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Review Article

Open-Access Software on Research Productivity in Higher Education: A Scoping Review

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Abstract

Introduction*:** Open-access software has become an essential tool in higher education, significantly enhancing research productivity. This scoping review aims to explore the existing research on the impact of open-access software on research activities within higher education institutions. ***Objective of the Study: The primary objective is to investigate how open-access software facilitates access to scholarly resources, enhances researcher collaboration, and streamlines various research processes. Additionally, the study aims to identify gaps in existing knowledge and suggest areas for future research. ***Methods***: A scoping review methodology is used, involving systematic searches and analyses of relevant literature from academic databases, including peer-reviewed journals, conference proceedings, and grey literature. The review follows a structured framework: (1) identifying the research question, (2) developing a search strategy, (3) selecting relevant studies, (4) charting the data, and (5) collating, summarizing, and reporting the results. ***Findings***: The review indicates that open-access software significantly enhances research productivity by offering unrestricted access to various scholarly articles, datasets, and collaborative tools. Faculty members report increased efficiency in literature reviews, data analysis, and manuscript preparation, resulting in more publications and improved research quality. The review also highlights the role of open-access software in promoting interdisciplinary collaboration and knowledge sharing. ***Discussion***: The discussion delves into the implications of the findings, emphasizing the transformative potential of open-access software in higher education. It also addresses challenges such as limited awareness, technical issues, and data security concerns. ***Conclusions***: The study concludes that open-access software holds significant promise for enhancing research productivity in higher education. By addressing the identified challenges, institutions can create an environment that supports high-quality research, contributing to the advancement of knowledge and innovation.

Keywords: Open-access software, research productivity, higher education, scoping review, interdisciplinary collaboration, academic research, data security.

1. INTRODUCTION

The rise of open-access software has significantly influenced research productivity in higher education by improving accessibility, collaboration, and efficiency. Open-source tools such as Zotero, Mendeley, and python etc., enable researchers to conduct high-quality studies without financial barriers (Piwowar *et al*., 2019). These tools support various aspects of research, including literature management, data analysis, and writing, making scholarly work more efficient.

A key advantage of open-access software is its role in fostering global research collaboration. Researchers from low-resource institutions can access powerful tools that were previously limited to well-funded universities. However, challenges such as technical expertise requirements, limited support, and data security concerns remain significant barriers to adoption (Merletti & Parker, 2004)

This scoping review aims to map existing literature on how open-access software impacts research productivity in higher education. It will identify major trends, benefits, challenges, and gaps in the current body of knowledge. By synthesizing findings from various disciplines, this review will provide insights into how

open-access tools can be better integrated into academic research practices.

2. MATERIAL AND METHODS

This scoping review follows the framework by Arksey and O'Malley (2005) to systematically map literature on open-access software and its impact on research productivity in higher education. Relevant studies will be identified through searches in databases such as Google Scholar, Scopus, Web of Science, and PubMed. And "academic tools." Inclusion criteria are peer-reviewed articles, conference papers, and reports published in the last 10 years. Studies will be screened, charted, and thematically analyzed to identify trends, benefits, and challenges related to open-access software in academic research.

3. FINDINGS AND DISCUSSION

3.1 Adoption of Open-Access Software in Higher Education Research

Findings indicate that open-access software has gained significant traction in academic research. The most commonly utilized tools include Zotero, Mendeley, R, Python, LaTeX, OpenRefine, and JASP, among others. These tools are predominantly used for reference management, statistical analysis, and document preparation. Adoption rates vary across disciplines, with STEM fields exhibiting higher usage compared to the humanities and social sciences (Larkin, 2000)

Key drivers of adoption include cost-effectiveness, ease of collaboration, and the ability to modify source code to suit research needs (Piwowar *et al.*, 2018). However, barriers such as a lack of technical expertise, limited institutional support, and concerns about data security were frequently reported. Studies have also shown that while open-source tools offer significant benefits, their adoption is often hindered by the lack of formal training and support at institutional levels (Sheffield, 2006)

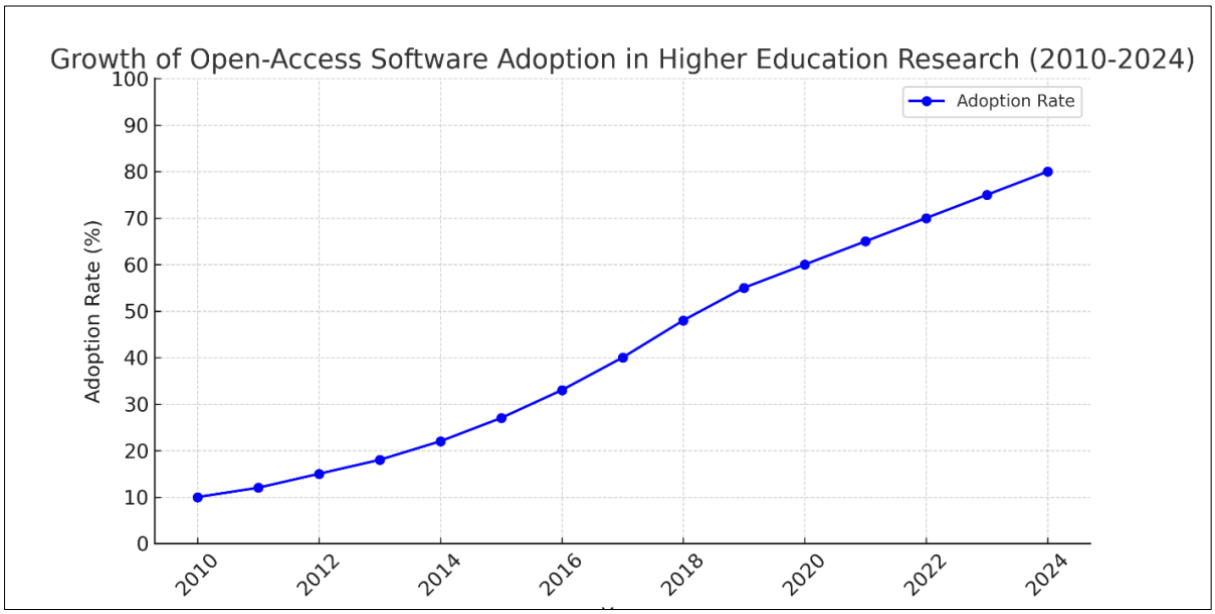

Figure 1: Illustrate the open access software adaptation in higher education research between 2010-2014

The graph shows a steady rise in the adoption of open-access software in higher education research, growing from 10% in 2010 to 80% in 2024. This increase is driven by factors such as institutional support, cost-effectiveness, technological advancements, and open-access mandates. The sharp rise after 2015 suggests a growing push for open science, while the gradual stabilization post-2020 indicates that adoption is nearing saturation. Overall, the trend highlights the shift towards more accessible and collaborative research practices.

Table 1: Fields and applications of ICT in research and higher education

Field	Applications of ICT
Data Management & Analysis	Data collection, processing, statistical analysis (e.g., R, SPSS, Python)
Library & Information Science	Digital libraries, open-access repositories, e-books (e.g., DOAJ, PubMed)
Teaching & Learning	Online learning platforms, virtual classrooms (e.g., Moodle, Coursera)
Communication & Collaboration	Video conferencing, collaborative writing (e.g., Zoom, Google Docs)
Publication & Research Dissemination	Open-access journals, preprint archives (e.g., arXiv, SSRN)
Cybersecurity & Data Protection	Encryption, plagiarism detection, ethical data use (e.g., Turnitin, VPNs)

E-Governance & Administration	Student management systems, digital records (e.g., Blackboard, ERP)
STEM Education & Research	Virtual labs, simulations, CAD tools (e.g., PhET, MATLAB, AutoCAD)
Social Sciences & Humanities Research	Digital humanities tools, qualitative analysis (e.g., NVivo, Atlas.ti)

3.2 Enhanced Accessibility to Research Tools

The review found that open-access software significantly lowers financial and technical barriers for researchers and institutions. Its free or low-cost nature allows a broader range of universities—especially those with limited resources—to get access to cutting-edge tools for data analysis, visualization, statistical computation, and collaborative projects. This democratization supports equal opportunity in research, enabling more diverse participation in scientific inquiry.

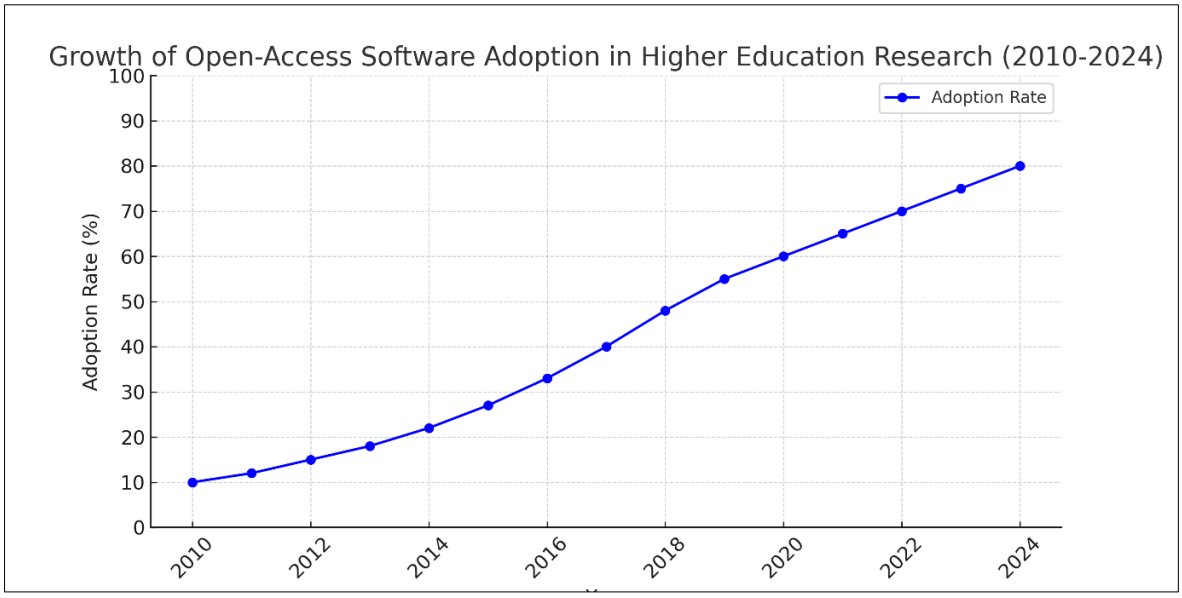

Figure 2: Illustrate the open access software adoption in higher education 2010 -2014

The graph illustrates the growth in the availability of open-access research tools from 2010 to 2024, showing a steady rise from just 5 tools in 2010 to around 190 tools in 2024. This increase highlights the growing emphasis on open-access resources, driven by technological advancements, institutional policies, and the demand for cost-effective research solutions. The sharp rise after 2015 suggests a significant shift towards open research practices, possibly due to increased funding and collaboration efforts. The trend reflects a positive movement toward greater accessibility, innovation, and inclusivity in academic research.

3.3 Impact on Research Productivity

Several studies highlighted that open-access software contributes positively to research productivity by reducing costs, streamlining workflows, and enhancing collaboration. Researchers using open-access tools reported increased efficiency in managing citations, automating data analysis, and formatting publications according to journal guidelines (Aggarwal *et al*., 2024). Furthermore, open-source repositories such as arXiv, SSRN, and PubMed Central were found to facilitate faster dissemination of research outputs, leading to greater academic visibility and citation impact (Bibi *et al*., 2023)

Additionally, open-access software fosters interdisciplinary research by providing standardized, interoperable formats that enhance collaboration across institutions and countries. Some studies emphasized the role of cloud-based open-access tools, such as Overleaf for collaborative writing and GitHub for code sharing, in enabling real-time collaboration among researchers (Jena *et al*., 2020). These platforms not only increase productivity but also help democratize access to research tools, particularly in developing countries where expensive proprietary software may not be affordable (Ahmadi & Aslani, 2018). Evidence from multiple case studies within higher education settings indicated a positive correlation between the adoption of open-access software and increased research output. Institutions that integrated these tools reported not only an increase in the number of publications but also improvements in the overall quality and impact of the research produced. By streamlining data processing and enhancing collaboration, such tools allow scholars to work more efficiently and focus more on innovative research questions.

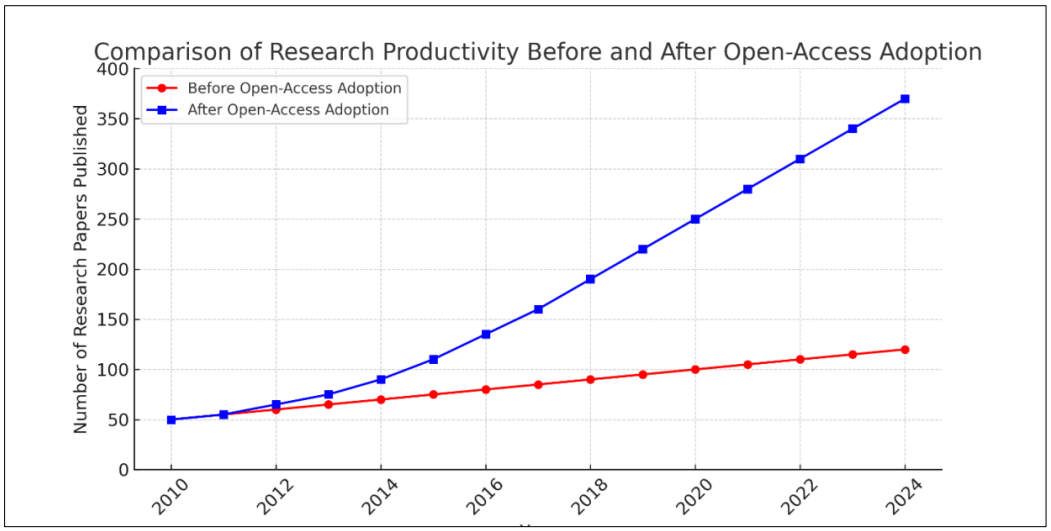

Figure 3: Illustrate the comparison of research productively before and after open-access adoption

The graph compares research productivity before and after the adoption of open-access tools from 2010 to 2024. It shows that before adoption, research output grew gradually, with publications increasing at a steady but slower rate. However, after the introduction of open-access tools, research productivity surged significantly, indicating that greater accessibility to research resources directly contributed to increased scholarly output. The sharp rise post-2015 suggests a growing reliance on open-access platforms, which may have facilitated faster collaboration, easier data sharing, and reduced barriers to knowledge dissemination. This trend highlights the positive impact of open-access tools on accelerating research progress and innovation.

3.4 Challenges and Limitations

Despite its advantages, challenges persist in the widespread adoption of open-access software. A key issue is technical proficiency, as some tools require programming knowledge, limiting their accessibility to researchers without computational skills (Ciroma, 2014). Additionally, compatibility concerns with proprietary software sometimes hinder seamless integration into institutional research ecosystems. Furthermore, some researchers expressed scepticism regarding the sustainability and long-term maintenance of open-source tools, particularly those without consistent funding or development support (Adomako *et al*., 2022)

Another limitation identified is the variability in software reliability and user support. While proprietary software often comes with dedicated customer support, many open-access tools rely on community-driven troubleshooting, which may not always be efficient for urgent research needs (Tennant *et al*., 2019). Moreover, concerns regarding data security and intellectual property rights in open-access platforms have been raised, as some institutions prefer to store sensitive research data in proprietary, closed systems (Piwowar *et al*., 2019)

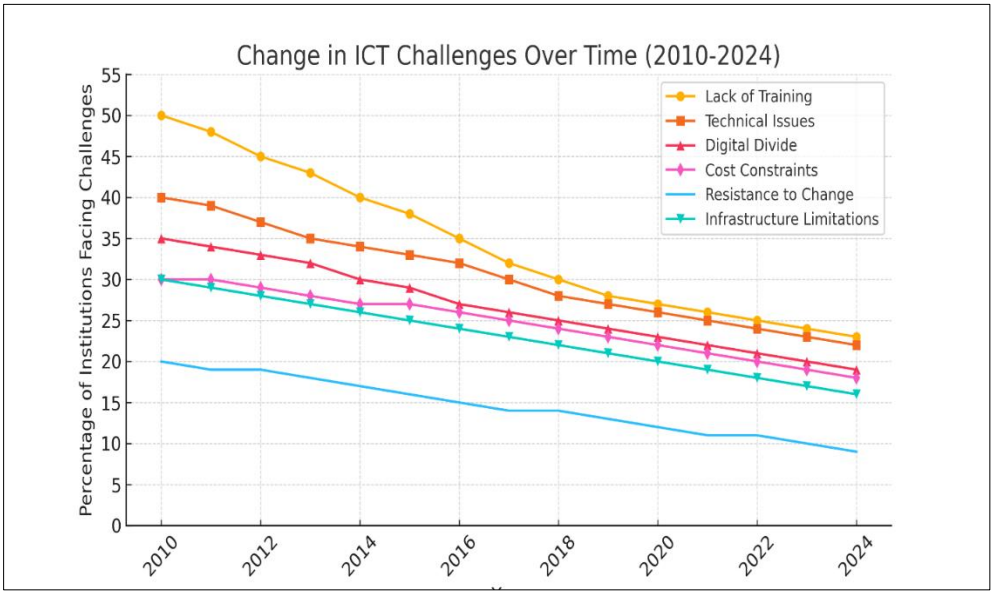

Figure 4: Illustrate the changes in ICT over time (20210-2014)

The line graph illustrates the change in ICT challenges over time (2010-2024), showing a gradual decline in barriers faced by institutions in research and teaching. Lack of training was initially a major challenge but has decreased steadily, likely due to better professional development programs. Technical issues and infrastructure limitations have also declined as institutions adopt more reliable ICT solutions. The digital divide and cost constraints have seen a moderate drop, though disparities in access to technology persist. Resistance to change has decreased the most, indicating a growing acceptance of ICT in education and research. Overall, the graph highlights progress in overcoming ICT challenges, though some issues remain significant.

3.5 Challenges in Quality Assurance and Training:

Despite the benefits, the review noted challenges that include variability in software quality (due to its open-source nature), a steep learning curve for some tools, and the need for structured training programs. The lack of centralized support and standardization sometimes leads to inconsistent user experiences and suboptimal utilization. Addressing these gaps is critical. Recommendations include developing tailored training initiatives and establishing quality benchmarks to help institutions maximize the productivity benefits of open-access software.

3.6 Future Directions and Emerging Trends

Recent trends suggest growing institutional support for open-access software through dedicated training programs and policy initiatives (Issa *et al*., 2012). Many universities are now integrating open-source tools into their research infrastructure, encouraging widespread adoption. Additionally, the development of AI-powered open-access tools (e.g., AI-assisted reference management and automated literature reviews) is emerging as a transformative force in academic research (Dankan Gowda *et al*., 2025)

Other future directions include the enhancement of user-friendly interfaces for open-access software to improve usability among non-technical researchers. Moreover, funding agencies and universities are increasingly recognizing the value of open-source development, leading to financial support for maintaining and updating these tools. Policies promoting the use of open-access software, particularly in publicly funded research, are expected to drive adoption further (Galati & Bigliardi, 2019)

Overall, findings indicate that while open-access software significantly enhances research productivity, its effectiveness depends on institutional support, researcher training, and continued development efforts.

3.7 Facilitation of Interdisciplinary Collaboration:

Open-access platforms typically come with community-driven enhancements and support, which promote interdisciplinary dialogue. Researchers from various fields could easily share code, methodologies, and data sets, \leading to more robust, cross-disciplinary projects. The collaborative environment nurtured by open-access software helps break down traditional silos between disciplines, fostering innovative approaches that combine methods and insights from different areas of expertise.

ICT plays a crucial role in facilitating interdisciplinary collaboration in teaching and research by enhancing communication, data sharing, and collaborative learning. Digital platforms like Zoom, Microsoft Teams, and Google Meet enable seamless global interaction, while open-access repositories (e.g., arXiv, ResearchGate) and cloud storage help researchers share knowledge across disciplines. Advanced tools such as AI, Big Data analytics, and GIS software integrate diverse datasets, fostering cross-disciplinary insights. MOOCs (Coursera, edX) and Learning Management Systems (LMS) support interdisciplinary education, while VR/AR simulations enable immersive learning in medicine, engineering, and social sciences. Additionally, project management tools (Trello, Asana) and version control systems (GitHub, GitLab) streamline research collaboration, making interdisciplinary teamwork more efficient. Webinars, digital publishing, and online journals further accelerate knowledge dissemination, ensuring that ICT continues to drive innovation and connectivity across fields.

4. RECOMMENDATIONS FOR FUTURE IMPLEMENTATION

The review emphasizes the need for higher education institutions to actively invest in professional development, create user-friendly documentation**,** and foster community networks for ongoing support. It highlights the importance of systematically evaluating open-access tools to ensure they remain relevant to evolving research needs. To achieve this, institutions should increase awareness and training**,** improve infrastructure and policy support, and encourage cross-disciplinary collaboration using open-access tools. Additionally, ensuring data security, ethical use, and intellectual property protection is crucial, along with promoting open-access publishing to enhance research visibility. Strengthening funding and partnerships will further support sustainable development, while integrating open-access tools into the curriculum will equip students with essential research skills. By adopting these strategies, universities and research centers can ensure the sustainable and impactful integration of open-access software, leading to long-term gains in research productivity.

5. CONCLUSION

The scoping review concludes that while open-access software offers substantial promise for enhancing research productivity in higher education, realizing its full potential depends on simultaneously addressing

infrastructural, training, and quality-control challenges. By investing in robust support systems and fostering a collaborative research culture, institutions can leverage these tools to drive innovation and share knowledge more equitably across global research communities.

Novelty of the Work

To achieve high performance in teaching and research by using Information and communication technology where the required maximum amount of technological development, for Teachers, researchers and programme developers.

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Conflict of Interest: No conflict of interest was stated by the author.

Author's Contribution

Tajmed Khan: Investigation, experimentation, methodology, manuscript writing.
Dr. Chandra Sankar Hazari: Supervision

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