

Modern information and communication technologies in professional training of sociology students: Evolving needs and significance in the digital age

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Abstract. This article presents a comprehensive analysis of the evolving landscape of information and communication technologies (ICT) in applied sociology, with a focus on their integration into the professional training of students. We examine the current state and future directions of digital tools for sociology education, including statistical software packages, digital data collection platforms, AI-assisted analysis tools, and data archiving systems. The comparative analysis encompasses both universal and specialized software products available on the market today, highlighting their advantages and disadvantages for empirical sociology research. We address how these technologies support quantitative and qualitative analysis, causal explanations, and social process forecasting. The paper also examines the impact of the COVID-19 pandemic on accelerating digital transformation in sociology education and explores the digital divide challenges in educational contexts. Critical digital pedagogy frameworks and contemporary learning theories are discussed as foundations for effective technology integration. We conclude that the core component of digital literacy for sociology specialists involves developing algorithmic thinking and the ability to select and implement appropriate technology solutions for various research needs. The paper offers strategic recommendations for sociology departments, instructors, software developers, and students to enhance the effectiveness of ICT integration in sociology education.

Keywords: digitalization of sociology education, information and communication technologies, digital sociology, statistical software packages, digital divide, critical digital pedagogy, algorithmic thinking

1. Introduction

Training specialists in humanities in Ukraine, particularly sociologists, has taken on renewed importance given the growing need for sociological interpretation of contemporary problems and events. This necessitates significant improvement of educational processes in higher education institutions. According to the standard of

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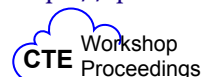
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higher education in Ukraine, training of bachelors of sociology in the field of knowledge 05 “Social and Behavioral Sciences”, specialty 054 “Sociology” should be grounded in social sciences and humanities [27]. However, the mathematical and technological components of vocational training are increasingly vital in the digital age.

The study of complex mass socioeconomic, socio-political, and socio-cultural phenomena cannot be confined to theoretical frameworks alone. It inherently involves mathematical formalization and modeling of social reality to draw accurate, well-grounded conclusions. Mathematical procedures have become essential due to both the current stage of social processes development and the dynamics of social transformation. Furthermore, social management and forecasting are impossible without comprehensive knowledge of gathering, processing, and analyzing sociological information using digital tools. The mathematical methods utilized in sociology already have a wide range of applications, which has been expanded significantly through the integration of information and communication technologies (ICT).

The global COVID-19 pandemic served as a catalyst that dramatically accelerated the adoption of digital technologies in educational environments [26]. What might have taken years of gradual implementation was accomplished in weeks as educational institutions transitioned to emergency remote teaching. This sudden shift highlighted both the potential and limitations of digital technologies in sociology education, forcing a reevaluation of teaching methodologies and student engagement approaches [11].

Digital sociology has emerged as a significant subfield that examines both the use of digital tools for sociological research and the sociological study of digital environments [18]. The field recognizes that digital transformation affects not only the tools sociologists use but also the very subjects and phenomena they study. Contemporary sociologists must develop competencies in digital data collection, analysis, and interpretation while maintaining critical perspectives on how these technologies shape social interactions and structures [21].

Against this backdrop, this article aims to review the evolving landscape of information and communication technologies in applied sociology, examining their integration into the professional training of sociology students. We analyze the current state and future directions of digital tools, platforms, and methodologies while addressing the challenges of the digital divide and exploring frameworks for effective digital pedagogy in sociology education. The paper concludes with strategic recommendations for various stakeholders involved in sociology education.

2. Evolving theoretical frameworks for digital sociology education

The integration of ICT into sociology education necessitates a reexamination of the theoretical frameworks that guide teaching and learning in the digital age. Traditional learning theories have evolved to accommodate the realities of technologically mediated education, while new theories have emerged specifically to address digital learning environments.

2.1. From traditional learning theories to digital frameworks

Learning theories have undergone significant development over the past century, with behaviorism, cognitivism, and constructivism forming the foundation of traditional educational approaches [7]. However, the digital transformation of education has prompted the emergence of new theoretical frameworks better suited to technology-enhanced learning environments.

Constructivism, with its emphasis on learners actively building knowledge through experience and reflection, has found renewed relevance in digital contexts. Digital tools enable students to engage in authentic, situated learning experiences where they can construct meaning through interaction with information and peers [3]. Meanwhile,

connectivism has emerged as a learning theory specifically for the digital age, positing that knowledge exists within networks rather than solely in the minds of individuals [17]. According to connectivist principles, learning involves building and navigating connections between information sources, and digital technologies serve as vital conduits for these connections.

Masethe, Masethe and Odunaike [15] argue that the continued evaluation of learning for each generation holds pedagogy to high standards, necessitating guidance in modern educational theory for continuous learning. The rapid development of science and technology principles stimulates educational growth and requires new learning methodologies. Learning in the 21st century has undergone profound changes due to mobile tools and emerging technologies, reshaping how knowledge is constructed and shared.

2.2. Critical digital pedagogy

Critical digital pedagogy has emerged as a framework that combines critical pedagogy principles with digital tools and environments. As Bećirović [2] explains, digital pedagogy encompasses teaching and learning in online, hybrid, and face-to-face environments, with digital technologies serving as vital drivers in educational transformation. This approach emphasizes not just the technical skills of using digital tools but also the critical examination of how these tools influence power dynamics, access to education, and social justice issues.

Gutiérrez-Ujaque [10] argues that digital pedagogy demands a critical approach to address challenges stemming from technological inequalities, global crises like COVID-19, and the ethical and social implications of digital society. Higher education must develop practices prioritizing critical literacy and consciousness to navigate these challenges effectively. This critical approach encourages students to question the assumptions embedded in digital technologies and consider how these technologies can either reinforce or challenge existing social inequalities.

Critical digital pedagogy extends beyond the mere use of digital tools to encompass a philosophical stance on education that values student agency, collaboration, and social justice. It encourages sociology educators to create learning environments where students can critically engage with both digital tools and the social phenomena they study through these tools. This approach aligns with the broader goals of sociology education, which seeks to develop students' critical thinking about social structures and processes.

2.3. Digital sociology as an emerging field

Digital sociology represents more than just the application of digital tools to sociological research; it constitutes an emerging field that examines how digital technologies shape social life and how social factors influence technological development. Tsao [28] notes that the development of digital sociology shows a clear trend of collaboration between social scientists, data scientists, and digital tools, creating interdisciplinary research networks that produce new forms of knowledge.

The field encompasses several key areas, including:

- The study of how digital technologies affect social interactions, institutions, and structures
- The development and application of digital methods for sociological research
- Critical examination of the societal implications of algorithms, big data, and artificial intelligence
- Analysis of digital platforms and their influence on social behavior and organization

As Smirnov [25] observes through corpus analysis of sociological texts, the digitalization of society has had profound effects on sociology itself. Since 2019, approximately one in five sociology publications mentions digital platforms, indicating the growing centrality of digital phenomena to sociological inquiry. This trend necessitates that sociology education prepare students not only to use digital tools but also to critically analyze the digital social world they inhabit and study.

3. Information technologies for collecting sociological data

The landscape of data collection technologies in sociology has expanded dramatically in recent years, offering researchers new ways to gather, process, and analyze information. These technologies not only increase efficiency but also enable new forms of research that were previously impractical or impossible.

3.1. Contemporary digital data collection platforms

Contemporary digital data collection platforms range from simple online survey tools to sophisticated systems for complex, multi-method research. At least ten common services facilitate empirical sociological research:

1. **E-mail surveys** provide a rapid and straightforward way to work with target audiences, particularly for expert evaluations. This approach is frequently used to distribute invitations to participate in other research activities.
2. **Online research in newsgroups, internet forums, and teleconferences** allows researchers to engage with communities united by common interests, enabling the use of open-ended questions and semi-structured formats.
3. **Web-based survey platforms** such as Survio, SurveyMonkey, Simpoll, and Google Forms offer varied functionality for questionnaire design, respondent management, and data analysis.
4. **Online focus groups** provide opportunities for in-depth qualitative research with geographically dispersed participants.
5. **Computer Assisted Web Interface (CAWI)** enables online surveys using web resources without researcher participation.
6. **Tablet Assisted Personal Interviewing (TAPI)** facilitates field research with digital data capture.
7. **Computer Assisted Telephone Interviewing (CATI)** automates telephone survey processes.
8. **Computer Assisted Personal Interviewing (CAPI)** utilizes electronic questionnaires via email or websites with researcher participation.
9. **Mobile data collection apps** enable surveys through smartphones, incorporating features like GPS location and multimedia capture.
10. **Social media analytics tools** help researchers gather and analyze social media content for insights into public opinion and behavior.

Modern digital platforms significantly enhance researchers' capabilities for data collection. Table 1 provides a comparative analysis of major online survey platforms based on key features.

3.2. Social media as data sources

Social media platforms have become valuable sources of data for sociological research, offering insights into public opinion, social interactions, and cultural phenomena. Panchenko, Khomiak and Pikilnyak [20] demonstrates how Twitter can be used effectively in sociology education, providing examples of student activities for Social Statistics and Demographics courses. These platforms allow researchers to observe

Table 1

Comparative analysis of online survey services (2024).

Features	Survio	Survey Monkey	Qualtrics	Google Forms	Microsoft Forms	Typeform
Respondent database management	✓	✓	✓	✓	✓	✓
Automated data processing	✓	✓	✓	✓	✓	✓
Advanced statistical analysis	—	✓	✓	—	—	—
Visual reports and dashboards	✓	✓	✓	✓	✓	✓
Customizable design	✓	✓	✓	✓	✓	✓
Branching logic	✓	✓	✓	✓	✓	✓
Mobile optimization	✓	✓	✓	✓	✓	✓
Artificial intelligence features	—	✓	✓	—	—	—
API integration	—	✓	✓	✓	✓	✓
Free plan available	✓	✓	—	✓	✓	✓
GDPR compliance	✓	✓	✓	✓	✓	✓

naturally occurring social interactions and discourse without the artificiality often associated with traditional research methods.

Sociologists increasingly employ digital tools to scrape, mine, and analyze social media data, revealing patterns and trends in social behavior. This approach offers several advantages:

- Access to large volumes of data in real-time
- Opportunities to study naturally occurring interactions
- Ability to track changes in public discourse over time
- Insights into population segments that might be difficult to reach through traditional methods

However, social media research also presents challenges related to data representativeness, ethical considerations, and methodological rigor. Not all demographic groups use social media equally, and platform algorithms can influence what content is visible to researchers. Furthermore, issues of consent and privacy require careful consideration when using publicly available social media data for research purposes.

3.3. Advantages and limitations of digital data collection

Digital data collection methods offer numerous advantages over traditional approaches, including:

- Resource efficiency, with lower material costs per respondent
- Ability to conduct large-scale, global surveys in short timeframes
- Reduced interviewer effects in online surveys
- Organizational flexibility for respondents
- Automatic data recording and preliminary analysis
- Possibilities for rapid adjustments to research instruments

Despite these advantages, digital data collection methods have significant limitations:

- Representativeness issues, as findings typically cannot be generalized beyond internet users
- Sample biases due to self-selection among willing participants
- Challenges in verifying participant identity and preventing multiple submissions

- Difficulties in assessing the accuracy of obtained data
- Technical constraints on questionnaire design
- Limited ability to provide clarifications or prevent question omissions

These limitations are particularly pronounced in the context of digital inequalities, where access to and proficiency with digital technologies vary significantly across demographic groups [1]. The digital divide – disparities in access to digital technologies based on factors such as socioeconomic status, geography, age, and disability – presents a significant challenge for digital data collection in sociology.

4. Evolution of software for sociological data analysis

The landscape of software tools for sociological data analysis has evolved significantly over the past decade, with new capabilities and approaches emerging alongside established solutions. These tools range from comprehensive statistical packages to specialized applications for specific analytical techniques.

4.1. Current state of statistical software packages

Statistical software packages remain essential tools for sociological research, enabling complex analyses of quantitative data. The market includes both universal/semi-universal packages applicable across research domains and specialized tools designed specifically for sociological applications.

4.1.1. Universal and semi-universal packages

Several major statistical packages continue to dominate the market, each with unique strengths and limitations:

IBM SPSS Statistics remains one of the most widely used data processing programs in social sciences. The latest version, IBM SPSS Statistics 29, released in January 2024, integrates enhanced data visualization capabilities and improved support for large datasets. Its advantages include a developed apparatus for statistical analysis, versatility, user-friendly interface, and comprehensive help system. However, it requires substantial computational resources and has a relatively high cost, which can limit accessibility for some users [5].

OCA (processing of sociological questionnaires), initially developed in 1989 by A. Gorbachyk with support from the Institute of Sociology of the National Academy of Sciences of Ukraine, continues to be updated. The latest version, OCA CATI Android (2022), includes enhanced mobile capabilities for field research. Its advantages include interface conciseness and relative affordability, though its functionality remains somewhat limited compared to larger statistical packages [9].

Vortex, created by D. Shkurin at Ural Federal University, offers a modular approach to data analysis with versions ranging from basic to comprehensive. Unlike many competitors, it includes tools for developing data collection instruments and supports multiple data collection methodologies. The latest version, Vortex 11.2, introduces improved visualization capabilities and enhanced support for unstructured data [24].

R has gained significant traction in academic sociology in recent years. This free, open-source programming language provides extensive capabilities for statistical computing and graphics. Its package ecosystem allows for highly specialized analyses, while its scripting capabilities enable reproducible research workflows. However, R's command-line interface presents a steeper learning curve compared to graphical alternatives.

Stata offers a balanced approach between programming flexibility and ease of use, with strengths in panel data analysis and survey statistics. Its latest version, Stata

18, includes enhanced visualization capabilities and improved performance for large datasets.

Jamovi represents a newer entrant in the statistical software landscape. Built on R, it provides an accessible graphical interface while maintaining the analytical power of its underlying engine. Its open-source nature and focus on transparency in statistical reporting have made it increasingly popular in educational contexts.

Figure 1 illustrates the relationships between major statistical packages and their primary analytical strengths, highlighting how different tools connect to various methodological approaches in sociology. This interconnectedness reflects the increasing integration of quantitative and qualitative methods in contemporary sociological research.

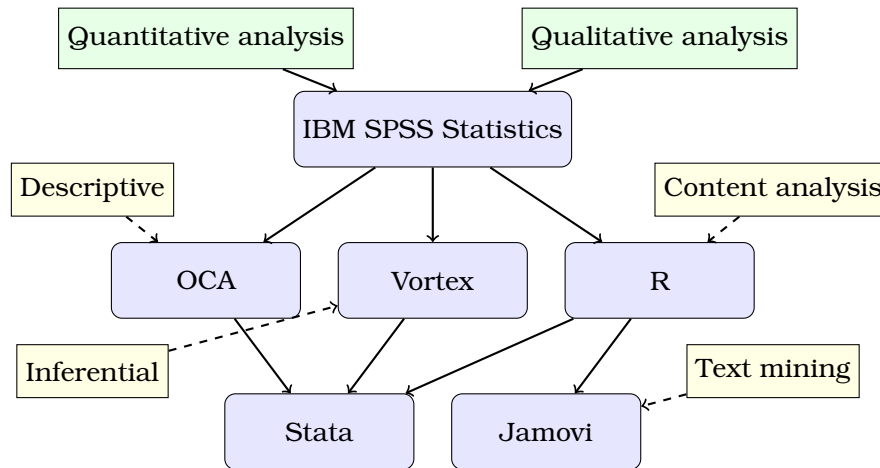


Figure 1: Relationships between major statistical packages and analytical approaches in sociology.

Table 2 provides an updated comparative analysis of the capabilities of major statistical packages currently used in sociology education and research.

Table 2
Comparative analysis of statistical packages for sociology (2024.)

Features	SPSS	R	Stata	Vortex	Jamovi
Research tool design	—	—	—	✓	—
Basic statistical methods	✓	✓	✓	✓	✓
Advanced data filtering	✓	✓	✓	✓	—
Linear modeling	✓	✓	✓	✓	✓
Multidimensional modeling	✓	✓	✓	✓	✓
Nonparametric methods	✓	✓	✓	✓	✓
Factor analysis	✓	✓	✓	✓	✓
Cluster analysis	✓	✓	✓	✓	✓
Structural equation modeling	✓	✓	✓	—	✓
Machine learning capabilities	Limited	Extensive	Limited	—	Limited
Open source	—	✓	—	—	✓
Programming extensibility	Limited	Extensive	Moderate	Limited	Moderate
Learning curve	Moderate	Steep	Moderate	Moderate	Gentle
Visual interface quality	High	Low (varies)	Moderate	Moderate	High

4.1.2. Specialized analytical tools

Alongside general-purpose statistical packages, specialized tools have emerged to address specific analytical needs in sociology:

SociometryPro facilitates the processing of sociometric survey data, enabling researchers to calculate group and individual sociometric indices and visualize social networks. The latest version, SociometryPro 3.0, introduces enhanced visualization capabilities and improved compatibility with other software packages [14].

Text analysis tools have evolved significantly, with options ranging from simple word frequency analyzers to sophisticated platforms for qualitative content analysis:

- **NVivo** has become a standard for qualitative data analysis, supporting coding of text, images, audio, and video. Recent versions incorporate AI-assisted coding suggestions to accelerate analysis processes.
- **MAXQDA** offers comprehensive tools for qualitative and mixed methods research, with strong support for team-based projects and visual analysis tools.
- **Atlas.ti** provides robust capabilities for unstructured data analysis with an emphasis on conceptual network building.
- **QDA Miner** combines qualitative coding with quantitative content analysis functions, enabling mixed-method approaches.

Social network analysis tools help researchers map and analyze relationships between individuals, groups, and organizations:

- **Gephi** offers powerful visualization and exploration capabilities for network data, with an intuitive interface accessible to students.
- **UCINET** provides comprehensive network analysis functions with particular strengths in measures of centrality and subgroup identification.
- **NodeXL** integrates with Microsoft Excel, lowering the barrier to entry for network analysis.

4.2. Artificial intelligence in sociological analysis

Recent advances in artificial intelligence (AI) and machine learning have begun to transform sociological research methods. These technologies offer new capabilities for analyzing large, complex datasets and extracting patterns that might be difficult to discern through traditional methods.

Joyce and Cruz [12] notes that AI integration into sociological research presents both opportunities and challenges. On one hand, AI-powered tools can enhance the efficiency and scope of data analysis, enabling researchers to work with larger datasets and identify subtle patterns. On the other hand, these tools raise important questions about data ethics, algorithmic bias, and the interpretability of results.

Bryda and Sadowski [4] presents a qualitative research methodology using advanced AI-based linguistic models for free-text interview coding and thematic analysis. The authors describe two strategies for inductive coding of interview transcriptions: generative coding and lexico-semantic coding. Both approaches use bottom-up logic, employing language models like ChatGPT and natural language processing techniques to automate building the codebook structure. This innovative coding technique enhances the precision and efficiency of qualitative data analysis and has the potential to automate routine qualitative data coding procedures.

AI applications in sociology include:

- **Automated content analysis** of text, images, and audio-visual materials
- **Natural language processing** for sentiment analysis, topic modeling, and discourse analysis
- **Machine learning algorithms** for pattern recognition and prediction in social data

- **Computer vision** for analyzing visual sociological data

As these technologies continue to develop, sociology education must evolve to ensure students understand both the technical aspects of AI tools and their methodological implications. This includes critical considerations of algorithmic bias, data privacy, and the ethical use of automated analysis methods.

5. Digital transformation in sociology education after COVID-19

The COVID-19 pandemic catalyzed an unprecedented acceleration in the digital transformation of higher education. For sociology programs, this transformation went beyond simply moving existing courses online – it necessitated a fundamental reconsideration of teaching methodologies, student engagement strategies, and the role of technology in sociological education.

5.1. Emergency remote teaching and its legacy

When educational institutions worldwide transitioned to emergency remote teaching in early 2020, sociology departments faced significant challenges in maintaining educational quality while adapting to digital platforms. Haslam, Madsen and Nielsen [11] describe this as “crisis-driven digital transformation”, where rapid changes were implemented out of necessity rather than through careful planning.

This accelerated transformation revealed both strengths and weaknesses in existing educational approaches. On one hand, it demonstrated the feasibility of technology-mediated sociology education at a scale previously unimagined. On the other hand, it highlighted significant gaps in digital infrastructure, faculty preparedness, and student access to technology.

Shin and Hickey [23] examined college students’ emergency remote teaching and learning experiences during COVID-19, finding that many students experienced learning loss and decreased motivation. The study revealed that pre-existing educational and social inequities were exacerbated during emergency remote teaching, particularly regarding accessibility, digital divide, and mental health issues. These challenges were especially pronounced for students from disadvantaged backgrounds.

5.2. Blended learning models in sociology education

As institutions have moved beyond emergency responses, many sociology programs have adopted blended learning approaches that combine the strengths of online and face-to-face instruction. Vij and Singh [29] argues that blended learning has immense potential in the long run and is destined to become the mainstream form of teaching since it makes learning easier and more rewarding.

Blended learning models in sociology education typically incorporate:

- Synchronous online sessions for interactive discussions and collaborative activities
- Asynchronous components for content delivery and independent learning
- Face-to-face sessions for experiential learning, complex discussions, and community building
- Digital tools for ongoing communication, feedback, and assessment

McPhee and Pickren [16] demonstrates how blended learning can benefit international students in humanities and social sciences, showing that multiple cultural references and multimedia can form the basis for developing new potentials between learners, knowledge, and disciplinary practice. This approach is particularly valuable in sociology, where cultural context plays a crucial role in understanding social phenomena.

Effective blended learning in sociology education requires thoughtful integration of digital tools with pedagogical approaches appropriate to sociological inquiry. This includes designing learning activities that encourage critical thinking, collaborative knowledge construction, and the application of sociological concepts to real-world situations. When implemented effectively, blended learning can enhance student engagement, accommodate diverse learning preferences, and develop digital literacy skills essential for contemporary sociological practice.

5.3. Digital literacy and competency development

The accelerated digital transformation in sociology education has highlighted the importance of digital literacy – not just for students but also for faculty members. Digital literacy in sociology encompasses more than basic technology skills; it includes the ability to critically evaluate digital tools, navigate digital environments effectively, and apply digital methods appropriately to sociological questions.

Deja et al. [6] examined the self-assessment of psychological empowerment in the workplace among humanities and social science graduates who completed digital literacy courses. The study found that digital literacy instruction supported the psychological empowerment of graduates employed in the business services sector, with information literacy courses corresponding to the highest empowerment scores. This suggests that digital literacy training has benefits beyond technical skills, contributing to graduates' sense of competence and self-determination in professional contexts.

For sociology students, key digital competencies include:

- *Data literacy* – the ability to gather, analyze, and interpret various forms of digital data
- *Media literacy* – skills in critically analyzing digital media content and understanding its social implications
- *Information literacy* – competence in finding, evaluating, and using digital information sources
- *Computational thinking* – the capacity to formulate problems and solutions in ways that can be effectively addressed through computational methods
- *Digital communication* – skills in effectively communicating sociological insights through digital platforms and formats

Developing these competencies requires intentional integration of digital skills development throughout the sociology curriculum, rather than isolated technology courses. As Fedorova and Nikiforova [8] argues, digital competence development should not be regarded as an information technology disciplines' prerogative but should follow an interdisciplinary approach to course design.

6. Digital inequality and its implications for sociology education

The digital transformation of sociology education occurs against a backdrop of significant digital inequality. These disparities – in access to technology, digital skills, and supportive environments for technology use – have profound implications for who can participate in and benefit from digitally enhanced sociology education.

6.1. Dimensions of the digital divide

The digital divide has evolved from a simple binary of access versus non-access to a multidimensional concept encompassing various forms of inequality in digital contexts. Wei et al. [30] conceptualized three levels of the digital divide:

1. **The digital access divide** (first-level) refers to inequality in access to information technology in homes and schools

2. **The digital capability divide** (second-level) concerns inequality in the capability to exploit IT arising from the first-level divide and other contextual factors
3. **The digital outcome divide** (third-level) involves inequality in outcomes (e.g., learning and productivity) arising from the second-level divide and other contextual factors

This framework helps us understand how digital inequalities manifest in sociology education, where students may face barriers at any or all of these levels. Access to technology remains uneven across socioeconomic groups, geographical locations, and demographic categories. Even when access is available, students may lack the skills, confidence, or supportive environments needed to effectively utilize digital tools for learning. These capability differences, in turn, lead to disparate outcomes in terms of educational achievement, skill development, and career opportunities.

6.2. Addressing digital inequality in sociology programs

Sociology programs have a dual responsibility regarding digital inequality: to ensure equitable access to digital education for their students and to develop students' critical understanding of digital inequality as a social phenomenon.

Khandagale [13] examined strategies adopted by educators to mitigate the impact of the digital divide, finding that teachers employed various pedagogical, technological, and socio-cultural approaches. Pedagogical strategies included using diverse instructional methods, adapting teaching approaches, and leveraging students' prior knowledge. Technological strategies involved utilizing available digital resources, promoting digital literacy, and employing free open-source software. Socio-cultural strategies encompassed building collaborative networks, creating inclusive classroom environments, and fostering positive teacher-student relationships.

Institutional approaches to addressing digital inequality may include:

- Providing necessary hardware and internet access to students with financial need
- Offering digital skills training and ongoing technical support
- Designing courses with flexibility regarding synchronous participation and digital tool requirements
- Developing alternative pathways for students with limited digital access or capabilities
- Collaborating with community organizations to extend digital access beyond campus boundaries

At the same time, sociology curricula should incorporate critical analysis of digital inequality, helping students understand its causes, manifestations, and consequences. This creates valuable opportunities for praxis, where students can connect theoretical understandings of inequality with practical efforts to address it within their educational communities.

7. Preserving and sharing sociological data in the digital age

The digital transformation has significantly expanded capabilities for preserving, sharing, and reusing sociological data. Digital archives and data repositories enable more efficient data management while creating new opportunities for secondary analysis, replication studies, and longitudinal research.

7.1. Digital archives and data repositories

Digital archives for sociological data have evolved from simple storage facilities to sophisticated platforms for data discovery, access, and analysis. Major repositories include:

- The Council of European Social Science Data Archives (CESSDA), established in 1976, which coordinates an informal association of European national data archives encompassing approximately 70,000 studies in the social sciences and humanities
- The Inter-university Consortium for Political and Social Research (ICPSR), which maintains one of the world’s largest archives of digital social science data
- The UK Data Service, which provides access to major UK government-sponsored surveys, cross-national surveys, longitudinal studies, and qualitative data
- The National Sociological Data Bank “Kyiv Archive,” established in 2014 at the initiative of the Kyiv International Institute of Sociology and Center “Social Indicators” in cooperation with the Kyiv-Mohyla Academy [19]

These repositories serve multiple functions, including:

- Developing methods and standards for accumulating sociological information
- Providing information and reference support for researchers
- Coordinating research efforts and preventing unnecessary duplication
- Facilitating the exchange of primary empirical data
- Creating conditions for secondary and comparative analysis
- Supporting computational and analytical operations for users

The evolution of these repositories reflects broader trends toward open science, data sharing, and collaborative research. Many now offer advanced features such as online analysis tools, visualization capabilities, and application programming interfaces (APIs) for programmatic data access.

7.2. Big data and computational sociology

The emergence of big data – characterized by volume, velocity, variety, and complexity – has created new opportunities and challenges for sociological research and teaching. Computational sociology has developed as an approach that leverages advanced computational methods to analyze large-scale social data and model complex social phenomena.

Witte [31] notes that searching and accessing literature as a routine, day-to-day social science task has changed dramatically with digital technologies. The paper looks specifically at developments in survey research, face-to-face interviewing, and experimental methods as examples of how particular approaches to sociology have been transformed by new communication and information technologies.

Big data approaches in sociology involve:

- Analysis of large-scale administrative data
- Social media mining and network analysis
- Computational text analysis of documents, discourse, and media content
- Agent-based modeling and simulation of social processes
- Integration of multiple data sources through data linking and fusion techniques

These approaches offer unprecedented opportunities to study social phenomena at scale, but they also present challenges related to data quality, representativeness, ethics, and interpretation. Sociology education must prepare students to navigate these challenges, developing both technical skills for working with big data and critical perspectives on its limitations and implications.

8. Recommendations for enhancing ICT integration in sociology education

Based on our analysis of the evolving landscape of information and communication technologies in sociology education, we offer strategic recommendations for key stakeholders involved in this educational ecosystem.

8.1. For sociology departments

Sociology departments play a crucial role in establishing institutional frameworks that support effective integration of ICT into educational programs. We recommend that departments:

- **Develop a comprehensive digital strategy** that aligns technology integration with departmental educational goals and disciplinary values
- **Invest in reliable digital infrastructure**, including both hardware and software resources appropriate for sociological teaching and research
- **Provide ongoing professional development** for faculty to enhance their digital competencies and pedagogical approaches
- **Establish technology support systems** specifically designed for sociology education needs
- **Incorporate digital competencies** throughout the curriculum rather than isolating them in dedicated technology courses
- **Address digital inequality** by implementing policies and programs that ensure all students can access and benefit from digital learning opportunities
- **Foster partnerships** with technology developers, data repositories, and other institutions to expand digital resources and opportunities

8.2. For individual instructors

Individual sociology instructors make critical decisions about how technologies are integrated into their teaching practice. We recommend that instructors:

- **Adopt reflective approaches** to technology integration, carefully considering how digital tools align with learning objectives
- **Implement blended learning models** that combine the strengths of digital and face-to-face educational approaches
- **Utilize digital tools to enhance active learning**, creating opportunities for students to engage directly with sociological data and concepts
- **Design authentic assessment activities** that develop students' digital competencies in contexts relevant to sociological practice
- **Model critical approaches** to digital technologies, helping students understand both their potential and limitations
- **Engage in ongoing professional development** to stay current with emerging technologies and pedagogical approaches
- **Share effective practices** with colleagues through formal and informal professional networks

8.3. For software developers

Developers of software tools for sociology education and research can enhance their products' educational value by:

- **Designing user interfaces** that balance simplicity for beginners with advanced capabilities for experienced users

- **Creating educational resources** specifically designed for sociology teaching contexts
- **Developing affordable educational licensing options** to ensure accessibility for students and educational institutions
- **Supporting data interoperability** between different software tools to enable integrated workflows
- **Engaging with sociology educators** to understand disciplinary needs and educational contexts
- **Building tools that support collaborative learning** and research activities
- **Addressing accessibility requirements** to ensure usability for students with disabilities

8.4. For students

Students can take an active role in developing their digital competencies for sociological education and practice by:

- **Approaching technology learning** as an ongoing process rather than a one-time achievement
- **Seeking opportunities to apply digital skills** in authentic sociological contexts
- **Developing critical perspectives** on how digital technologies shape social processes and research practices
- **Building peer learning communities** to share knowledge and resources
- **Exploring diverse digital tools** beyond those required in courses
- **Documenting digital competencies** through portfolios, certifications, or other credentials
- **Advocating for equitable access** to digital resources and opportunities

9. Future directions and challenges

As we look toward the future of information and communication technologies in sociology education, several key trends and challenges emerge that will shape developments in this field.

9.1. Emerging technologies and their potential

Several emerging technologies hold significant potential for transforming sociology education in the coming years:

- **Artificial intelligence and machine learning** will increasingly support both research and educational processes, from automated coding of qualitative data to personalized learning pathways
- **Virtual and augmented reality** offer possibilities for immersive sociological experiences, allowing students to virtually enter different social contexts and visualize complex social data
- **Advanced data visualization tools** will make complex sociological patterns more accessible and interpretable
- **Mobile research technologies** will expand capabilities for field research and real-time data collection
- **Blockchain and decentralized technologies** may transform approaches to data ownership, privacy, and verification

Smirnov [25] notes that we can expect continued growth in the use of digital platforms as data sources, with increasing complexity in the software tools employed. The trend toward researchers developing their own algorithms for data collection and analysis is likely to continue, reflecting the growing intersection of sociology with computational and data science approaches.

9.2. Persistent challenges and ethical considerations

Despite technological advances, several challenges will require ongoing attention:

- **Digital inequality** will continue to affect who can access and benefit from digitally enhanced sociology education
- **Privacy and ethics** concerns will intensify as data collection becomes more pervasive and analytical capabilities more powerful
- **Algorithmic bias** in research and teaching tools requires vigilant critical analysis
- **Technological determinism** must be balanced with critical sociological perspectives on technology itself
- **Maintaining human connection** in increasingly digital educational environments remains essential
- **Rapid technological change** creates challenges for curriculum development and faculty development

Sharifzadeh [22] highlights methodological challenges posed by the digitization of social science research that have been largely overlooked, arguing that while digital methods can serve as valuable complementary tools, they are not sufficient to fully engage with the core practices and phenomena of social science research.

9.3. Toward a critical digital sociology education

The future of ICT in sociology education lies not just in adopting new technologies but in developing critical, reflective approaches to their use. This necessitates:

- Continuing to develop theoretical frameworks that help us understand the relationship between technology and sociological education
- Creating educational models that balance technical skills with critical analysis
- Building institutional capacity for thoughtful technology integration
- Developing new forms of collaboration between sociologists, technologists, and educational specialists
- Maintaining focus on core sociological questions and values while embracing technological change

As Possamai-Inesedy and Nixon [21] argue, the digital transformation presents both challenges and opportunities for sociology. By approaching this transformation with critical awareness and intentional design, sociology education can harness the potential of digital technologies while maintaining its disciplinary integrity and commitment to understanding social processes in all their complexity.

10. Conclusion

The landscape of information and communication technologies in sociology education has evolved dramatically, transforming how students learn to analyze social phenomena and conduct sociological research. Our examination has revealed several key insights that shape our understanding of this evolving field.

First, the variety of digital tools available for sociological research has expanded significantly, from sophisticated statistical packages to specialized applications for qualitative analysis, social network mapping, and computational modeling. These tools enable new forms of inquiry and analysis, extending the methodological repertoire available to sociology students and researchers. Meanwhile, digital data collection platforms have transformed how sociologists gather information, creating opportunities for larger-scale research, real-time data collection, and access to previously difficult-to-reach populations.

The COVID-19 pandemic served as a catalyst for accelerated digital transformation in sociology education, forcing rapid adoption of online and blended learning approaches. While this transition revealed significant challenges related to digital inequality, pedagogical adaptation, and technological infrastructure, it also demonstrated the potential of technology-enhanced education to create flexible, engaging learning experiences when thoughtfully implemented.

Digital sociology has emerged as both a methodological approach and a subject of study in its own right, examining how digital technologies shape social life and how these technologies can be harnessed for sociological inquiry. This dual focus offers rich opportunities for integrating technology into sociology education in ways that develop both technical skills and critical perspectives.

Critical digital pedagogy provides a valuable framework for sociology education, emphasizing not just the use of digital tools but critical engagement with questions of power, access, and representation in digital contexts. This approach aligns well with sociology's broader commitment to critical analysis of social structures and processes.

Despite these advances, significant challenges remain. Digital inequality continues to affect who can access and benefit from digitally enhanced sociology education. Ethical questions regarding data privacy, algorithmic bias, and technological determinism require ongoing attention. And the rapid pace of technological change creates challenges for curriculum development and faculty preparation.

Looking toward the future, we can anticipate continued evolution in both technologies and approaches to their integration in sociology education. Artificial intelligence, virtual reality, and advanced data visualization tools offer new possibilities for teaching and research. At the same time, growing recognition of the need for critical, reflective approaches to technology use provides a foundation for thoughtful integration of these tools.

The most effective approaches to ICT integration in sociology education will balance technological innovation with disciplinary integrity, developing students' technical capabilities while maintaining focus on core sociological questions and values. By fostering digital literacy that encompasses both practical skills and critical perspectives, sociology education can prepare students to navigate and shape an increasingly digital social world.

In conclusion, the leading component of digital literacy for sociology specialists involves not just mastering specific software tools, but developing algorithmic thinking and the ability to select appropriate technological solutions for various research needs. By approaching technology as both a tool for sociological inquiry and a subject of sociological analysis, we can prepare students for effective practice in an increasingly digital professional landscape while maintaining the critical perspectives that are central to sociological thinking.

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