory, historical belonging, object provenance, and the right of different groups to interpret heritage. Colonial and postcolonial contexts require particular consideration, where digital description, open access, and the re-cataloguing of archaeological collections may reproduce previous classification schemes or create conditions for the inclusion of local knowledge, alternative descriptions, and the participation of source communities.

In the work of C. Bonacchi (2021), digital heritage was presented as a changing form of cultural memory linked to big data, platform communication, and user participation in engaging with the past. The authors' findings demonstrated that digitalisation was not confined to expanding access to objects but transforms the modes of production,

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*Corresponding author (o.khomenko@e-u.edu.ua)

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dissemination, and discussion of cultural meaning. This approach allows for a shift from a general understanding of digitalisation as a technical process to the consideration of digital heritage as an environment in which the relationships between data, memory, cultural meanings, and participants in interpretation were altered. The development of this issue was traced in the study by J. Huggett (2021), which documents the increasing role of algorithmic procedures in archaeological practice. Algorithms, software environments, and digital models participate in the selection, processing, and presentation of data; therefore, the results of digital analysis depend not only on the source materials but also on the logic of the tools employed. In a later work, J. Huggett (2024) links the digital turn in archaeology to changes in methodological approaches, professional norms, and modes of interpreting archaeological data. Taken together, these findings demonstrated that digital archaeology affects not only research tools but also the conditions under which archaeological knowledge was formed. If the works of C. Bonacchi and J. Huggett focus on changes in digital heritage and archaeological practice overall, T. Zoldoske (2024) specifies this issue through the role of metadata. In his work, metadata were defined as a prerequisite for the discovery, linking, and reuse of archaeological materials. Standardised descriptions, vocabularies, and information links transform a digital archive not merely into a repository but into a research network through which objects, collections, territories, and historical contexts can be juxtaposed. For the analysis of cultural identity, this holds methodological significance, as it was metadata that record an object's provenance, the conditions of its description, and its connection to a specific classification system.

The question of digital procedures acquired an additional dimension in the work of M. Tenzer *et al.* (2024), where the application of artificial intelligence in archaeology was associated with the processing of large volumes of information, pattern recognition, automated classification, and the ethical issues of using algorithms. The authors' findings point to the necessity of considering algorithmic transparency, data bias, and researcher accountability when shaping interpretive outcomes. This correlates with the problem of the digital representation of cultural heritage, since algorithmic classification can influence which features of an object become visible and which remain outside the description. A similar logic manifests in the work of D. Belteki *et al.* (2025), where the datafication of cultural collections was presented as a process altering documentation, cataloguing, and data exchange within cultural heritage institutions. Digital infrastructures provide new forms of disseminating museum and archival descriptions, yet they retain a connection with previous classification systems, terminology, and the administrative history of collections. In a postcolonial context, this means that placing a collection online does not in itself resolve questions of object provenance, the right to description, and the participation of source communities in refining metadata.

The transition from data and metadata analysis to the institutional and user environment was presented in the work of J. Pereda *et al.* (2025). Online cultural heritage was described as a socio-technical system in which digital infrastructures, users, institutions, data, and mechanisms of co-production of knowledge interact. Such a conclusion enables the consideration of digital archaeological projects not merely as platforms for storage or material demonstration but as environments where relationships were formed between researchers, museums, educational audiences, local communities, and users of digital heritage. At the level of archaeological data production, this issue was elaborated in the work of S. Perry *et al.* (2025). The authors' findings were linked to a critique of uniform models of describing the past and to the necessity of reconsidering archaeonormativity through storytelling and alternative forms of data presentation. In this approach, archaeological information was understood not solely as the result of recording facts but also as a product of choices regarding language, narrative structure, material accessibility, and the mode of interpretation. This allows digital archaeology to be linked to the question of which groups gain the opportunity to participate in the creation of descriptions of the past. This line of enquiry continued in the work of F. Dolcetti (2025), where human-centred and participatory approaches were presented as conditions for creating a digital archaeological experience. The findings of this work showed that digital archaeological products can perform not only a demonstrative function but also be used for the collaborative description, discussion, and rethinking of cultural material.

Thus, the studies enumerated above delineate several trajectories of analysis within digital archaeology: the transformation of heritage in the context of big data, algorithmic agency, the development of digital infrastructures, the role of metadata, the application of artificial intelligence, the datafication of museum collections, the socio-technical organisation of online heritage, alternative forms of archaeological narrative, and user participation in the creation of digital experience. Notably, these trajectories were predominantly presented as discrete lines of inquiry. The question of how they collectively reshape the perception of cultural memory, historical belonging, and the postcolonial rethinking of archaeological heritage remains insufficiently synthesised. The aim of the study was to ascertain how the use of digital methods in the study of archaeological heritage influences the conceptualisation of cultural memory, historical continuity, and the right to interpret the past in colonial and postcolonial societies. The research objectives were: to systematise the principal digital methods for studying archaeological heritage and determine their role in the preservation, visualisation, and interpretation of cultural materials; and to reveal how digital archives, three-dimensional reconstructions, metadata, and the participation of source communities affect the conceptualisation of cultural memory and the postcolonial rethinking of the past.

## MATERIALS AND METHODS

The study was carried out as a theoretical-analytical inquiry. It comprised qualitative content analysis, as well as the comparison and systematisation of scholarly publications, digital platforms, museum catalogues, professional reports, and project materials dedicated to digital archaeology and its influence on the perception of cultural identities. The source base of the study consisted of materials examining 3D documentation of archaeological sites, digital twins, 3D reconstructions, archaeological repositories, geoinformation mapping, virtual museums, digital collections, online catalogues, and the digital repatriation of cultural heritage.

Qualitative content analysis was employed to identify the principal thematic and functional trajectories of digital archaeology. The purpose of applying this method was to determine which forms of the digitisation of archaeological heritage were represented in scholarly publications, digital platforms, museum catalogues, professional reports, and project materials. On the basis of this method, materials devoted to the 3D documentation of archaeological sites, digital twins, 3D reconstructions, archaeological repositories, geoinformation mapping, virtual museums, digital collections, online catalogues, and the digital repatriation of cultural heritage were examined. Materials from CyArk (n.d.a) and CyArk (n.d.b) were used to examine the 3D documentation of monuments, the digital recording of the condition of heritage objects, and the creation of digital models of objects accessible for remote study. The issues of digital twins, virtual reconstruction, and the management of archaeological sites were examined on the basis of the works of M. Hostettler *et al.* (2024) and W. Liu *et al.* (2024). The problematic of 3D reconstructions and the virtual presentation of archaeological heritage was explored through the studies of E. Champion & H. Rahaman (2020), I. Liritzis & P. Volonakis (2021) and R. Spallone *et al.* (2022). Materials from the Archaeology Data Service (n.d.), The Digital Archaeological Record (n.d.), and re3data.org (n.d.) were used for the analysis of digital archaeological archives, repositories, and the reuse of research data. The integration of archaeological databases, the handling of metadata, and cross-archive material connectivity were examined on the basis of the S. Basset (2020) and ARIADNEplus (2023) infrastructures. Museum online catalogues and the digital representation of collections were analysed using materials from the British Museum (n.d.) and the Pixelated Realities (2025). Geoinformation mapping and spatial analysis of archaeological landscapes were examined on the basis of the study by M.A. Canuto *et al.* (2018). Emergency digital documentation of heritage objects under conditions of risk was studied through the example of ICOMOS (2019) materials. The systematisation of epigraphic heritage and the creation of a digital repository of inscriptions were examined using materials from Archaeological Survey of India (n.d.) and the Press Information Bureau, Government of India (2023). Issues of digital repatriation, the participation of source communities, the postcolonial rethinking of heritage, and control over digital copies were analysed on the basis of the works of C. Poske (2024) and A. Mohammed (2025).

The comparative method was applied to juxtapose digital archaeological projects in different regional and institutional contexts. The purpose of the method was to identify differences between projects in terms of their technological format, research function, and significance for the perception of cultural identity. Examples from the United Kingdom, Ukraine and the European Union, Syria, Guatemala and Mexico, China, and India were selected for comparison. The selection of these countries and regions was conditioned by the fact that they reflect different institutional and functional models of digital archaeology: the infrastructural model of data access, the digital recording of heritage under conditions of risk, landscape-analytical mapping, the reconstructive-managerial use of digital twins, and the archival-epigraphic systematisation of written monuments. The comparison was conducted according to the following criteria: country or region of project implementation, project or platform, digital format, data corroborated by sources, and the project's significance for the perception of identity.

The method of systematisation was used to organise the source materials into the main analytical blocks of the study. Its purpose was to group information according to the trajectories of digital archaeology and to determine their role in the representation of archaeological heritage. On the basis of this method, the materials were distributed across the following blocks: types of digital archaeological projects, forms of expanding access to heritage, the participation of local communities in the interpretation of digital materials, the influence of 3D reconstructions on the perception of the historical past, the role of digital archives in the analysis of colonial collections, the educational use of digital projects, the conditions for the decolonisation of the historical narrative, and the risks of digital archaeology for cultural identity. Systematisation was applied to scholarly publications, digital repositories, museum online catalogues, project materials, and institutional platforms dealing with the recording and preservation of data, visualisation and reconstruction, archival storage, spatial analysis, museum and educational interpretation, as well as the digital return of cultural materials to countries and communities of origin.

The logical-analytical method was applied to establish the connection between digital technologies, modes of representing archaeological data, and changes in the perception of cultural identity. The purpose of the method was to explain how digital repositories alter the regime of access to archaeological materials, how 3D reconstructions shape a spatial image of the past, how geoinformation projects reveal territorial connections and cultural contacts, and how digital repatriation correlates with issues of object provenance, the right to interpretation, and cultural sovereignty. This method was applied to materials that reveal the technological basis of digital archaeological projects, the forms of representing archaeological data, the regime of access

to materials, and the connection between digitisation and questions of cultural memory, local identity, and the post-colonial rethinking of heritage.

The method of theoretical generalisation was employed to develop a final model of digital archaeology's influence on cultural identity. On the basis of this method, four levels of digital archaeology's influence were distinguished: access, visualisation, interpretation, and identification. The material for generalisation comprised the results of the examination of digital repositories, 3D models, virtual exhibitions, geoinformation projects, digital archives, regional case studies, and digital repatriation projects.

## RESULTS AND DISCUSSION

Digital archaeological projects differ not only in the technologies employed but also in their research function. Digitisation was represented by seven principal forms: 3D documentation and digital twins, 3D reconstruction of lost architectural elements, the creation of digital archaeological archives of field and museum materials, integrated research infrastructures, geoinformation projects, virtual museums and interactive exhibitions, and digital repatriation projects. Digital archaeological projects were considered as tools that transform the modes of presenting archaeological data and influence the perception of cultural identity (Table 1).

**Table 1.** Principal types of contemporary digital archaeological projects

| Group of digital archaeological projects | Technological basis | Primary function | Significance for the perception of cultural identity |
|---|---|---|---|
| 3D Documentation and digital twins | Laser scanning, photogrammetry, digital modelling, digital twins | Precise recording of a monument's condition, monitoring, preservation, and object management | Enable the perception of a monument as a spatially integral object, rather than merely a ruin or museum fragment |
| 3D reconstructions | Reconstructive modelling, architectural analogies, virtual restoration | Recreation of lost or partially destroyed architectural elements and historical context | Form a visually complete image of the past, yet require a clear distinction between proven and hypothetical elements |
| Digital archaeological archives | Digital repositories, databases, metadata, digitised reports and images | Long-term storage, description, and reuse of archaeological materials | Broaden access to data and create conditions for the re-analysis of archaeological collections |
| Integrated research infrastructures | Common description standards, cross-archive integration, semantic data linkage | Unification of archaeological data from diverse collections, countries, and research systems | Allow for the comparison of materials from different regions and the identification of cross-cultural connections |
| Geoinformation projects | Geographic Information Systems, digital cartography, spatio-temporal analysis | Analysis of the distribution of monuments, historical landscapes, routes, and zones of cultural exchange | Portray identity as a result of territorial connections, migrations, and interactions |
| Virtual museums and interactive exhibitions | Virtual and augmented reality, 3D visualisation, interactive museum environments | Public presentation of archaeological objects and educational interpretation of heritage | Render archaeological heritage accessible to a broad audience and influence public representation of the past |
| Digital repatriation projects | Digital copies, online access, virtual collections, collaborative digital archives | Restoration of access for source communities to cultural objects and data | Linked to the reconsideration of ownership, cultural sovereignty, and postcolonial justice |

**Source:** ompiled by the author based on data from Archaeology Data Service (n.d.), CyArk (n.d.a, n.d.b), The Digital Archaeological Record (n.d.), re3data.org (n.d.), E. Champion & H. Rahaman (2020), S. Basset (2020), R. Spallone *et al.* (2022), ARIADNEplus (2023), M. Hostettler *et al.* (2024), W. Liu et al. (2024), A. Mohammed (2025)

The typology presented has enabled the identification of several levels of digital transformation of archaeological heritage. The first level was associated with the recording and preservation of data. It encompasses 3D documentation, digital twins, archaeological archives, and integrated research infrastructures. These projects ensure more accurate registration of objects, long-term preservation of materials, and the possibility of their subsequent scientific re-analysis. The second level was associated with the spatial and visual interpretation of archaeological data. It was constituted by 3D reconstructions, geoinformation projects, virtual museums, and interactive exhibitions. In this instance, digitisation was not limited to the preservation of information but shapes a particular mode of representing the past. An archaeological object was embedded within a reconstructed environment, a cartographic context, or a museum narrative, which influences the perception of its historical and cultural significance. The third level was associated with the socio-cultural reconceptualisation of heritage. It was most distinctly manifested in digital repatriation projects, where digital copies, archives, and models were employed to restore access for source communities to objects of cultural memory. Within a postcolonial context, such projects acquire particular significance, as they engage with issues of the right to interpretation, cultural sovereignty, and the revision of previous museum classifications. Thus, the typology presented demonstrates that digital archaeological projects perform not only a technical but also an epistemological function. They alter the conditions of the production, storage, and dissemination of

knowledge about archaeological heritage. For the study of cultural identities, this signifies that digitisation becomes a factor not only in the preservation of the past but also in its reinterpretation within contemporary historical, educational, and postcolonial contexts.

In the current study, digital archaeological projects were systematised according to their technological basis and research function: 3D documentation, digital twins, 3D reconstructions, digital archives, geoinformation projects, virtual museums, and digital repatriation. This corresponds with the findings of G. Bitelli *et al.* (2025), where high-precision 3D surveying and data post-processing were applied to museum archaeological objects. In contrast to the aforementioned work, where the emphasis was placed on the technical recording and digital presentation of museum materials, the current study considers three-dimensional documentation as one element of a broader typology of digital archaeology. The results of the study also align with the work of S. Barzaghi *et al.* (2024), where the management of 3D cultural heritage data was examined through FAIR principles, the Aldrovandi digital twin, object provenance, and metadata provenance. In contrast to that approach, which was oriented towards the organisation, preservation, and reuse of 3D data, the current study incorporates digital twins and 3D repositories into a system influencing access, visualisation, and interpretation of archaeological heritage. The delineation of virtual museums and interactive exhibitions in the study corresponds with the work of O. Jamil & A. Brennan (2025), where Gaussian Splatting and generative artificial intelligence 3D models were linked to the creation of immersive virtual environments for presenting architectural heritage. In contrast to that work, where attention was focused on visual aesthetics and the technical capabilities of immersive representation, the current study examines virtual and interactive formats through their connection to the educational perception of culture, the public representation of the past, and digital access to archaeological materials.

Digitisation expands access to archaeological heritage through remote engagement with materials, the reuse of research data, interaction with digital spatial models, and the provision of digital copies to countries and communities of origin (Archaeology Data Service, n.d.). Digital repositories reduce dependence on the physical location of archaeological materials: field reports, images, artefact descriptions, drawings, and datasets can be utilised by researchers and educational institutions irrespective of the location of the museum, archive, or excavation site (The Digital Archaeological Record, n.d.). The Archaeology Data Service (n.d.) was oriented towards the preservation and dissemination of archaeological data, while tDAR (The Digital Archaeological Record, n.d.) accumulates documents, images, datasets, and other materials from archaeological investigations. A distinct direction was constituted by 3D repositories and digital models, which provide access to objects that were difficult to study directly. This pertains to monuments in remote locations, objects with restricted museum display regimes, destroyed fragments, and artefacts requiring delicate handling. Such a format allows engagement not only with an object's description but also with its digital spatial representation, including its form, scale, and structure (Champion & Rahaman, 2020).

Integrated infrastructures expand access not to a single object, but to interconnected bodies of archaeological data. ARIADNE (Basset, 2020) aggregates archaeological data and metadata according to thematic, spatial, and temporal criteria, thereby enabling the comparison of materials from different collections, regions, and research projects. For the analysis of cultural identity, this mode of access makes it possible to examine heritage through connections between territories, migrations, exchanges, and cultural contacts, rather than solely within the bounds of a single collection or national archive. Separately, digital access was examined in relation to societies whose heritage has been displaced, removed, or described by external research traditions. Digital repatriation provides countries and communities of origin with digital copies, descriptions, and archival materials related to their cultural heritage. Crucially, such access does not substitute for the physical return of objects, but creates an additional channel for engaging with heritage, memory, and historical descriptions (Poske, 2024; Mohammed, 2025). Thus, the broadening of access renders archaeological materials available beyond their place of storage, enables the re-analysis of data within new scholarly contexts, and involves a wider circle of participants in the interpretation of heritage. In the context of cultural identity, this means that the past ceases to be represented solely through museological or academic selection and becomes accessible to local and postcolonial interpretations.

Digital projects alter not only access to archaeological materials, but also the distribution of interpretative authority. If a digital archive was created solely by a museum or a research institution, the local community remains an external user of a ready-made description. A different outcome arises when representatives of communities of origin were involved in refining names, describing the cultural functions of objects, adding oral histories, and determining the conditions of access to materials. Scholarship on digital repatriation emphasises that the return of digital copies and descriptions concerns not only access, but also questions of ownership, cultural sovereignty, and the right to interpret heritage (Poske, 2024; Mohammed, 2025). The participation of local communities may take a consultative, collaborative, or community-driven form. In the consultative model, the community comments on an already prepared project; in the collaborative model, museums, researchers, and community representatives shape the digital description together; in the community-driven model, the initiative originates from the bearers of cultural memory. For the analysis of cultural identity, the collaborative and community-driven models allow for the integration of local knowledge, language,

memory, and the cultural meanings of objects alongside academic classification (Poske, 2024).

Analysis of the sources has demonstrated that 3D reconstructions perform not only a visualisation function, but also an interpretative one. They transform fragmentary archaeological data into a model of the presumed historical appearance of an object, an architectural environment, or a museological context (Spallone *et al*., 2022; Liu *et al*., 2024). The primary effect of 3D reconstructions was associated with a shift in the scale of perception. The archaeological object was presented not as an isolated fragment, but as part of a spatial structure: a building, a complex, a settlement, a ritual space, or a landscape. This makes it possible to analyse not only the form of the object, but also its potential connections with the surrounding environment, function, and cultural context (Spallone *et al*., 2022). At the same time, a 3D reconstruction was not a direct reproduction of the past. It depends on the state of preservation of the object, the composition of the sources, the analogies selected, and the researchers' assumptions. Therefore, the reconstructed model captures a particular scholarly version of the object, rather than its definitive historical appearance (Hostettler *et al.,* 2024). For the perception of cultural identity, this means that a 3D reconstruction can establish a visual image of a past society: its architecture, technologies, spatial organisation, and symbolic practices. However, the extent of this influence was determined by the transparency of the reconstruction: it was essential to distinguish between elements corroborated by archaeological data and those restored hypothetically. Consequently, 3D reconstructions should be regarded as a tool of scholarly visualisation with a pronounced interpretative component. Their efficacy depends not only on the technical quality of the model, but also on the methodical documentation of sources, assumptions, and the level of reliability of the restored elements.

Digital archives allow archaeological collections to be considered not merely as an assemblage of objects, but as data with a history of provenance, movement, description, and institutional custody. For collections assembled during the colonial period, this was significant, since museum classifications often reflected an external research optic and did not incorporate local ways of understanding heritage. A digital archive records not only the image or description of an object, but also the metadata associated with it: place of discovery, date of acquisition, institutional affiliation, research history, previous names, and classification variants. This enables the tracing of artefacts' provenance, the identification of gaps in documentation, and the comparison of museum descriptions with the territorial and cultural context of the object (Archaeology Data Service, n.d.; The Digital Archaeological Record, n.d.). In a postcolonial context, digital archives create the conditions for the re-examination of collections. One and the same object may be represented as a museum exhibit, an archaeological source, and an element of the memory of a community of origin. Therefore, the significance of a digital archive was determined not only by the volume of digitised materials, but also by whether it permits the refinement of metadata, the inclusion of alternative descriptions, and the linking of the object to local knowledge (Poske, 2024). Digital repatriation projects advance this approach by providing countries and communities of origin with access to digital copies, descriptions, and archival materials. However, the digital form does not eliminate the question of the physical return of objects or of control over cultural data. Research emphasises that digital repatriation should be considered not as a technical substitute for restitution, but as one of the mechanisms of access, collaboration, and the revision of colonial regimes of heritage description (Poske, 2024; Mohammed, 2025). Consequently, digital archives participate in the rethinking of colonial collections when they do not confine themselves to the publication of images and brief descriptions. Their analytical role manifests itself in the disclosure of objects' provenance, the revision of metadata, the accommodation of local interpretations, and the creation of conditions for collaborative work among museums, researchers, and communities of origin.

Regional analysis has shown that digital archaeological projects were shaped in accordance with a country's historical experience, the state of preservation of monuments, the structure of museum collections, and the objectives of cultural policy. In some instances, digitisation was aimed at organising access to archaeological data and museum holdings; in others, at recording objects under threat of destruction, reconstructing archaeological complexes, or systematising epigraphic heritage. Therefore, the influence of digital projects on the perception of cultural identity does not manifest itself universally, but through specific national and institutional contexts (Table 2).

**Table 2.** Regional models of digital archaeological heritage

| Country/ region | Project / platform | Digital format | Sources corroborating | This significance for identity perception |
|---|---|---|---|---|
| Great Britain | Archaeology Data Service (ADS); British Museum Collection Online | Digital archaeological repository; online database of museum collections | ADS ensures long-term professional curation of archaeological data and its accessibility for reuse; the British Museum Collection Online provides access to nearly 5 million objects in over 2 million records, and also documents research into the history and provenance of museum items | Digitisation was linked to institutional access to archaeological data and museum collections. Within the context of colonial heritage, the availability of online descriptions and provenance data creates a foundation for analysing the history of object acquisition and their museological interpretation |

**Table 2.** Continued

| Country/ region | Project / platform | Digital format | Sources corroborating | This significance for identity perception |
|---|---|---|---|---|
| Ukraine / EU | Europeana; 3D-4CH; Ukrainian 3D models of cultural heritage | Pan-European digital platform; 3D models of heritage objects | The first Ukrainian 3D models were published on Europeana via the 3D-4CH project; the European Commission links this to the preservation of heritage under threat | Digitisation inscribes national heritage within a pan-European digital space. 3D models allow objects to be presented not merely as local monuments, but as part of a transnational system of cultural heritage preservation |
| Syria | Project Anqa, Damascus | 3D scanning, photogrammetry, panoramic photography, web platform | Project Anqa created 3D records of endangered heritage objects in Damascus, archived the data, and made the images and materials accessible via a web platform; the project was focused on the emergency documentation of heritage in the Middle East and North Africa | Digitisation was associated with the documentation of objects under risk of destruction. Here, the perception of heritage was shaped through the preservation of a digital image of the urban and architectural environment, available for further analysis and public presentation |
| Guatemala / Mexico | PACUNAM LiDAR Initiative; research on the Maya lowlands | LiDAR-mapping; spatial analysis of the archaeological landscape | LiDAR survey of the Maya lowlands revealed ancient settlements and structures hidden beneath the forest canopy; research by M.A. Canuto *et al.* demonstrated the significance of airborne laser scanning for studying the complexity of the ancient Maya landscape | Digital archaeology changes the scale of perception of the pre-Columbian past: heritage was viewed not as an assemblage of individual monuments, but as a spatially organised system of settlements, infrastructure, and landscape interconnections |
| China | Digital twin of the Pishan archaeological site, Zhejiang Province | Digital twin; virtual reconstruction of an archaeological site | Application of a digital twin to the Pishan archaeological site and its use for the virtual reconstruction of an object preserved primarily at the foundation level | Digitisation was employed for the reconstruction and management of an archaeological site. This makes it possible to a local monument as part of a historical environment suitable for research, museum display, and educational use |
| India | Bharat Shared Repository of Inscriptions, BharatSHRI | Digital repository of inscriptions; digital epigraphic museum | BharatSHRI was posited as a national repository and virtual museum of ancient Indian inscriptions; the initial phase envisages the digitisation of 100,000 inscriptions | Digitisation was linked to the systematisation of epigraphic heritage. Access to inscriptions, transcriptions, and metadata makes it possible to connect archaeological data with language, territories, dynasties, and historical memory |

**Source:** compiled by the author based on data from Archaeology Data Service (n.d.), Archaeological Survey of India (n.d.), British Museum (n.d.), M.A. Canuto *et al.* (2018), ICOMOS (2019), Press Information Bureau, Government of India (2023), W. Liu *et al.* (2024), Pixelated Realities (2025)

The data presented in the table reflect the differences in regional models of archaeological heritage digitisation according to the predominant objectives and institutional conditions of project implementation. In Great Britain and EU countries, digital initiatives were primarily associated with the establishment of a sustainable infrastructure for accessing archaeological and museum data. In the British case, this was manifested through the development of professional repositories and open museum catalogues, which enable the study of collection provenance, the history of their acquisition, and methods of museological description. In the European and Ukrainian example, the emphasis was shifted towards the 3D documentation of at-risk objects and their integration into the pan-European digital space. The Syrian example demonstrates a documentation model of digital archaeology. In this instance, digital technologies were applied to record architectural heritage susceptible to damage or loss. In Guatemala and Mexico, conversely, digitisation was linked to expanding the scale of archaeological analysis: LiDAR mapping allows pre-Columbian heritage to be considered not as an assemblage of individual monuments, but as a spatially organised system of settlements, infrastructure, and landscape interconnections. The Chinese and Indian examples reflect different forms of institutional utilisation of digital data. In China, a digital twin was employed for the reconstruction and management of a specific archaeological site. In India, the digital repository of inscriptions was oriented towards the systematisation of epigraphic heritage and the creation of a unified database of written testimonies. In both cases, digital projects connect archaeological materials with research, educational, and museological practices. Consequently, regional differences were manifested in the dominant function of the digital project. Characteristic of Great Britain and the EU was an infrastructural model of access; of Syria – a documentation model for heritage preservation under risk; of Guatemala and Mexico – a landscape-analytical model; of China – a reconstructive-managerial model; and of India – an

archival-epigraphic model. This differentiation demonstrates that digital archaeological heritage influences the perception of identity through diverse mechanisms: access to collections, the documentation of vulnerable objects, the spatial re-conceptualisation of the past, the reconstruction of local monuments, and the systematisation of written sources.

The study identifies regional models of digital archaeological heritage: infrastructural, documentational, landscape-analytical, reconstructive-managerial, and archival-epigraphic. This aligns with the findings of G. Chen *et al*. (2025), where the reconstruction of cultural heritage in virtual space was linked to preserving the image of heritage lost or damaged after catastrophes, as well as to engaging with the cultural memory of displaced groups. In contrast to that work, which focuses on virtual reconstruction following destruction and on user perception of the digital environment, the study examines regional models through the lens of differing institutional objectives, technological formats, and modes of representing cultural identity. The use of photogrammetry, temporal data integration, semantic documentation, and virtual reconstruction enabled the recording of the stratigraphic context within an active urban infrastructure setting. Unlike that research, where the analysis centres on a single urban archaeological case and the methodological process of its digital recording, the study juxtaposes the reconstructive-managerial model with other regional formats of digital archaeology. The postcolonial dimension of the regional models aligns with the work of J. Eyssette (2025), where AI-assisted museums in Morocco and Egypt were linked to algorithmic heritage, museum representation, coloniality, and techno-cultural empowerment. This finding corresponds with the study, wherein digital archaeological heritage was regarded not only as technological infrastructure but also as a medium for re-examining museum descriptions, access to cultural data, and the participation of diverse groups in interpreting the past. In contrast to that work, which was oriented towards North African museums and the application of artificial intelligence (AI) in the museum sphere, the study incorporates the postcolonial aspect into a comparative framework of regional models of digital archaeology.

Digital archaeological projects transform the educational perception of culture by facilitating a shift from textual description to the visual and interactive study of heritage. 3D reconstructions, virtual museums, and digital collections allow an archaeological object to be examined through its form, scale, spatial positioning, and relationship with the historical setting (Liritzis & Volonakis, 2021). In educational environments, such projects afford the opportunity to study inaccessible, damaged, or fragmentarily preserved objects without direct contact. This broadens the approaches to working with archaeological material and enables its integration into teaching scenarios related to regional history, the origins of cultural forms, and intercultural connections. At the same time, the educational value of a digital project depends on its scholarly support. A 3D model or virtual exhibition must include information on sources, the degree of reconstruction, and hypothetical elements, for without such explanatory detail, the visual image may be perceived as the definitive version of the past (Liritzis & Volonakis, 2021).

The digitisation of archaeological data can contribute to the decolonisation of the historical narrative; however, this effect does not arise automatically. The mere fact of making a collection available online does not alter the interpretive framework if previous museum descriptions, colonial terminology, and a unidirectional logic of object classification persist. In this case, the digital archive reproduces the pre-existing knowledge model, merely in a new technological form (Mohammed, 2025). The analysis identified two opposing scenarios (Fig. 1).

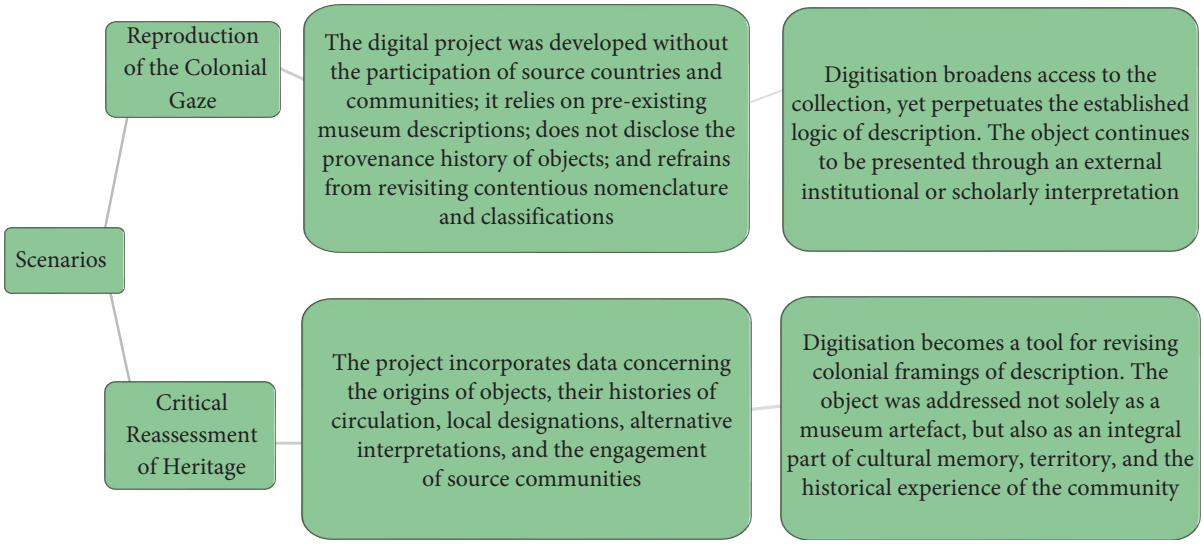


**Figure 1.** Scenarios of digitisation impact on the decolonisation of the archaeological narrative
**Source:** compiled by the author based on C. Poske (2024), A. Mohammed (2025)

Three conditions were fundamental to the decolonisation of the archaeological narrative: transparency of object provenance, participation of source communities in the description of materials, and the possibility of updating metadata. When these conditions were met, digitisation allows an object to be presented not merely as a museum exhibit, but as part of the cultural memory, territory, language, and historical experience of a specific community (Poske, 2024; Mohammed, 2025). Consequently, digital archaeological projects influence the decolonisation of the historical narrative not through technology per se, but through a change in the regime of data description and interpretation. Their analytical role manifests itself when the digital environment reveals not only the object but also the history of its study, movement, classification, and incorporation into museum or scholarly knowledge systems.

The analysis of digital archaeological projects demonstrates that their influence on cultural identity was not confined to expanding access and visualising heritage. The digital environment simultaneously creates new risks associated with data selection, methods of reconstruction, control over digital copies, and the conditions for source community participation. Therefore, the assessment of digital archaeology must consider not only technological capacities but also the methodological, ethical, and postcolonial constraints that may affect the interpretation of cultural heritage (Table 3).

**Table 3.** Risks of digital archaeology for cultural identity

| Risk | Manifestation in digital archaeology | Potential impact on identity perception |
|---|---|---|
| Technological simplification of culture | An archaeological object was presented through a 3D model, virtual tour, or brief digital description | A complex historical, social, and ritual context may be reduced to a visually convenient form |
| Illusion of complete authenticity | A 3D reconstruction may incorporate confirmed, hypothetical, and analogically restored elements | The user may perceive the reconstruction as the definitive historical appearance of the object |
| Unequal access to digital infrastructure | The creation of repositories, digital twins, and virtual exhibitions requires equipment, funding, and specialists | Source communities may become dependent on external institutions that control digitisation, storage, and data access |
| Shift in emphasis towards visual appeal | A virtual exhibition or 3D model was used primarily as a museum-communication or tourism product | The cultural significance of the object may be presented in a fragmentary manner, without disclosure of sources and the degree of hypotheticality |
| Control over digital copies and metadata | A digital copy may be stored, distributed, and described by external organisations | Issues of ownership, the right to describe, conditions of access, and cultural sovereignty persist |

**Source:** compiled by the author based on R. Spallone et al. (2022), M. Hostettler *et al.* (2024), C. Poske (2024), A. Mohammed (2025)

The data presented demonstrate that the principal risks of digital archaeology were linked not to the use of technologies as such, but to the conditions of their deployment. The most significant were methodological non-transparency of reconstructions, unequal access to digital infrastructure, and control over digital copies and metadata. These factors can restrict the participation of source communities and entrench unidirectional modes of cultural heritage interpretation.

In the study, the risks of digital archaeology for cultural identity were linked to the technological simplification of culture, the perception of reconstruction as a definitive version of the past, unequal access to digital infrastructure, a shift in emphasis towards visual form, and control over digital copies and metadata. This aligns with the results of L. Stacchio *et al.* (2024), where neural rendering in the field of cultural heritage and creative industries was examined through the ethical principles of trust, transparency, authenticity, authorship, intellectual property, and the accountability of participants in the digital process. In contrast to that work, which focuses on the ethical regulation of neural network visualisation, the study considers the risks of digital representation through their impact on the perception of cultural identity and the interpretation of the archaeological past. The issue of control over digital copies and data corresponds with the work of I. Spano & Y. Zhang (2025), where the digitisation of intangible cultural heritage was linked to Indigenous data sovereignty, the protection of traditional knowledge, languages, and cultural practices, as well as the risk of data colonialism in corporate digitisation projects. The authors indicate that existing legal mechanisms do not always ensure the protection of the intangible heritage of Indigenous communities in the digital environment. In contrast to that work, which was oriented towards intangible heritage and traditional knowledge, the study transposes the issue of data control into the sphere of digital archaeology, where digital copies, metadata, and conditions of access can likewise affect the participation of source communities in the description and interpretation of heritage.

Based on the results of the analysis, a generalised model was developed, reflecting how digital archaeological projects influence the perception of cultural identity. The model comprises four levels: access, visualisation, interpretation, and identification. These levels demonstrate a sequential transition from the technical placement of archaeological data in a digital environment to its incorporation into cultural memory, educational practices, and the postcolonial reinterpretation of heritage (Table 4).

**Table 4.** Model of the influence of digital archaeology on identity

| Level of influence | Manifestation in digital archaeology | Criterion of influence | Outcome for the perception of cultural identity |
|---|---|---|---|
| Access | Online archives, digital repositories, open museum catalogues, 3D models | The possibility of accessing archaeological data outside its physical storage location | Heritage becomes accessible to a wider range of participants: researchers, educational institutions, local communities, and diasporas |
| Visualisation | 3D reconstructions, digital twins, virtual museums, interactive exhibitions | The presentation of an object in a spatial and visual form | The archaeological object was perceived not only as a fragment or exhibit, but as part of a historical environment |
| Interpretation | Metadata, provenance information, alternative descriptions, local commentaries | The possibility of juxtaposing academic, museum, local, and postcolonial explanations | Heritage receives multiple descriptions, which creates conditions for revising previous classifications and colonial narratives |
| Identification | Educational projects, digital repatriation, participation of source communities | The connection of archaeological data with the memory, territory, language, and historical experience of a community | Archaeological heritage was incorporated into processes of cultural self-understanding and public discussion of the past |

**Source:** compiled by the author based on a synthesis of the research results

As this model demonstrates, the influence of digital archaeological projects was formed in stages. Access to digital materials becomes the initial condition for the further apprehension of archaeological heritage, as it reduces dependence on the physical location of the object, museum, or archive. On this basis, visualisation expands the modes of perceiving the material: the archaeological object was presented not only as a description or fragment, but also as a spatial model linked to a specific historical environment. Subsequently, digital data moves into the interpretative plane, where the possibility arises to juxtapose academic, museum, local, and postcolonial versions of heritage description. As a result, digital projects connect archaeological objects with contemporary notions of origin, cultural memory, and historical continuity. Thus, the model shows that digital archaeology influences cultural identity not through a single technology, but through a set of interconnected mechanisms: the expansion of access to data, the alteration of the visual image of the past, the revision of descriptions, the participation of source communities, the digital return of cultural memory, and the educational reinterpretation of heritage.

The data analysis has established that digital archaeological projects exert a significant influence on the perception of cultural identities across different regions. Their significance lies not only in the preservation and visualisation of archaeological data, but also in changing the ways the past was interpreted. 3D reconstructions, digital archives, virtual museums, and geoinformation platforms allow cultural heritage to be presented as a multi-layered historical process connected to local memory, colonial experience, postcolonial reinterpretation, and contemporary forms of cultural self-identification. In countries with a colonial legacy, digital archaeology can perform a significant function. It creates conditions for restoring access to cultural objects, revising museum descriptions, incorporating the voices of local communities, and critically analysing previous historical narratives. However, digitalisation by itself does not guarantee the decolonisation of archaeological knowledge. Its outcome depends on research ethics, transparency of interpretation, community participation, and equitable distribution of control over digital data. Consequently, digital archaeological projects modernise the understanding of cultural identities, as they transfer archaeological heritage from the status of a closed scientific or museum object into a space of open, visual, and polyphonic cultural dialogue.

## CONCLUSIONS

The conducted research has made it possible to determine that digital archaeological projects were changing the methods of recording, storing, visualising, and interpreting archaeological heritage. The analysis identified 3D documentation and digital twins, 3D reconstructions, digital archaeological archives, integrated research infrastructures, geoinformation projects, virtual museums, and digital repatriation projects. These forms of digitalisation correlate with different modes of handling archaeological data: preserving the condition of monuments, reconstructing lost elements, archival storage, spatial analysis, museum visualisation, and providing digital access to countries and communities of origin. Digitalisation expands access to archaeological materials through online repositories, digital models, cross-archive infrastructures, and digital copies of heritage objects. Field reports, images, find descriptions, 3D models, and metadata become accessible outside the physical storage location of the object. In the context of studying cultural identity, this creates conditions for comparing materials from different regions and analysing territorial connections, migrations, exchanges, and cultural contacts. A distinct place was occupied by the participation of local communities in the interpretation of digital heritage. Such participation may take a consultative, collaborative, or community-led form. In these models, local knowledge, language, memory, and the cultural meanings of objects were incorporated into the description of heritage alongside academic and museum classifications. 3D reconstructions form a spatial image of the past; however, their use requires a demarcation between confirmed and hypothetical elements. Digital archives allow archaeological collections to be examined through the history of their origin, movement, descriptions, and institutional custody. In a postcolonial context, this was linked

to the revision of museum classifications, the inclusion of local interpretations, and discussions regarding the rights to describe cultural objects.

The regional analysis revealed differences in models of digital archaeology. In the UK and the EU, digital projects were linked to access infrastructure; in Syria, to the documentation of heritage under conditions of risk; in Guatemala and Mexico, to the landscape-analytical study of archaeological spaces; in China, to reconstruction and site management; and in India, to the systematisation of epigraphic heritage. Digital archaeological projects also participate in the educational perception of culture through 3D reconstructions, virtual museums, and digital collections. At the same time, the digitalisation of archaeological data does not automatically lead to the decolonisation of the historical narrative. This process depends on the transparency of object provenance, the participation of source communities in describing the materials, and the possibility of updating metadata. Based on a synthesis of the results, a model of the influence of digital archaeology on cultural identity was proposed, comprising four levels: access, visualisation, interpretation, and identification. Concurrently, the limitations of digital archaeological projects were identified: the technological simplification of culture, the perception of reconstructions as the definitive version of the past, unequal access to digital infrastructure, and control over digital copies and metadata. A limitation of this research was its theoretical-analytical nature, as the work does not include an empirical assessment of the perception of digital heritage by users and source communities. Further research may be directed towards interviews, questionnaires, and comparative analysis of user experience in different regional and museum contexts.

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