ENHANCING RESEARCH COLLABORATION AND SUSTAINABILITY WITH AI-DRIVEN PLATFORMS

An empirical study

Lappeenranta–Lahti University of Technology LUT & Aalborg University (Copenhagen)

Nordic Master’s Programme in Sustainable ICT Solutions of Tomorrow, Master’s thesis

2025

Helen Batuwantudawa

Examiner(s): Professor Jari Porras (LUT University)

Associate Professor Lene Tolstrup Sørensen (Aalborg University)

ABSTRACT

Lappeenranta–Lahti University of Technology LUT & Aalborg University (Copenhagen)

LUT School of Engineering Science & Department of Electronic Systems (AAU)

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Enhancing Research Collaboration and Sustainability with AI-Driven Platforms: An empirical study

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Examiner(s): Professor Jari Porras (LUT University) and Associate Professor Lene Tolstrup Sørensen (Aalborg University)

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Academic research is being transformed by artificial intelligence (AI), which makes it possible to automate, collaborate, and share information. However, it is currently unknown to what extent AI-driven platforms promote sustainable research practices and fair collaboration. This paper examines the advantages, drawbacks, and implications for future practice of AI-driven platforms as they improve academic research collaboration and sustainability. A quantitative survey of 55 researchers was combined with a systematic literature study as part of a mixed-methods strategy. Associations between demographic factors, the use of AI tools, and perceived advantages and difficulties were investigated using appropriate statistical methods. According to the findings, artificial intelligence (AI) technologies increase research productivity, facilitate interdisciplinary collaboration, and eliminate repetitive effort, all of which support sustainability. Adoption is, however, constrained by problems like tool fragmentation, subscription fees, and data protection difficulties. The study's conclusion proposes the development of unified, ethical, and easily accessible AI ecosystems to promote equitable and sustainable research collaboration.

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DECLARATION OF AI USE

Notice on the use of Artificial Intelligence

As required by LUT University's academic regulations, I declare the use of the following Artificial Intelligence tools and systems in the development of the project:

- I used *Quillbot*, *Grammarly*, and *ChatGPT* only to enhance the clarity, flow, and grammatical accuracy of my own original drafts. These tools were used to refine sentence structure and reduce repetition. No part of the academic content, arguments, or conclusions was generated by AI. All text was critically reviewed and finalized by me.
- *ChatGPT* was used as a technical assistant tool during data analysis to help in troubleshooting and debugging Python scripts. Assistance included solving syntax errors and optimizing code, but the logic of the analysis and interpretation of the data are entirely mine.
- I used *ChatGPT* to check my understanding of complex theoretical ideas during the early stages of my research. These interactions were a study aid and did not provide source text in the final manuscript directly.

I hereby assume full responsibility for the contents of this thesis and attest that it is an original work created by me.

I declare that all the AI tools used in the development of this thesis are in line with LUT University's standards and guidelines (LUT University 2023). The information provided above accurately reflects the extent and nature of AI usage in this work.

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Appendices

1 Introduction

Collaboration is vital in the research field for *knowledge sharing, innovation and problem solving* across researchers and the institutions. Good collaboration helps researchers to overcome complex global challenges like climate change, sustainable development and social equity, and other issues which overtake the capacity of individual or institutions. (Wagner et al., 2019; Katz & Martin, 1997). Although, collaboration is difficult due to problems such as *geographical boundaries, unequal access to infrastructure and communication weaknesses.* (Bozeman et al., 2013). These difficulties can be seen specially in developing regions, which has limited resources and geographical gaps which restrict participation in global research networks (OECD, 2023).

Research collaboration is found to be well-aligned with United Nations Sustainable Development Goals (SDGs). In particular, the target SDG 9 (Industry, Innovation and Infrastructure) and SDG 17 (Partnerships for the Goals) highlight innovation fostering and partnership building for inclusive knowledge creation towards sustainable development (United Nations, n.d.) "Collaboration and Enhanced Connectivity for knowledge Sharing, Innovation Capacity Enhancement" says that effective collaboration would lead to sustainable research ecosystems that will serve the well-being of society and technological advancement (Negi, Jaiswal & Mathur, 2025).

Research collaboration is increasingly AI-driven and that is why the way how it is started, managed and continued gets redefined. Automation, pattern recognition and predictive analysis with the use of AI models permit accelerating, broadening and enlightening of research processes (Jordan & Mitchell, 2015). AI-powered platforms like *Elicit, ResearchRabbit,* and *SciSpace* use machine learning to facilitate literature discovery, identify connections between studies and potential collaborator pairs (Valluru et al., 2025). Tools such as *ChatGPT* and *Paperpal* also aid academic writing, summarization, and multilingual communication (Kasneci et al., 2023). The primary stages in the research process that AI can promote collaboration and knowledge creation are illustrated in Figure 1 (adapted from Aalto University, 2023). From "Planning" (writing proposals) to "Reuse" (discovering open resources), the model lays out how AI's impact is interwoven across the research lifecycle. Critically, all of this growing support enables greater personal productivity in tasks like analysis and editing, which in turn can support an increasing effectiveness (and ultimately sustainability) of the research process.

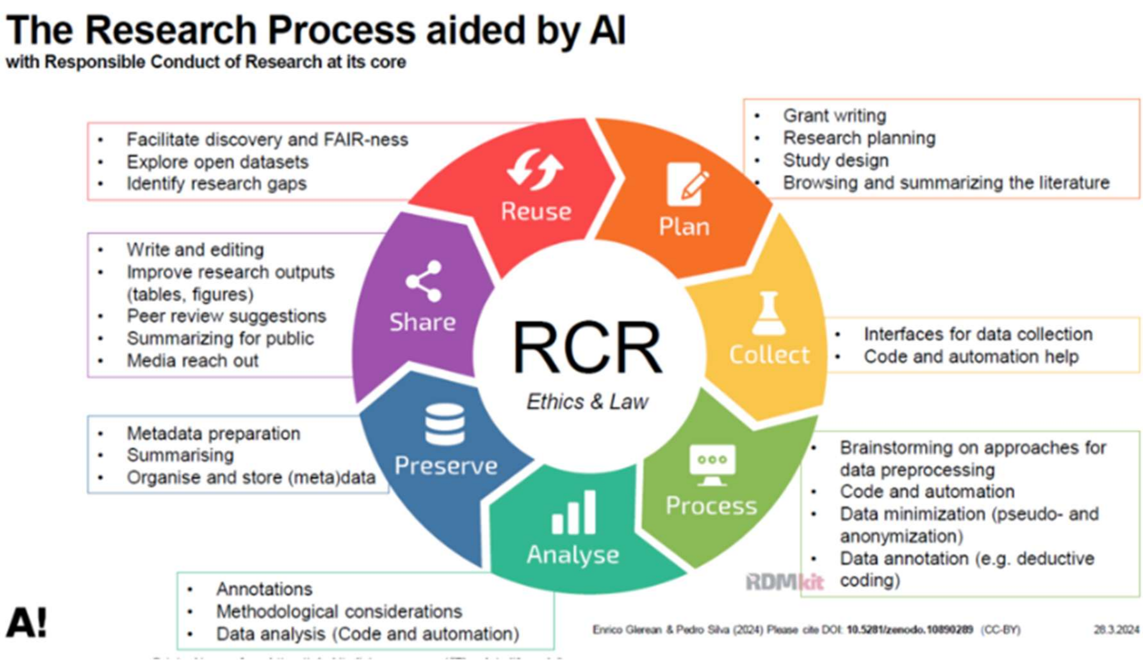

Figure 1. The Research Process Aided by AI (Adapted from Aalto University (2023)

This way of automated AI platforms not only make the research fast, easy and retrievable like mentioned above but it also encourages sustainable research. AI has made inroads into increasing research sustainability by reducing redundant effort through the automation of repeatable tasks and facilitating open access distribution of AI work (Vinuesa et al., 2020). For instance, Cloud-based AI applications support remote collaboration that is reducing the environmental effects of travel and physical resource deployment (UNEP, 2024). AI also promotes economic and social sustainability by broadening accessibility to advanced analytics capabilities amongst research professionals in low resource environments (Nagar, 2024).

Yet, as much as AI can improve both collaboration and sustainability, it also brings new hazards and inequalities. The compute intensive nature of AI leads to large carbon footprints (Strubell et al., 2019), and the increasing reliance on proprietary systems exacerbates inequalities between well-funded and under-resourced institutions (Bender et al., 2021). Ethical considerations, in terms of academic honesty, authorship and transparency add to the complexity of implementing AI in research settings (Dwivedi et al., 2023).

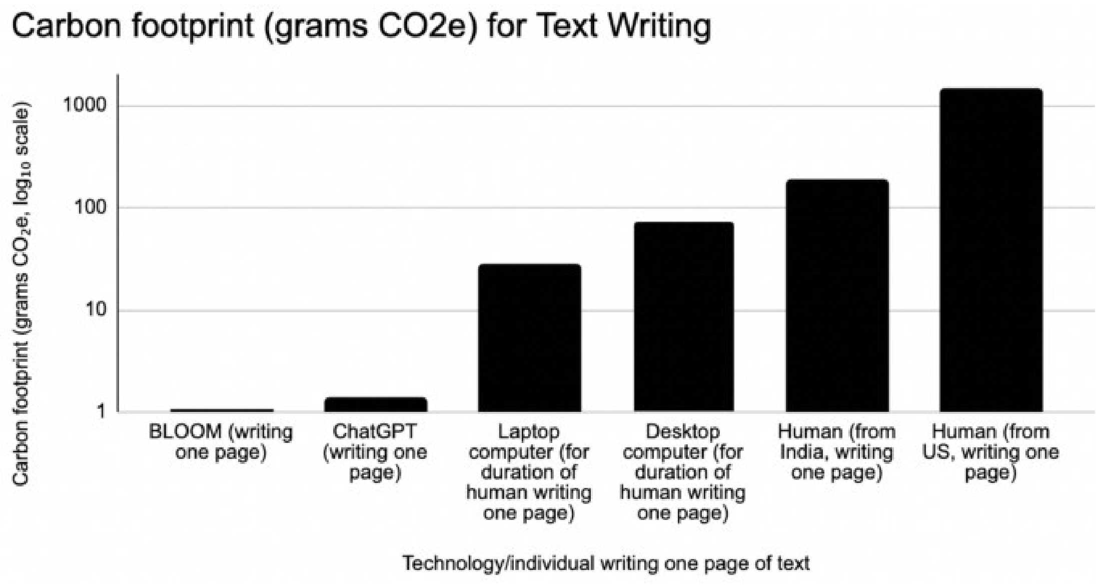

Figure 2. Carbon footprint for text writing (AI vs. human). (Source: Luccioni, 2023)

One aspect of this trade-off is shown in Figure 2, while overall AI energy demands are high, some applications, such as text generation using specific models (e.g., BLOOM, ChatGPT), may result in a significantly lower carbon footprint than the prolonged energy use associated with human writing on conventional computers. The complicated environmental trade-offs that come with adopting AI are shown by this data. These conflicts highlight the importance of adopting AI in collaborative research in a fair, moral, and sustainable approach.

1.1 Problem Definition, Aim, Objectives, and Expected Outcomes

Despite an increasing number of AI-enabled research platforms, little is understood about how these can be used together to further sustainability and research collaboration. Work in these areas frequently zeroes in on particular tools or technical features, without reflecting much on what such actually mean for the institution as a whole (or about the broader implications they may have) (Mezzadri, 2025). Concerns regarding the fragmentation of tools, high subscription fees, and data privacy have hampered adoption especially by early-career researchers and institutions in developing countries (Rana et al., 2024). Also, from the academic point of view, research regarding AI often focuses on performance and effectiveness indicators but ignores social, cultural, and ethical aspects contributing to a sustainable collaboration (Kumar et al.. (2024).

The primary objective of this study is to characterize how AI-driven platforms enhance research collaboration and contribute to sustainable research ecosystems in academia. Perhaps a more important challenge is to contribute not just with isolated products, features or technologies, but rather integrate complex technical social and ethical issues to which can provide deep insight. The primary aims of this study are to:

- Identify major AI platforms in support of academic collaboration and analyse their main functionalities.
- Examine the role of AI in sustainable research (openness, efficiency and inclusivity) with a critical eye towards understanding its environmental and economic impact.
- Investigate obstacles to adoption, including ethical, privacy and equity issues.
- Produce evidence-based policy guidelines and recommendations for universities, policymakers, AI platform developers and researchers that promote the ethical and sustainable integration of AI in research.

The main research question guiding this thesis is:

How can AI-driven platforms foster sustainable research collaboration in academia?

Main research question followed by sub research questions as follows:

SRQ1: *Which AI-driven platforms currently support academic research collaboration, and how do their features and applications contribute to sustainable research practices?*

SRQ2: *What ethical, technical, and institutional challenges affect the effective and responsible use of AI-driven platforms in academic research collaboration?*

SRQ3: *How can insights from current practices inform guidelines for fostering ethical, equitable, and sustainable AI integration in academic research collaboration?*

The expected outcomes of this research include a comprehensive overview of how AI tools are applied within academic collaboration, an analysis of the barriers and enablers influencing their sustainable use, and the development of practical guidelines for fostering ethical and effective AI adoption in academia. These findings aim to inform institutional strategies and policy frameworks that promote equitable, transparent, and sustainable research ecosystems.

1.2 Structure of the Thesis

This thesis contains six chapters, each referring a different viewpoint of the research question and objectives:

Chapter 1: Introduction- Background of the study, Problem statement, Purpose and objectives of the study Scope and structure of research.

Chapter 2: Literature Review and Theoretical Frameworks – Uncover the theoretical basis by clarifying terms and frameworks. Presents an overview of AI for research collaboration and sustainability. Relates with other models, underlines comparative understanding and revelations, and indicates relevant aspects for the focus of the thesis.

Chapter 3: Methodology – Outlines the research design, survey methodologies and analytical methods utilized.

Chapter 4 Results - Integrated Qualitative and Quantitative Analysis – Describes the findings, literature results, Results from analysis on the Platform and series.

Chapter 5 – Discussion - Discussion of results in relation to the literature, implications.

Chapter 6: Conclusion - Provides a summary of the findings, recommendations and future research.

2 Literature Review and Theoretical Framework

This chapter presents the review of literature, related to *AI and research collaboration and sustainability*, as it is developed out of theory and existing empirical evidence to guide the conceptual model for this study. Far from being merely the descriptive backdrop, it seeks to get at how digital transformation itself, and in particular artificial intelligence (AI), is remaking the collaborative aspect of academic research and the sorts of long-term sustainability that it brings.

The focus of the review is on *scientific research collaboration*, rather than educational or administrative collaboration, as this reflects the central concern of the study to learn how AI supports scholarly knowledge development. This analysis falls into three broad sections:

1. Sustainability and research collaboration in academic context.
2. AI vs information and communication technologies (ICTs).
3. Summary of the theoretical findings which defines the study scope.

By combining the above finding into a conceptual framework will be then used to build empirical research.

2.1 Conceptual and Theoretical Foundations

This section establishes the theoretical context of research collaboration and its connection to sustainability. It defines key concepts, explores the importance of communication in collaborative processes, and outlines how sustainable collaboration has become a guiding principle in modern research practices. These foundations provide the basis for understanding how emerging technologies especially AI reshape academic collaboration dynamics.

2.1.1 Defining Scientific Research and Collaboration

Scientific research is the organized search for new knowledge founded on observation, experiment, and analysis, driven by principles of transparency, reproducibility, and consistency (OECD, 2023). *Collaborative research* is two or more researchers or institutions joining forces to produce joint scientific outputs, with a common sharing of intellectual, financial, and technical resources (Katz & Martin, 1997). Cross-disciplinary, inter-institutional, and international collaborative research involves bringing together disparate know how and expertise to address complex problems (Wagner et al., 2019).

Collaborative research is the standard of modern science. Over 90% of papers published in high-impact journals today have more than one author, reflecting the connection between global knowledge networks (Wagner et al., 2019). However, effective collaboration depends on *coordination, trust, and communication* across disciplinary as well as geographical boundaries (Cummings & Kiesler, 2007). These organizational and social drivers have an immediate effect on how effectively scientists co-produce knowledge.

Figure 3. Five types of research collaboration. (Springer Nature Research Solutions, October 2023)

To address complex global challenges, researchers collaborate across diverse institutional and geographical boundaries. Figure 3 illustrates the five primary types of collaboration based on the stakeholders involved, ranging from internal partnerships within an academic institution to complex international research alliances.

2.1.2 Communication in Collaboration

Effective communication is the key for research collaboration. It ensures that both parties are clear about their roles, co-ordinate effectively and have agreed objectives. To communicate effectively, there needs to be several types of methodology. and are generally divided into two types of communication: *synchronous (real-time)* and *asynchronous (delayed)*.

Modes of communication in research collaboration

- **Live meetings and conferences:** Build trust, align on strategy and generate creative ideas.
- **Virtual Meeting and Video Call:** Real-time cooperation transcends the distance (via PC or mobile).
- **Email and async forums:** Encourage long-term documentation, conversation, coordination.
- **Collaborative digital tools:** Combine file sharing, messaging and project management within a single system.

Hybrid teams that mix synchronous and asynchronous channels exhibit better coordination quality and participant satisfaction than teams which use only one mode. (Cummings & Kiesler, 2007).

2.1.3 Linking Research Collaboration and Sustainability

Sustainable research focuses on *resources' maximisation, equity* and *enhancing long term knowledge resilience* (OECD 2023; Vinuesa et al., 2020). In such settings, AI-enabled platforms boost collaborative power by advancing *cross-border communication*, *access* and *efficiency* (Kasneci et al., 2023).

Research collaboration and sustainability can be linked to the United Nations' *Sustainable Development Goals (SDGs)* as follows:

- **SDG 4 (Quality Education)**: AI allows making scientific information accessible to all, providing equal access to research and generation of skills through language assistance, tutoring and intelligent search technologies (UNESCO, 2021; Kasneci et al., 2023).
- **SDG 9 (Industry, Innovation and Infrastructure)**: AI increases research productivity and sustains innovation ecosystems via enlarged data-based cooperation and digital infrastructure (Vinuesa et al., 2020; OECD, 2023).
- **SDG 13 (Climate Action)**: AI driven virtual collaboration reduces the number of routine face-to-face meetings and associated travel, with potential, though indirect application to carbon saving. (But when considering that large-scale computing used by AI has an environmental footprint which is against of the goal. (Strubell et al., 2019; Nagar, 2024)).
- **SDG 17 (Partnerships for the Goals)**: AI platforms impartially encourage international collaboration and interdisciplinarity, showing the collaborative aspects of global efforts on sustainable development (Wagner et al., 2019).

Together, these aspects show that AI-supported collaboration is a part of sustainable practice in research, due to its ability to encourage *innovation, participation*, and *global alliances,* but it presents the requirement of governance structures to enable the capability to manage ethical and environmental compromises (Francisco and Linnér, 2023). Hence, sustainable collaboration is both the *outcome* and the of *achieving accountable AI-supported research environments.*

2.2 Digitalisation, ICT, and the Foundations of AI

The development of digital technology has brought about a fundamental transformation in research methodologies by facilitating *data-intensive research practices*, *real-time knowledge exchange*, and *worldwide collaboration* (Hey et al., 2009; OECD, 2023). By enabling *cloud storage*, *digital libraries*, *remote collaboration platforms*, and *high-performance computing*, all of which together constitute the digital infrastructure of modern science information and communication technologies (ICTs) have redesigned research systems (Borgman, 2015; Tenopir et al., 2020). By making it possible for *extensive data* *collecting, open-access repositories, automated procedures*, and *machine-readable scientific outputs* and these technologies prepared the way for AI tools (Jordan & Mitchell, 2015). Understanding this evolution from ICT to AI is essential for determining AI's role in the broader technological transformation of research collaboration and the future of academic knowledge production (Kasneci et al., 2023).

2.2.1 ICT's Contribution to Research Reform

The scientific field has undergone a significant transformation due to the digitalization of research, its production, distribution, and evaluation. Large-scale collaboration, sharing of data, and distributed processing have been enabled by information and communication technologies (ICTs), producing new forms of collective intelligence (Hey et al., 2009). Cloud storage, open-access databases, and collaborative platforms have politicized engagement by enabling researchers to contribute to global projects from various locations (OECD, 2023).

ICTs have also created the technological foundation for artificial intelligence in higher education. The emergence of data-intensive research the "fourth paradigm of science" has driven the need to employ automation and machine learning to handle complex datasets (Hey et al., 2009). With the help of advanced analytics and modelling, ICT enabled infrastructures now support interdisciplinary research at a scale and speed which were previously unattainable.

2.2.2 Sustainability and ICT

Although ICTs allow for the development of ecologically friendly research by promoting digital collaboration and less material consumption, on another scale, their energy-heat-needing and hardware-disposing practice raise new environmental concerns. One the other hand, technology replaces physical transport, encourages co-operative work and saves resources as data can be exchanged in a virtual way (UNEP, 2024). They advocate for the publication of open-access and the sharing of knowledge that maximizes inclusivity in research settings (Vinuesa et al., 2020). On the flip side, energy and e-waste consumption through data centres are of massive ecological concern (Strubell et al., 2019; Nagar, 2024).

Hence, sustainable digitalisation should balance technological progress with environmental accountability. The new step of this process is represented by AI, which adds intelligent algorithms able to automate cognition and negatively learn to perform the request of users, broadening the research skills. These conceptual perspectives on possibilities and limits are condensed in the subsequent summary section to outline the parameters of the empirical analysis.

2.3 Summary of Theoretical Findings and Study Scope

This chapter showed how AI technologies are transforming research collaboration by raising ethical and environmental concerns while simultaneously increasing productivity, diversity, and innovation. Transparent, equitable, and responsible AI integration is necessary to balance these potential and hazards in order to foster sustainable research collaboration. The methodology for empirically examining these theoretical relationships and assessing how AI-driven platforms affect sustainability and research collaboration in academic environment is described in the following chapter.

3 Methodology

The methodology employed in addressing the research objectives and questions mentioned earlier in this report are described in this chapter. A *convergent mixed-methods* design combined *quantitative* and *qualitative* approaches to investigate the impact of AI media on research collaboration and sustainability.

The approach is phased to accommodate a stepwise process, in which the *systematic review of literature* and *analysis of platforms* established the conceptual and empirical baseline, to inform specifically the design and interpretation of quantitative survey data. Methods used on data collection, analysis and compilation are described in this section. The survey results are triangulated with a systematic literature review (SLR) and platform analysis, leading to a comprehensive picture of how AI supports research in terms of collaboration and sustainability in the research context.

3.1 Research Design

This section outlines the study design and rationale for using a mixed methods approach, and it describes the sequence of phases that were followed in *collecting*, *analysing* and *combining* data.

A parallel triangulation mixed-methods design is used in the study, whereby quantitative and qualitative data will be collected at the same time, but are separately analysed before integrated to interpretation. Reliability is strengthened by enabling one method's results merge with another's.

Under the quantitative part, a survey is used to collect data on the researchers' *usage patterns*, *knowledge*, and *problems* with AI-driven platforms. As for the qualitative part, an *analysis of research articles* on AI-driven platforms, *sustainability-related maps*, and *systemic issues* is conducted. These two strands of secondary data are connected in the interpretation phase. This method allows for a broad understanding of sustainability collaborative exploration, combining *literary concepts* and *practical information*.

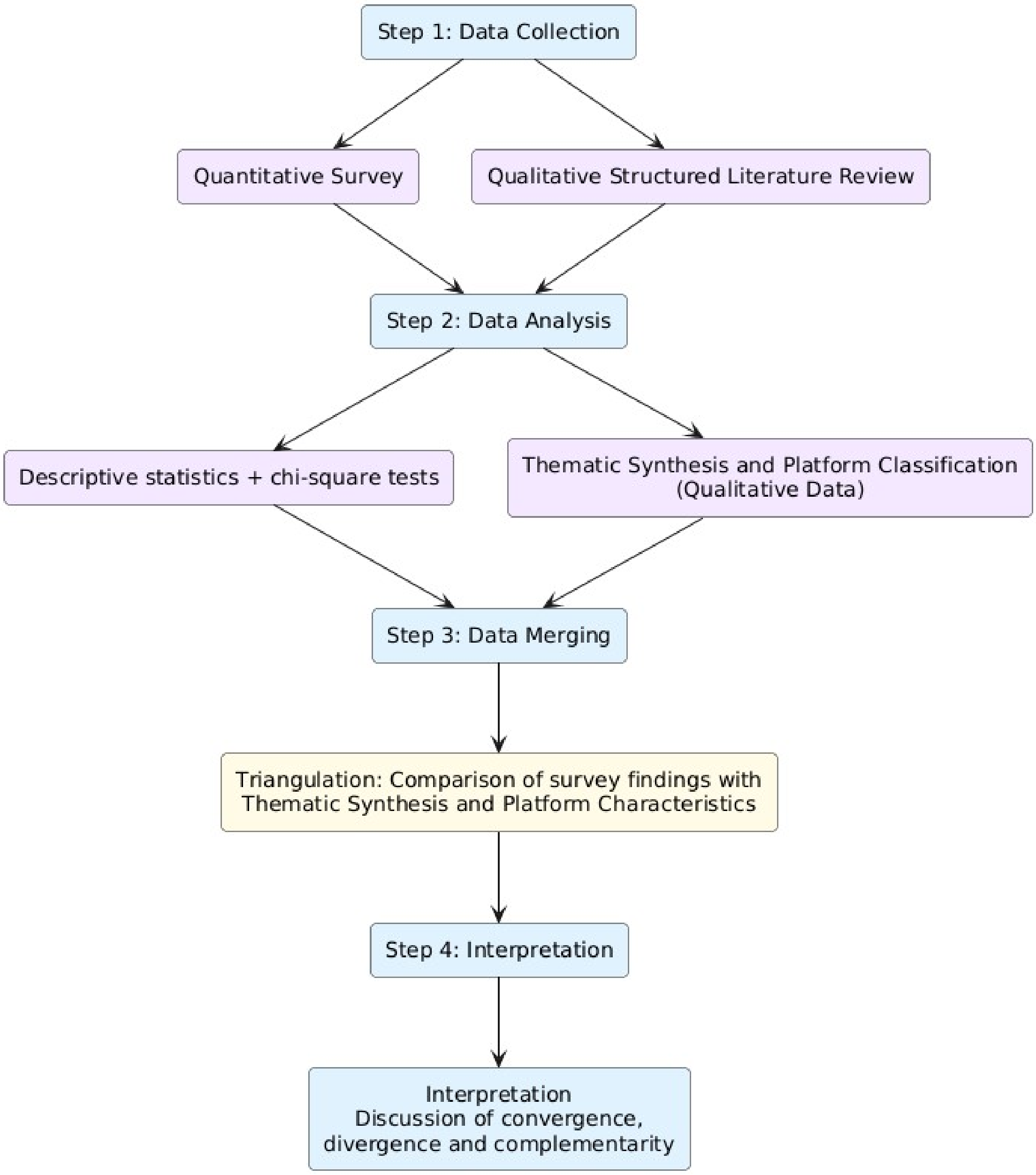

Figure 4. Methodological Phases

The methodological process, illustrated in Figure 4, defines the precise function of each research component in the study's sequential narrative. The Platform Classification and Thematic Synthesis (Step 2) were critical qualitative actions designed to generate specific analytical outputs.

The purpose of this analysis was two-fold:

- To establish the *thematic baseline* and *identify the core research gaps* (the outcomes of the Systematic Literature Review).
- To create the *contextual data set* (the platform characteristics, seen in Table 2 in chapter 4) against which the subsequent quantitative survey results would be compared.

The outcome of this analysis is presented in Chapter 4, where the *themes, gaps*, and *platform classifications* are used to structure the discussion of the empirical findings, ensuring a logical flow from identified problem to collected evidence.

Table 1. Methodological Phases of the Research Design

Phase	**Methodological Focus**	**Activities and Rationale**	**Output**
Phase 1: Conceptual Framework Development	Systematic literature review	A structured review of peer-reviewed publications was carried out. Identifying the theoretical foundations, key variables, and core research gaps necessary to define the overall thematic framework (e.g., Efficiency, Ethics, Governance).	Conceptual framework and key themes guiding the survey design. (Table 2)
Phase 2: Platform Exploration and Contextualization	AI Platform Evaluation and Classification	A detailed analysis of over 20 representative AI tools was conducted, resulting in the classification of 6 key platforms (Table 3). This addressed SRQ1 by identifying the technical landscape (functions, benefits, and inherent challenges), creating a factual inventory to inform the survey questions and later analysis.	Comparative summary of AI research tools (Table 3) to serve as a technological baseline for interpreting empirical data
Phase 3: Survey Instrument Design	Quantitative cross-sectional design	A structured questionnaire was developed based on insights from the literature review. It included closed-ended, Likert-scale, and open-ended questions, and was pilot-tested with	Validated survey instrument (n = 55)

		five academic researchers to confirm clarity and content validity.	
Phase 4: Data Collection	Convenience sampling through online distribution	The survey was distributed via academic mailing lists, LinkedIn, and ResearchGate. Participation was voluntary and anonymized, with informed consent and GDPR compliance strictly maintained.	Empirical dataset representing researcher perspectives on AI-driven platforms
Phase 5: Data Analysis	Descriptive, Inferential and Qualitative analysis	Data were cleaned, coded, and analyzed. Statistical methods (descriptive statistics and chi-square tests) were used to summarize quantitative data. Simultaneously, qualitative data (themes and platform characteristics) were prepared for cross-comparison.	Statistical findings and Qualitative Data Set (themes and platform characteristics) informing the analysis and discussion chapters.
Phase 6: Integration and Synthesis	Mixed-methods triangulation	Quantitative findings were integrated with thematic synthesis and platform characteristics. This phase enabled validation of results, identification of converging themes, and development of evidence-based conclusions and recommendations	Synthesized interpretations and final conclusions.

3.2 Qualitative Component: Literature Review

A systematic literature review (SLR), which provided the theoretical framework and identified important topic elements and research gaps, constituted the qualitative component of this study. *To define and frame the ensuing quantitative survey (Section 3.2), this SLR was essential*. The methodological execution is described in this section, along with the search strategy, inclusion and exclusion criteria, and synthesis procedure. The review pursued three main objectives:

- To analyse the current state of AI-driven platforms that support academic research collaboration.

- To identify the benefits, challenges, and ethical implications of AI-assisted research activities.
- To reveal gaps and inconsistencies in the existing body of literature to inform the empirical (survey) phase of the study.

This inquiry was guided by the following research framework:

Main Research Question:

How can AI-driven platforms foster sustainable research collaboration in academia?

Sub-Research Questions:

1. Which AI-driven platforms currently support academic research collaboration, and how do their features and applications contribute to sustainable research practices?
2. What ethical, technical, and institutional challenges affect the effective and responsible use of AI-driven platforms in academic research collaboration?
3. How can insights from current practices inform guidelines for fostering ethical, equitable, and sustainable AI integration in academic research collaboration?

To address these questions, peer-reviewed journal articles, conference papers, white papers, and technical reports published were systematically reviewed. A global perspective was adopted to ensure representation across diverse academic and institutional contexts, particularly those from regions with limited prior examination of AI in research collaboration. This approach provided a balanced and comprehensive understanding of current developments and remaining research gaps.

Keywords used in this study as follows.

AI, Scientific Research, Collaboration, Machine learning, AI powered research tools, AI Platforms, Sustainability, Research automation, AI-assisted teamwork, Research collaboration tools, Collaborative AI Platforms, Sustainable researching, Academic writing, Ethics, Academic databases, AI in academic publishing, Ethical AI in research, AI-driven digital repositories

General search queries used in the study:

("All Metadata": AI) AND ("All Metadata": Research)

("All Metadata": Machine Learning) AND ("All Metadata": Scientific Research) AND ("All Metadata": Collaboration)

("All Metadata": AI powered Research Tools) OR ("All Metadata": AI Platforms) AND ("All Metadata": Collaboration) OR ("All Metadata": Sustainability)

("All Metadata": Research automation) AND ("All Metadata": Collaboration)

("All Metadata": Research collaboration tools) OR ("All Metadata": collaborative AI platforms) OR ("All Metadata": sustainability)

("All Metadata": Sustainable researching) AND ("All Metadata": AI)

("All Metadata": AI) AND ("All Metadata": Academic writing) AND ("All Metadata": Ethics)

("All Metadata": AI) AND ("All Metadata": Academic databases)

According to the inclusion guidelines, to be considered eligible research, it had to be published in English, be distributed, and have a clear focus on AI, university research collaboration, or sustainability.

According to the exclusion guidelines, contents not shared, for example, personal blogs, opinion pieces, or Q&A forums and research published before 2015 (unless there was a significant citation to the original work) were excluded from the review. (Appendix 2)

During the process of data extraction, details related to every study that was identified were documented in a step-by-step manner by hand, including authors, year of publication, tested AI software, topic of research, main findings, and study limitations. All this data was entered into a formal data summary table (Appendix 3). In addition to the initial searches of databases, a snowballing technique was used by analysing the list of references and citations of crucial articles to identify further relevant studies. This approach gave more extensive coverage and permitted the inclusion of important studies that were not available in the first search results.

After that, a qualitative theme synthesis was used to arrange and analyse this data. Several important topics and research gaps emerged because of the synthesis's attempt to compile the literature, which shaped the survey instrument that followed (see Section 4.1.2 for the specific findings). The different literature and results were logically interpreted by this thematic synthesis, which also offered a strong foundation for combining them.

3.3 Evaluation and Classification of AI-driven Platforms

The Evaluation and Classification of AI-driven Platforms was conducted as a major qualitative task (Phase 2), running parallel to the Systematic Literature Review (SLR). Its purpose was to directly address the first part of Sub-Research Question 1 (SRQ1) by identifying and analysing the technological landscape of AI tools supporting academic research collaboration.

A detailed evaluation and classification of over 20 representative AI platforms was conducted, with the full dataset provided in Appendix 4. This evaluation produced the Comparative Summary Table of 6 main AI-driven platforms (Table 3 in Chapter 4). The selection of these 6 platforms was deliberate, emphasizing tools that are highly representative of core research functions; specifically, literature search, writing assistance, and collaboration/networking, and those that were empirically reported as most frequently used by survey respondents.

The criteria used for this classification were derived directly from the thematic synthesis resulting from Phase 1 and were used to assess the tools' contribution to sustainable research collaboration. Sustainability was operationalised through indicators such as *promoting open-access practices, reducing redundant effort, fostering inclusive participation*, and *supporting environmentally responsible digital research* (Vinuesa et al., 2020; Strubell et al., 2019). The current limitations and risks were also examined, including *hallucinations, high costs*, and *lack of clarity*. This classification thus established the technological baseline for interpreting the empirical survey findings.

3.4 Quantitative Component: Survey

This section defines the main content of the study. It discusses the use, opinions and experiences of AI-driven platforms by university researchers. The study focused on the following 4 main areas:

1. Types and frequency of use of AI-driven platforms in the research process
2. Experiences of the benefits and sustainability of these tools
3. Barriers and legal issues to their use
4. Demographic or institutional differences in opinions and experiences of AI

The target group included PhD candidates, post-PhD researchers, computer science lecturers, research assistants and students directly involved in research work. A convenience sampling approach was used, drawing on *academic mailing lists*, *LinkedIn*, and platforms such as *ResearchGate*. While this method ensured subject and geographical diversity, it also introduces potential biases, as participation depended on voluntary response. This limitation is acknowledged in the interpretation of findings. The group was invited via *academic email lists, LinkedIn* and digital platforms such as *ResearchGate*. 55 completed responses were received between March and April 2025.

The survey, developed using Google Forms, consisted of 14 items, including *closed-ended, Likert scale, multiple-choice (MCQs)*, and *open-ended* questions. These addressed demographic background, AI tool usage, perceived benefits and challenges, and views on sustainability. The questionnaire included demographic variables such as respondents' educational level, research field, years of experience, and institutional affiliation (see Appendix 1). These factors were selected based on literature indicating that disciplinary background and academic experience can influence how researchers adopt and perceive AI-driven platforms in collaborative and sustainable research contexts (Kasneci et al., 2023).

Finally, questions were asked about whether AI driven platforms had been used or not, name the AI-driven platforms, if used (e.g., *ChatGPT, Elicit, SciSpace, Paperpal, Grammarly*, etc.), and the research tasks for which those tools were used (literature review, academic writing, citation management, data analysis, idea generation).

A 5-point Likert scale and a 0-10 scale were also included to measure perceptions of the relevance of AI-driven platforms (e.g., time saving, reduced repetition, ease of access, etc.). Open-ended questions were used to obtain views on the benefits, problems (e.g., business costs, privacy issues, misinformation, distrust and environmental impact), and needs of AI-driven platforms.

The structure of the questionnaire was following to *five main themes* emerged from literature review about *efficiency*, *inclusivity*, *ethics*, *sustainability* and *governance* in research collaboration. A pretest was conducted with five university researchers to assess clarity, content validity, and contextual relevance based on the suggestions of survey design best practices (Dillman et al., 2014). Based on the pretest, minor re-wording and changes to ordering were made.

This study does not contain any private or personal information, which does not need a formal institutional ethical approval. Nevertheless, all participants consented to participate in the study by reading an introduction part with information about the purpose of the study, voluntary participation, and confidentiality. No personal identification information was obtained and all data were secured according to GDPR and local ethics regulations.

Data were cleaned and prepared for analysis. This involved removing the incomplete answers, coding the Likert scale scores and classifying open questions by topic. MCQs were separated to individual features and were quantified.

Analysis was performed by Microsoft Excel and Python. Data cleaning, descriptive statistics (frequencies and percentages) and summary tables were done on Excel. Python (Pandas, SciPy, Matplotlib, Seaborn) was used to perform chi-square tests and visualize the data. Data manipulation has been done in Python with Pandas, and the leading library for plotting have been Seaborn, Matplotlib.

Chi-square tests were employed in Python (SciPy) to examine relationships between categorical variables (e.g., education level, institution type, AI usage). While chi-square tests are suitable for this dataset, reliability testing such as Cronbach's alpha was not conducted, as the survey measured categorical perceptions rather than psychological scales. This is acknowledged as a methodological limitation. Additionally, the limited sample size constrains the statistical power of some results, which is noted as a methodological limitation.

The insights gained from the literature review and platform evaluation played a particularly important role in the design of the quantitative survey instrument. Findings such as the use of *AI-driven platforms*, *their benefits*, and *associated risks* were the primary guide for developing the survey questions. AI-driven platforms such as *ChatGPT*, *Elicit*, and *Paperpal*, which were highly cited in the literature, were included as alternatives in the survey. Advantages and limitations were used as coding criteria, when examining the responses of the open ended questions.

However, the small sample size (n = 55) in this study limits the generalizability of results. Because the survey was based on voluntary and self-reported responses, response bias is possible. With these limitations, the survey gives valuable perspective on how AI-driven platforms are actually being used in academic research, its perceived value and obstacles. These observations are further discussed in following chapters.

Research Standards and Ethical Conduct

At each stage, academic integrity was strictly maintained, and accurate citations were made according to the Harvard referencing system. Furthermore, the AI-generated content used was clearly identified and critically analysed. The evaluation of the AI-driven platforms was based entirely on an educational and functional perspective and was not related to any commercial advertising or symbolic material.

3.5 Summary

This chapter has outlined the research design, explaining the rationale for adopting a parallel triangulation mixed-methods approach. It detailed the study's three core components: the *Systematic Literature Review (SLR)*, which established the theoretical framework and identified core research gaps; the *AI Platform Evaluation and Classification* (Phase 2), which defined the technical landscape, specific features, and inherent challenges of the tools; and the survey-based *quantitative component*, which gathered empirical insights from 55 academic researchers. The synthesized qualitative findings comprising the theoretical themes from the literature and the specific tool attributes from the platform classification are used to contextualize and interpret the empirical survey results. The results and analysis from these methodological steps are presented in Chapter 4.

4 Results: Integrated Qualitative and Quantitative Analysis

This chapter presents the empirical outcomes of this research, combining both the qualitative (Systematic Literature Review and Platform Evaluation) and quantitative (Survey) components described in Chapter 3. These results represent the direct outputs of the research process undertaken by the author.

The chapter begins by outlining qualitative results derived from the author's systematic literature review and structured evaluation of AI-driven platforms. These were conducted as empirical stages of the study, not merely as background context. Consequently, these analyses established the thematic foundation and informed the design of the subsequent quantitative survey.

Next, chapter introduces empirical results from the survey data on AI tool usage, perceived sustainability impacts, and main ethical and governance issues as reported by respondents. Together, these results illustrate how AI-powered platforms affect scholarly collaboration and sustainability in practice.

To maintain methodological transparency, the results are presented in the same sequence as the research process, beginning with the author's qualitative analysis (Systematic Literature Review and Platform Evaluation) and followed by the quantitative findings (Survey Analysis). This structure ensures that each component of the methodology contributes logically and measurably to addressing the main research question.

4.1 Qualitative Analysis and Foundation (SLR and Platform Evaluation Results)

This section consolidates the findings from the systematic literature review (SLR) and the platform evaluation conducted in the qualitative component of the study. These results established the necessary thematic baseline and research gaps that guided the subsequent survey design.

4.1.1 Thematic Synthesis and Identified Research Gaps (Outcome of SLR)

The data has been organized into major recurrent themes on AI, collaboration, and sustainability through the qualitative thematic analysis. Table 2 (Thematic Synthesis of Literature) provides a summary of the entire thematic breakdown.

Table 2. Thematic Synthesis of Literature

Theme	Key Insights from Literature	Representative Sources	Implication for Current Study
Efficiency and Productivity	Automation of research tasks improves efficiency.	Kasneci et al. (2023)	Measure perceived efficiency benefits in survey.
Collaboration and Inclusivity	AI reduces language and geographical barriers.	Bender et al. (2021); Wagner et al. (2019)	Examine inclusivity and equitable access.
Ethics and Integrity	Authorship, privacy, and plagiarism concerns persist.	Dwivedi et al., (2023)	Investigate researcher attitudes toward responsible AI use.
Sustainability and Environmental Impact	AI reduces redundancy but increases energy demands.	Vinuesa et al. (2020); Strubell et al. (2019)	Explore perceptions of AI's sustainability contributions.
Governance and Access	Unequal access and lack of clear governance frameworks.	Maghsoudi et al. (2020); OECD (2023)	Identify institutional barriers to ethical AI adoption.

From this synthesis, four critical research gaps emerged that directly informed the development of the empirical survey instrument:

1. **Empirical gap** - Limited quantitative evidence on researchers' real-world experiences with AI tools.
2. **Integration gap** - Weak connection between collaboration, sustainability, and tool fragmentation in existing frameworks.

3. **Governance gap -** Weak understanding, and weak policies to define ethical and equitable use of AI at institutional levels.
4. **Contextual gap -** Most of previous research has had an emphasis in technologically developed countries which lead to a difficulty for generalizing the findings into less technology advanced and resource full areas.

4.1.2 Platform Evaluation (Outcome)

The AI Platform Evaluation and Classification was conducted as a major qualitative task (Phase 2) to directly address Sub Research Question1 (SRQ1) by analysing the technological landscape of AI tools supporting academic research. This evaluation involved a detailed analysis of over 20 representative AI platforms (full details in Appendix 4).

The study listed the main findings in Table 3 (Comparative Summary of Key AI-Driven Research Tools), around 6 major platforms chosen for that because they are more relevant on core research activities (e.g., literature discovery, writing and networking) and due to their high acceptance perceived in the following survey. This categorization arranged the tools by their dominant goal and considered their function to contribute to collaboration and sustainability in particular, this technological context seemed needed as a background for understanding survey outcomes.

Table 3. Comparative Summary of Key AI-Driven Research Tools

Platform	**Core Function**	**Collaboration Benefit**	**Sustainability Contribution**	**Challenges / Ethical Concerns**
Elicit	Literature discovery via natural language models	Enables the analysis of shared data.	Reduces redundancy and effort in reviews	Accuracy and citation reliability
ResearchRabbit	Visual mapping of citation networks	Identifies interdisciplinary and co-author links	Encourages inclusive collaboration	Algorithmic bias; database dependency

ChatGPT	Natural language generation (NLG)	Enhances writing and multilingual communication	Lowers language barriers; improves productivity	Authorship Inconsistency. data privacy
Paperpal	AI-based manuscript editing	Supports collaborative academic writing	Promotes equitable participation for non-native speakers	Subscription costs; opaque feedback
SciSpace	Reading and summarization assistant	Streamlines joint literature analysis	Enables reuse of knowledge and reduces duplication	Risk of over-reliance; incomplete coverage
TeamingForFunding	Partner and funding recommendation	Expands research networks and partnerships	Enhances resource efficiency and inclusivity	Privacy and access inequalities

4.2 Quantitative Analysis – Survey

Following the establishment of the qualitative foundation; the thematic synthesis (Section 4.1.1) and the technological baseline provided by the platform classification (Section 4.1.2), this chapter now proceeds to present the quantitative empirical findings from the researcher survey. These results provide practical insights into AI adoption rates, usage patterns, perceived sustainability impacts, and the institutional challenges reported by academic researchers, directly addressing the core research questions.

4.2.1 Respondent Profile (Outcome)

A total of 55 valid survey responses were collected from individuals actively engaged in academic research around the world (Finland, Denmark, Sri Lanka, UK, Ireland, Taiwan, USA, India, Pakistan, New Zealand and Canada). This geographic diversity enhances the global relevance of the findings and provides a broad perspective on AI adoption in research environments. The educational attainment and research experience of participants are presented in Figure 5 and Figure 6.

- 58% held a Master’s degree,
- 18% held a Bachelor’s degree,
- 13% were PhD candidates or graduates, and
- 9% were postdoctoral researchers.

This indicates that most respondents possess the academic maturity and research exposure necessary to meaningfully assess AI-driven platforms.

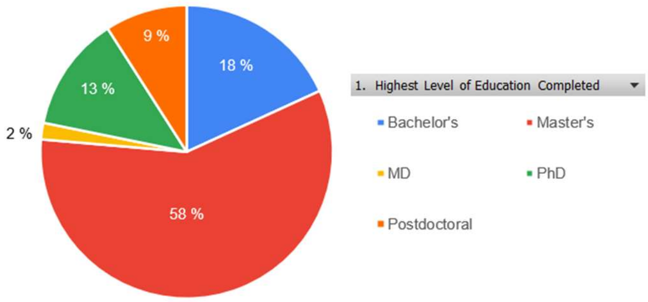

Figure 5. Level of Education of the Respondents

Figure 6 shows the distribution of research experience among participants. The largest group, 42%, reported 1-3 years of research experience, followed by 29% with more than 6 years. Meanwhile, 16% had less than one year, and 13% had 4 - 6 years of experience. This blend of early-career and experienced researchers strengthens the representativeness of the dataset.

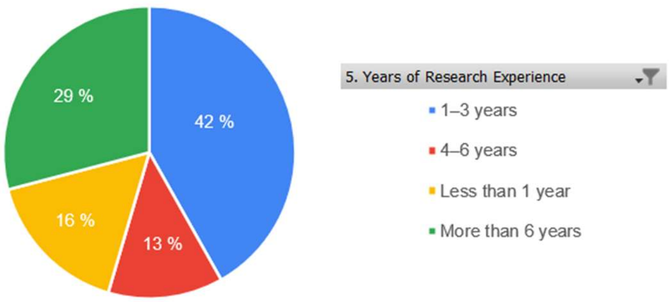

Figure 6. Research Experience of Respondents

These characteristics reflect a population of researchers who are digitally literate and actively engaged in research collaboration, providing a reliable foundation for analysing AI adoption and its perceived sustainability impact.

4.2.2 AI-Driven Platforms and Sustainable Research Collaboration (SRQ1)

This section addresses the first sub-research question: *Which AI-driven platforms currently support academic research collaboration, and how do their features and applications contribute to sustainable research practices?* It explores adoption rates, platform preferences, and how these tools assist in collaborative research practices. While AI is mainly used for literature search, writing, and idea generation, its direct role in enabling team-based collaboration remains limited.

Adoption of AI tools

As shown in figure 7, most respondents (84%) reported using AI-driven platforms in their research, indicating that AI is now a mainstream component of academic workflows rather than an experimental innovation. Only 9% stated they had not used any AI tools, while 7% were unsure implying that even non-users are aware of AI's growing relevance.

This widespread use reflects global academic trends where AI supports tasks such as *literature review, idea generation*, and *data analysis*. The adoption pattern also shows that users are not confined to technical fields; AI is influencing diverse disciplines and collaborative activities across academia.

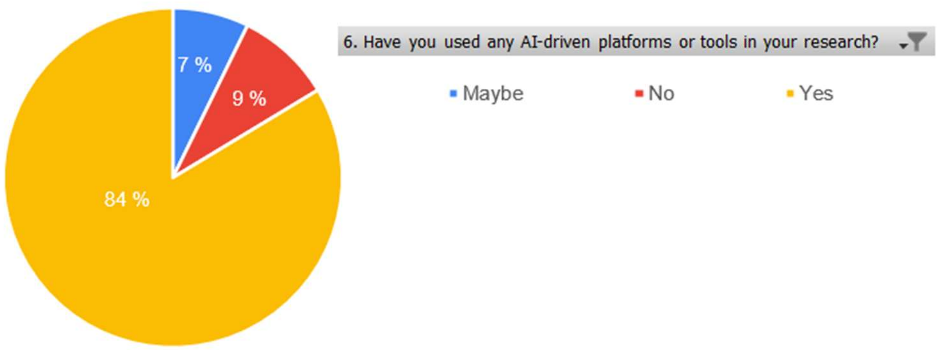

Figure 7. Adoption Of AI-Driven Platforms in Research by Respondents

This confirms literature findings that AI technologies have moved beyond experimentation and become an integral part of academic workflows (Kasneci et al., 2023). High adoption across experience levels and regions also suggests increasing accessibility of AI tools, particularly those that support writing and idea generation.

Most Used AI Platforms

As shown in figure 8, the most widely used AI platform among respondents was *ChatGPT*, utilised by over 40 participants. *Grammarly* ranked second (20 respondents), followed by *SciSpace, Elicit, and ResearchRabbit* (each cited by 5 -10 respondents). A few other tools, such as *Scite, Jenni, Claude*, and *Google Gemini*, were used by smaller groups.

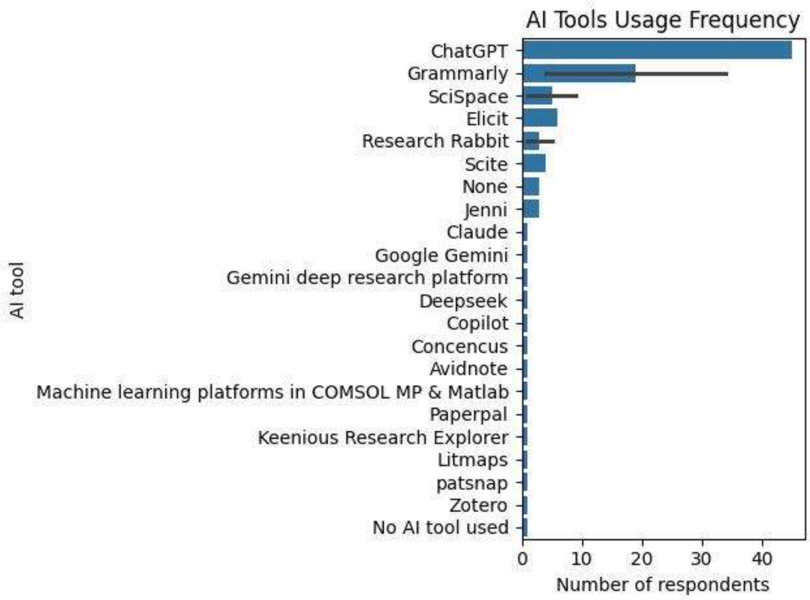

Figure 8. AI-Driven Platforms Usage Frequency

This distribution reflects the literature showing that tools supporting writing, summarisation, and idea generation are most dominant in the academic context. Collaboration-specific tools, such as *ResearchRabbit* and *TeamingForFunding*, remain less common, highlighting an existing gap in platforms that directly enable shared or co-authored research.

AI-Assisted Research Tasks

As shown in figure 9 AI tools were used most frequently for literature reviews (30 participants), followed by *writing, summarisation, idea generation*, and *coding* or *data analysis*. These results suggest that AI contributes mainly to early and middle stages of the research cycle; search, synthesis, and writing rather than later stages like collaboration or distribution.

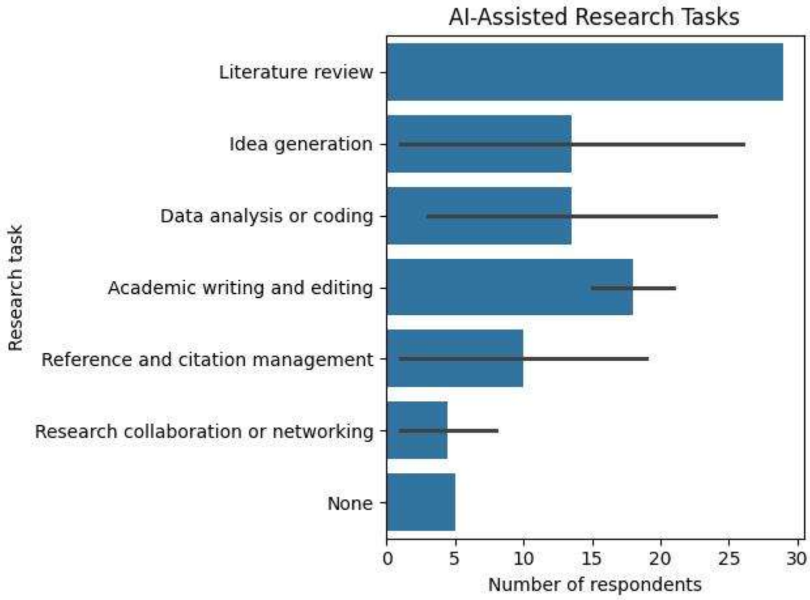

Figure 9. AI-Driven Platforms Assisted with Research Tasks

Few respondents reported using AI for *networking, co-author identification*, or *project management*, indicating that *AI currently supports cognitive collaboration (knowledge work) more than social collaboration (team coordination).*

This pattern echoes the literature reviewed in Chapter 2, where researchers note that AI enhances individual productivity but has yet to transform collective collaboration practices.

Perceived Sustainability Impact

Participants rated the perceived sustainability impact of AI-driven platforms using a 10-point Likert scale. As illustrated in Figure 10, most respondents rated AI's contribution positively, with a median score of **7**, indicating a generally favourable view of AI as a tool that supports sustainable research practices.

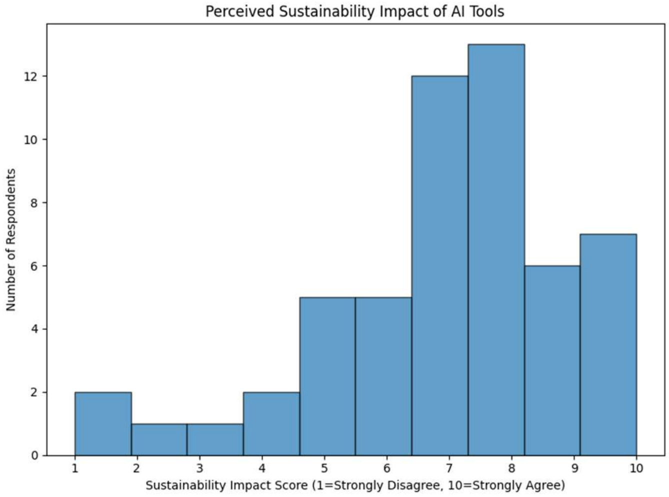

Figure 10. Perceived Sustainability Impact of AI-driven Platforms

The box plot in Figure 11 further improves this trend by showing that most responses clustered between **6 and 8**, with only a few outliers at the lower end of the scale.

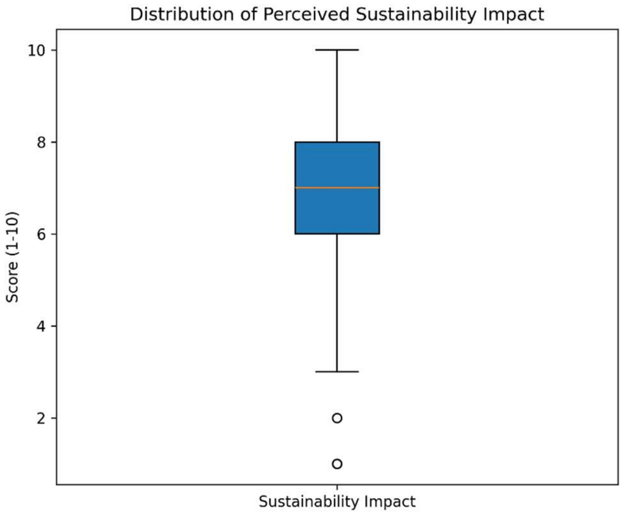

Figure 11. Distribution of Perceived Sustainability Impact

This suggests that researchers perceive AI as moderately to strongly beneficial for sustainability. In the open-ended responses, participants most attributed this impact to *timesaving, reduced repetitive work, and improved access to research resources* all of which reflect the *efficiency dimension of sustainability* highlighted in prior literature (Vinuesa et al., 2020). Consistent with the findings in Chapter 2, respondents rarely considered environmental sustainability factors, such as energy consumption or the carbon emissions of

AI systems. Given the nature of the open-ended question (Q14), this lack of emphasis was an expected result.

4.2.3 Challenges, Ethics, and Governance in AI Adoption (SRQ2)

Although AI adoption is high, several barriers prevent responsible and equitable use. As shown in Figure 12, the most cited issue was subscription cost, identified by over 30 respondents. High pricing limits accessibility, particularly in resource-constrained institutions, echoing concerns discussed in Section 2.4.1.

Identified Challenges

The study found that researchers are currently facing higher financial and infrastructural costs. As can be seen from the figure 12, "High subscription costs" was the most common reported challenge with around 30 respondents.

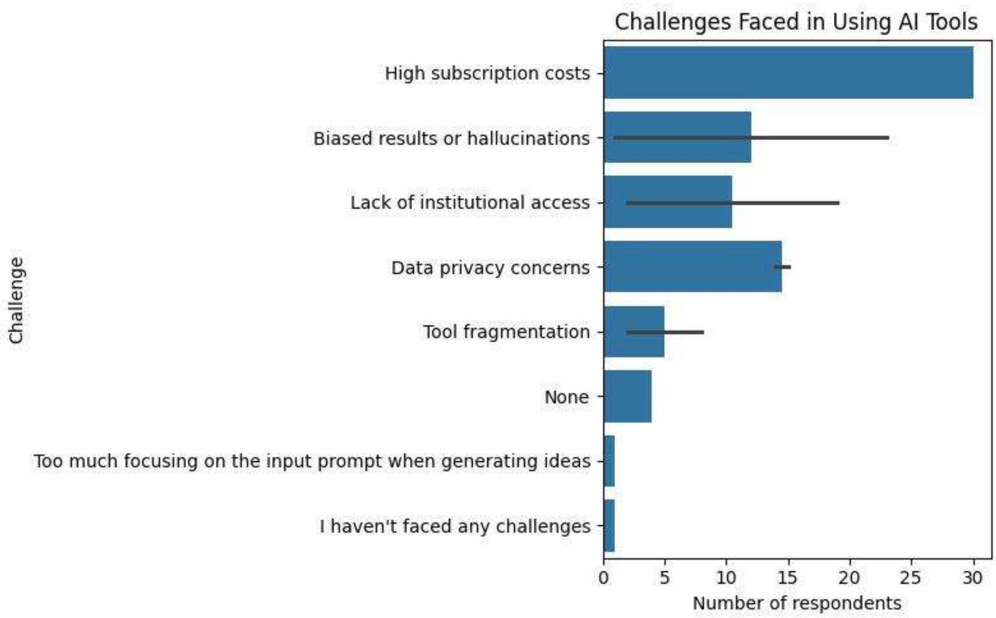

Figure 12. Challenges of Using AI-Driven Platforms

Other key challenges included:

- Data privacy and security concerns
- Inaccurate outputs ("hallucinations")

- Lack of institutional access

In the perspective of ethical awareness, respondents emphasized data privacy (individual risk); however, there were no broader concerns such as academic integrity or authorship were mentioned in the open-ended statements. This suggests that users are valuing *access* and *pricing* over *ethical guidance*. This finding supports the Chapter 2 conclusion: that *while effective AI use is increasing and shortage in the ethical AI literacy framework remains the same.*

Fragmentation and Lack of Integration

When respondents were asked whether current AI-driven platforms are well-integrated for end-to-end research workflows, most AI users expressed uncertainty regarding full integration. As shown in Table 4, out of the 46 respondents who indicated using AI tools, 24 respondents (52%) reported that AI platforms are only "partially integrated," while only 7 respondents (15%) agreed that AI tools are "fully integrated" into research processes.

Table 4. Contingency Table for AI Use and Integration

AI Integration Perception	Yes (AI Use)	No (AI Use)	Maybe (AI Use)
Yes	7	1	0
Partially	24	3	2
Not Sure	4	1	1
No	11	0	1

This pattern is visually supported in Figure 13, which illustrates that "partial integration" is the dominant perception among users.

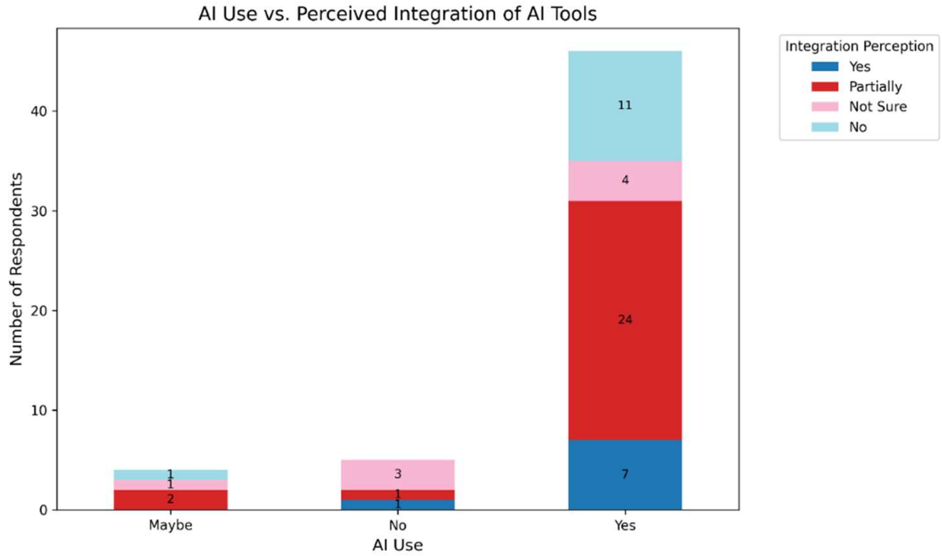

Figure 13. AI Use and Perceived Integration of AI-Driven Platforms

Although the chi-square test indicated no statistically significant association between *AI usage and perceived integration* ($\chi^2 = 11.34$, $p = 0.079$), the descriptive trend remains clear that *researchers widely use AI, but they do not experience these tools as seamlessly connected across the entire research workflow.*

4.3 Core Findings of Data Triangulation across Research Components

This section synthesizes the methodological inputs, primary results, and core empirical findings across the three main phases of the research: SLR, AI Platform Evaluation and Classification, and the quantitative Survey. The integration is based on data triangulation-a mixed-methods technique aimed at enhancing the validity and robustness of the conclusions by cross-referencing insights from conceptually distinct data sources. The table 5 acts as a map, explicitly aligning the outputs from each research component and showing how the qualitative foundation informed, contextualized, and was ultimately validated by the empirical data.

Table 5. Core Findings Across Research Components

Research Component (Methodological Input)	**Methodological Focus (Phase)**	**Primary Output (Direct Result)**	**Key Findings for Analysis (Empirical Outcomes)**
Systematic Literature Review (SLR)	Qualitative Component (Phase 1)	Thematic Synthesis of Literature	**Five Core Themes:** Efficiency, Inclusivity, Ethics, Sustainability, and Governance. **Four Critical Research Gaps:** Empirical, Integration, Governance, Contextual
AI Platform Evaluation and Classification	Qualitative Component (Phase 2)	Comparative Summary of Key AI-Driven Research Tools	**A Technological Baseline** detailing the core functions, benefits, and inherent challenges (e.g., subscription cost, bias) of 6 representative platforms
Survey	Quantitative Component (Phase 3 & 4)	Empirical Dataset from 55 academic researchers across diverse regions	**High AI Adoption** (84%); **Most Used Tools** (ChatGPT, Grammarly); **Primary Task** (Literature review)**; Positive Sustainability Perception** (Median=7); **Top Challenge** (High Subscription Costs); Low Integration (52% reported "Partially Integrated").

4.4 Summary

This chapter presented a detailed analysis of the survey results, integrated with the insights derived from the systematic literature review and platform classification. The findings reveal that AI-driven platforms have become integral to research workflows, significantly improving operational efficiency, accessibility, and productivity. However, their current contribution to systemic collaboration and sustainability is largely indirect, primarily facilitating individual performance rather than systemic cooperation.

Key empirical challenges identified include high subscription costs, tool fragmentation, and limited user awareness of environmental and ethical responsibilities. These findings provide the essential evidence base required to fully address the study's research questions.

The comprehensive answers to SRQ1 (Platforms and Features) and SRQ2 (Challenges) are derived from these presented results and further interpreted in Chapter 5. Critically, the guidelines and recommendations necessary to address SRQ3 (Fostering Ethical and Sustainable AI Integration) will be fully developed and presented in Chapter 6 (Conclusion), building upon the integrated evidence and interpretations from this chapter and the discussion that follows.

5 Discussion

This chapter addresses the study's core research question: *How can AI-driven platforms foster sustainable research collaboration in academia?* It moves beyond merely reporting the findings from Chapter 4 to interpret the integrated qualitative and quantitative data. The discussion analyses what the high adoption rates (84%) and usage patterns mean for collaboration, thereby providing the comprehensive answer to SRQ1 (Platforms and Features). Importantly, the chapter explores the cost-benefit trade-offs that determine true sustainability and equity by confronting the perceived efficiency gains (median score of 7) with the deep structural challenges of cost, fragmentation, and ethical awareness, which answers SRQ2 (Challenges). The synthesis of these interpreted findings builds the critical argument for the necessary guidelines and policy recommendations, which will be fully developed to address SRQ3 (Guidelines) in Chapter 6.

5.1 AI Adoption and the Nature of Collaboration

The literature predicted that AI would primarily enhance individual productivity, a hypothesis strongly supported by the survey: the 84% adoption rate was largely confined to tools for cognitive tasks like literature search and writing (e.g., ChatGPT, Grammarly). This confirms that AI-driven platforms are deeply embedded in academic work, primarily facilitating *cognitive collaboration* (knowledge work, such as data processing, writing, and literature synthesis) rather than *social collaboration* (team coordination).

However, the results uncovered a significant structural barrier; just as AI enhances efficiency and reach, its contribution to social collaboration has not yet transformed the interpersonal dynamics of *trust*, *shared decision making* and *communication* that define real human partnerships. As a result, *AI does not yet support the human synergy* that underpins genuine research partnership and allows the complexity of global challenges to be addressed.

5.2 AI, Sustainable Research Practice, and the Cost-Benefit Balance

Researchers rated AI’s contribution to sustainability positively (median=7), but this perception was narrowly focused on *operational efficiency* (time savings and reduced redundancy). This positive finding, while validating AI's role in resource optimization, must be critically weighed against the full economic and environmental footprint - the "*price of everything*" required to achieve systemic sustainability. The survey results fall in line with major aims such as quality education (SDG 4) and innovation (SDG 9), which related to increased productivity and access, but the environmental aspect like climate action (SDG 13) is still not well perceived only few researchers pointed out energy costs or carbon emissions linked to large AI models. In summary, AI today is emphasising the operation efficiency and inclusivity, rather than environmental and ethical sustainability which are less mature but still emerging to some users. The framework for assessing this comprehensive sustainability is defined below in Table 6.

Table 6. The Digital Sustainability Footprint (DSF) Framework

Dimension	**Meaning in Research Context**	**AI Contribution (Triangulated Findings: Survey, Literature, and Platform Analysis)**
Efficiency	Automation, reduced duplication, faster knowledge generation	**High** - strongly supported (median = 7)
Equity & Access	Open access, multilingual tools, affordability	**Moderate** - helps inclusivity but hindered by subscription costs
Ethics & Governance	Transparency, privacy, authorship integrity	**Low** - rarely mentioned by users despite literature emphasis
Environmental Impact	Energy use, hardware waste, digital emissions	**Very Low** - minimal awareness among respondents

The Price of Everything: Economic and Environmental Footprint

The study reveals that gains in efficiency are currently offset by significant, often unacknowledged, costs:

Economic Cost and Equity - *High subscription costs* were the most often mentioned issue in the study. This financial obstacle directly exposes digital fairness by limiting early-career researchers' and low-resource institutions' access. This discovery has significant real-world applications; private AI technologies produce a two-tiered research system that expand the knowledge gap between the Global South and North, where equal participation is critical for sustainable development. Sustainable research practices need to be accessible, inclusive and at present, challenging financial circumstances are making collaboration unfair or impossible for some.

Environmental Footprint (SDG 13) - Despite the conceptual link between AI and sustainability (SDG 13), the survey results found that, users were not well informed of both *energy costs* and *carbon emissions* of training large AI models. Concerns over the overall climatic impact of the digital research ecosystem are raised by the enormous computing demands of cloud-based AI, which outweigh the environmental gain of less travel from virtual collaboration.

However, the findings confirm that AI improves *operational sustainability*, but its contribution to *holistic, systemic sustainability* is undermined by significant, unmanaged economic and environmental costs.

5.3 Governance, Fragmentation, and the Equity Challenge

The barriers to AI adoption, which are the core focus of SRQ2, demonstrate that equity (affordability) is the foundational challenge to responsible governance. *High subscription costs* and *limited institutional access* reinforce disparities, indicating that institutional governance cannot succeed until access issues are fundamentally resolved.

The problem of affordability is compounded by tool fragmentation, a concept supported by the literature. Researchers are forced to switch between different AI tools for idea generation, writing, reviewing, and dissemination without a unified ecosystem. This high count of unintegrated platforms weakens the efficient AI possibilities.

This structural constraint also has far reaching consequences; it means one cannot create a joint research environment in which data and workflows are exchanged with minimal conflict. What is more, the dependence on proprietary AI platforms limited by lack of standardization and interoperability feeds directly into the governance gap and constrains transparency and academic freedom. This fragmentation therefore underscores the extreme need for integrated AI research ecosystems that balance collaboration, ethics and sustainability.

Why AI Still Fails to Enable True Collaboration?

Although AI can simulate collaboration, it cannot yet reproduce the social framework of collaboration. Five interrelated reasons explain this gap:

1. **Task-based design**: current systems optimise outputs, not collaboration.
2. **Lack of shared research spaces**: few tools allow synchronous, co-authored environments beyond basic document editing.
3. **Privacy and competition fears**: researchers hesitate to upload unpublished data.
4. **Limited interoperability**: absence of links with ORCID[1], Scopus[2], or institutional repositories prevents automated partner matching.
5. **Human trust and mentorship**: essential elements of collaboration cannot be algorithmically generated.

Survey evidence echoed these points:

- AI is not used for partner-finding or joint proposal writing.
- AI boosts individual capacity but not collective creativity which is a crucial insight that re-defines what "*AI-driven sustainable collaboration*" currently means.

5.4 Synthesis with Research Questions

Table 7 summarises how the combined findings from the literature review, platform evaluation and survey answer the research questions of this study. Together these findings demonstrate that, while AI technologies are already embedded in research practices, their contribution to sustainable collaboration remains partial and uneven.

[1] Open Researcher and Contributor ID for people who are involved in research, scholarship, and innovation, which provides a free, unique, persistent identity (PID).

[2] Comprehensive database of peer-reviewed literature including journals, conference papers, book chapters, and patents.

Table 7. Synthesis with Research Questions

Research Question	**Literature Expectation**	**Survey Evidence / Platform Output**	**Interpretation**
SRQ 1 – Which AI-driven platforms currently support academic research collaboration, and how do their features and applications contribute to sustainable research practices?	AI enhances individual work (efficiency); features support knowledge discovery/writing	**Platform Evaluation** identified core tool functions (e.g., Elicit, SciSpace); 84% **adoption**; use confined to cognitive tasks; **minimal networking use**	Confirms that AI contributes to **process sustainability** by enhancing **cognitive collaboration** (knowledge work efficiency) but is not yet fully utilized for **social collaboration** (team coordination), thereby limiting broader, systemic sustainability gains.
SRQ 2 – What ethical, technical, and institutional challenges affect the effective and responsible use of AI-driven platforms in academic research collaboration?	Challenges include cost, bias, privacy, and governance gaps.	**High Subscription Costs** dominate; low ethical awareness (authorship, integrity); Platform analysis noted inherent cost barriers for key tools.	Confirms that barriers exist and institutional **governance must begin with equity** (access/affordability).
SRQ3: How can insights from current practices inform guidelines for fostering ethical, equitable, and sustainable AI integration in academic research collaboration?	Requires policy to ensure transparency, equity, and interoperability	Identified need for **institutional access** and awareness of **environmental/ethical costs**.	The synthesis of findings **provides the necessary evidence base** for developing actionable, stakeholder-specific guidelines (addressed in Chapter 6)
Cross-theme Finding	Fragmented ecosystem limits efficiency.	Tools not end-to-end integrated; 52% report **partial integration**.	**Integration is essential** for unlocking the full potential of sustainable and collaborative adoption

5.5 Practical Implications

The findings concerning the *structural limitations* (fragmentation) and *ethical risks* (cost and equity) translate directly into actionable strategies for promoting systemic change. These

Practical Implications derive from the integrated results of SRQ1 and SRQ2 and serve as the foundation for the formalized guidelines that fully address SRQ3 in the conclusion.

- **For universities**, the priority is to provide institutional access to reliable AI platforms and training in ethical and inclusive use. Creating shared AI workspaces like institutional Overleaf [3] or data hubs would encourage genuine collaboration.
- **For policymakers and funders**, equitable licensing and open-source incentives are critical. Funding frameworks must be updated to support transparent, public AI infrastructures that comply with academic values of openness and reproducibility, moving away from systems that reinforce global resource disparities.
- **For developers**, the challenge lies in integration. Building interoperable systems that combine writing, data analysis, and networking functions would transform isolated tools into collaborative ecosystems.
- **For researchers,** AI needs to be treated as an authorial assistant, not as a black box or "magic wand," and researchers should retain their status as lead investigators. This means following institutional governance in the areas of privacy and ensuring that AI remains purely as a supportive aid enhancing human analysis without overtaking the fundamental roles for decision-makings and creative synthesis.

5.6 Limitations of the Study

This study is limited by its relatively small sample (n = 55) and cross-sectional design, which results in less statistical power, and could not have allowed the assessment of time trends. Furthermore, perceptions of sustainability effects were used rather than measured in this study. This optimization framework is recommended to be implemented on larger archival datasets across time in order to monitor the evolution of collaboration efficiency, carbon footprint and equity over time. In addition, if a qualitative interview component were added, we might also better understand the motives and ethics behind AI use.

[3] Overleaf is Cloud based software used for writing, editing and publishing scientific documents.

5.7 Summary

AI-powered platforms have become a general but weak part of academic research, as this chapter has prompted. AI improves efficiency and access, but not yet collaboration or systemic sustainability. The Digital Sustainability Footprint shows that productivity profits outweigh ‘awareness’ (ethics/environment). So, in the aggregate, AI serves to empower individual researchers rather than communities of research. Sustainable research collaboration will demand integrated digital ecosystems, inclusive access policies, and education that combines the competencies of technology with ethical understanding. These reflections provide the foundations for what follows in chapter 6.

6 Conclusion

This work aimed to answer the following question: *How might AI-driven platforms enhance sustainable academic research collaboration?* Employing a mixed-methods approach, including a systematic literature review, an AI platform classification (Phase 2), and an empirical survey among 55 researchers, the study offered a balanced, triangulated view on the influences of AI in terms of collaboration, ethics, and sustainable development.

These results validate AI's ability to redefine research workflows - as its potential has been well recognized (with an 84% high uptake rate among participants, using predominantly platforms such as ChatGPT and Grammarly). However, AI focuses on cognitive collaboration (e.g., discovery, writing synthesis) rather than social collaboration (human-centered interaction and joint decision making).

Participants rated AI's contribution to sustainability positively (median of 7) due to gains in *operational efficiency, saving time*, and *reducing duplication*. The most critical outcome, however, was the identification of a core conflict, summarized by the *Digital Sustainability Footprint (DSF) Framework* (Table 6 in Chapter 5), where efficiency is high, there is a noted lack of recognition by users of the wider sustainability dimensions, specifically *environmental impact* and *economic equity*.

This leads directly to the core challenges identified in SRQ2: *high subscription costs* and *tool fragmentation* are the most considerable barriers to equitable adoption. This confirms that while AI is valued for convenience, the structural and ethical systems needed for its sustainable use remain under construction, resulting in benefits being unequally distributed.

6.1 Recommendations

The ultimate goal, synthesized from the results of SRQ1 and SRQ2, should be the ethical and sustainable enhancement of human collaboration such that the benefits of AI outweigh its total cost. The following recommendations fully address SRQ3: *Guidelines for Fostering Ethical, Equitable, and Sustainable AI Integration.*

6.1.1 For universities and research institutions

- **Tackle Cost as an Equity Barrier**: There's a need for institutional licenses of popular AI tools to counter the high subscription fees, which are cited very frequently, and make opportunities hard to reach; instead, every researcher should have equal access.
- **Create Integrated Digital Workspaces**: Use collaborative digital environments that combine writing, analysis, and data sharing to address tool fragmentation and make co-creation between teams a reality.
- **Require ethical and environmental literacy**: Make data privacy, authorship attribution, and carbon footprint from large-scale computational models part of research ethics programs.

6.1.2 Policymakers and Funders

- **Prioritize sustainable AI governance:** This should be done by establishing transparent norms regarding data privacy, algorithmic accountability, and transparency in environmental reporting by the AI Vendors themselves.
- **Incentivize Open and Accessible Infrastructure**: Financial schemes will need to support regional or open-source AI infrastructures in ways that will guarantee low-resource contexts are not excluded due to commercial applications.
- **Demand Environmental Transparency**: Policy must ensure vendors report on their energy use and environmental impact in order to achieve sustainable procurement decisions.

6.1.3 For AI Platform Developers

- **Interoperability**: Design user-focused platforms that allow seamless data switching and integration with other existing tools, such as ORCID and institutional repositories, for an improved end-to-end collaborative productivity.

- **Design for Equity**: Using tiered cost models or institutional partnerships, essential features are provided to scholars hailing from developing regions, thereby reducing the economic barrier to adoption.

6.1.4 For Researchers

- **Critical Oversight**: View AI platforms as computing-based assistants - not as "magic wands" or subject-area controllers. Researchers will need to retain complete epistemic agency, in which human judgment continues to inform hypothesis generation and decision-making, while thoroughly validating AI outcomes, so as not to fall prone to automation bias.
- **Compliance With University Procedures**: Be aware of the university's governance and data protection policies that are in place. Researchers translating AI into clinical practice need to ensure that their use of this technology is consistent with ethical guidelines, by not submitting private or sensitive information into public-based models and being transparent in how their approach is performed.

6.2 Future Research Directions

This study suggests several critical areas for further investigation. This means that future research urgently needs to quantify the carbon and energy costs of large computational models in academic environments to establish a holistic view of digital sustainability.

- **Longitudinal Impact and Quality**: It is essential to conduct large-scale, long-term studies to trace changes in research quality, collaboration dynamics, and equity outcomes as the usage of AI matures across different fields.
- **Global Equity Comparison**: This will involve conducting research that can compare the adoption and access to AI between the Global North and South, showing ways of ensuring equitable participation and knowledge sharing.

- **Qualitative Ethical Deep Dive**: Employ qualitative approaches-interviews, ethnographies-to gain an enhanced understanding of how researchers navigate ethical weaknesses, trust, and authorship challenges in AI-aided collaboration.

6.3 Final Remarks

This thesis makes advances in the current understanding of AI technologies and its impact on academic research. It shows that AI is already optimized for performance and access, but its potential for ecological collaboration is still far from being understood. The research thus connects the conceptual to the empirical in demonstrating that AI currently extends individual scientists rather than remaking collaborative social dynamics.

Findings suggest that technology itself does not bring sustainability and equity. Real progress depends on thoughtful governance, global sharing, and open discussion. The more universities and societies depend on digital technologies, the harder it is to shepherd innovation with responsibility. It is only by adopting not only smarter machines but also smarter processes, with creativity, openness, and participation of human beings still at the heart of scholarship, that sustainable research collaboration will be born.

On balance, AI-assisted platforms are a bright future promise for research collaboration and knowledge generation in ways that are sustainable. But their taking root is contingent on a shared commitment to openness, morality, and collaboration. Engaging with such questions is needed to reach this balance and sets the scene for further research that will help progress towards a balanced, integrated, and sustainable digital world of research.

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Appendix 1. Survey Questions

AI in Research Collaboration & Sustainability

Dear Researcher,

I am currently conducting a research study as part of my Master's thesis, titled "Enhancing Research Collaboration and Sustainability with AI-Driven Platforms." The study explores the role of artificial intelligence in supporting academic collaboration, sustainable research practices, and scholarly tool integration.

As part of the research, I have developed a brief survey aimed at gathering insights from researchers and academic professionals regarding their use of AI tools in their research activities.

I would be truly grateful if you could take a few minutes to complete the survey. Your expertise and perspective would be highly valuable to the quality and depth of this study.

All responses are anonymous and will be used solely for academic purposes. Thank you very much in advance for your time and support. Please feel free to reach out if you have any questions or need further details about the research.

Warm regards,

Helen Batuwantudawa

Msc in Software Engineering

LUT, Lappeenranta, Finland

1. Highest Level of Education Completed *Mark only one oval.*

Bachelor's / Master's / PhD / Postdoctoral / Other (please specify)

2. Field of Study

3. Country of Education/Work

4. Type of Institution

Public University / Private University / Research Institute / Government Organization

5. Years of Research Experience

Less than 1 year / 1–3 years / 4–6 years / More than 6 years

6. Have you used any AI-driven platforms or tools in your research?

Yes / No / Maybe

7. **Which AI tools have you used for research activities?** *(Check all that apply.)*

Check all that apply.

ChatGPT / Elicit / Research Rabbit / Paperpal / Grammarly / Jenni / Scite / SciSpace / Avidnote / Other

8. Which research tasks have you used AI tools for? *(Check all that apply)*

Literature review / Academic writing and editing / Reference and citation management

Research collaboration or networking / Data analysis or coding

Idea generation / None

9. AI tools have helped me collaborate with other researchers more effectively.

Mark only one oval.

Strongly disagree / Disagree / Neutral / Agree / Strongly agree

10. I believe AI tools have made my research process more sustainable (e.g., saved time, avoided redundant work, improved access).

Mark only one oval.

1 2 3 4 5 6 7 8 9 10

11. What features do you find most helpful in AI tools for research collaboration?

Check all that apply.

Real-time feedback / Summarization / Researcher matchmaking / Co-authoring support

Other

12. Do you think current AI tools are well integrated for end-to-end research use (from literature to publishing)?

Mark only one oval.

Yes / No / Partially / Not sure

13. What challenges have you faced using AI tools in your research? *Check all that apply.*

High subscription costs / Data privacy concerns / Lack of institutional access

Tool fragmentation / Biased results or hallucinations / I haven't faced any challenges

Other

14. **If you could build the ideal AI research platform, what features would it have?**

Appendix 2. Inclusion / Exclusion criteria

Article	**Found & accessed**	**In English**	**Full Article**	**Relevant to topic**	**Ethics or Data Concerns**	**Include/Exclude**
Mapping the Landscape of AI-Driven Human Resource Management: A Social Network Analysis of Research Collaboration	Yes	Yes	Yes	Yes – AI in research collaboration	No	Include
A Multifaceted Vision of the Human-AI Collaboration: A Comprehensive Review	Yes	Yes	Yes	Yes- Human AI collaboration models	No	Include
Sustainable Software Engineering: Visions and Perspectives Beyond Energy Efficiency	Yes	Yes	Yes	Yes – Sustainability in research	Yes- Ethical AI use	Include
Research and Education Towards Smart and Sustainable World	Yes	Yes	Yes	Yes -AI smart environments, SDGs	Yes- Sustainability Goals	Include
Incorporating AI Literacy and AI Anxiety Into TAM: Unraveling Chinese Scholars' Behavioral Intentions Toward Adopting AI-Assisted Literature Reading	Yes	Yes	Yes	Yes-AI in academic publishing	Yes- AI anxiety & ethics	Include
Human Participants in AI Research: Ethics and Transparency in Practice	Yes	Yes	Yes	Yes- Ethical aspects of AI in research	Yes-Bias & Privacy	Include
The Use of Generative AI and AI-Assisted Technologies in Writing for Elsevier	Yes	Yes	Yes	Yes- Literature discovery tool	No	Include
Research Rabbit (Tool)	Yes	Yes	Yes	Yes- Literature Discovery tool	No	Include
Elicit (Tool)	Yes	Yes	Yes	Yes – Research automation tool	No	Include
Neat vs. Scruffy: Early AI Researchers	Yes	Yes	Yes	Partial – Background on AI culture	No direct ethics	Exclude
Ethics of AI for Cultural Heritage	Yes	Yes	Yes	Yes – AI in cultural research context	Yes – Ethics focus	Include

Researchers' Concerns on AI Ethics	Yes	Yes	Yes	Yes – Ethics survey among researchers	Yes – Ethics, bias	Include
R&D Investment in Tech Enterprises (AI)	Yes	Yes	Yes	Yes – AI in R&D and sustainability	No	Include
Tech-Based ESG Reporting Platforms	Yes	Yes	Yes	Yes – AI & sustainability reporting	Yes – Ethics, sustainability	Include

Appendix 3. Data summary table

Author	Title	Year	Abstract	Venue	Database	Location	Length and Year	Stakeholders	Used Methods	Benefits/Drawbacks
Y. K. Dwivedi et al.	So what if ChatGPT wrote it?	2023	Examines the opportunities and ethical concerns surrounding ChatGPT's use in research and policy.	Int. J. Info. Management	IEEE	Global	N/A	Researchers, educators	Multidisciplinary analysis	Boosts productivity; raises ethical concerns
Y. Wang et al.	Survey on Metaverse	2022	Explores the fundamentals, security, and privacy of the metaverse with implications for collaborative work.	IEEE Commun. Surv.	IEEE	Global	Survey 2022	Developers, researchers	Survey analysis	Immersive collaboration; privacy concerns
C. König	Ethics of Artificial Intelligence for Cultural Heritage	2024	Discusses ethical challenges and opportunities of applying AI in cultural heritage, emphasizing transparency.	Unknown	IEEE	Global	2024	Cultural institutions, AI developers	Ethical review	Highlights transparency needs; ethical concerns

P. Riekki and J. Mämmelä	Research and Education Towards a Smart and Sustainable World	2021	Explores how smart technologies including AI can contribute to sustainability in education and research.	IEEE Access	IEEE	Global	2021	Academics, educators	Case analysis	Promotes smart sustainability; tech access challenges
Q. Pan et al.	AI Literacy and AI Anxiety in Chinese Scholars' Adoption	2025	Examines how AI literacy and anxiety influence Chinese scholars' adoption of AI-assisted literature tools.	IEEE Access	IEEE	China	Survey 2025	Scholars, institutions	Survey-based TAM analysis	Improves reading efficiency; raises AI anxiety
E. Jantunen et al.	Researchers' Concerns on Artificial Intelligence Ethics	2024	Investigates researchers' concerns on AI ethics using scenario-based surveys highlighting policy needs.	Unknown	Online	Global	Survey 2024	Researchers, policy makers	Scenario-based survey	Identifies ethics gaps; calls for clear policies
X. Xiao et al.	R&D Investment Management in Tech Enterprises Under AI	2024	Explores how AI influences R&D investment strategies in tech enterprises.	IEEE Access	IEEE	Global	2024	Tech companies, investors	Quantitative analysis	Enhances R&D decisions; data-driven risks

M. McKee	Human Participants in AI Research: Ethics and Transparency	2024	Analyses ethical and transparency concerns when involving human subjects in AI research.	IEEE Trans. Tech. Soc.	IEEE	Global	2024	Researchers, ethics boards	Policy review	Promotes ethical AI; transparency challenges
N. Kotzev, E. Marinov, M. Markova-Karpuzova	Sustainable Solutions: Advancing in Tech-Based ESG Reporting Platforms	2024	Discusses how tech-based platforms enhance ESG reporting and sustainability compliance.	Unknown	Online	Global	2024	Corporations, ESG analysts	Case studies, platform analysis	Streamlines reporting; tech adoption hurdles
Elsevier	The Use of Generative AI and AI-Assisted Technologies in Writing	2024	Outlines policies and standards for using generative AI in academic writing.	Elsevier Policy	Elsevier Online	Global	Policy 2024	Authors, publishers	Policy guideline review	Provides clarity on AI usage; implementation challenges
Research Rabbit	AI-powered literature discovery and visualization	2025	Provides AI-based literature discovery with network visualizations.	Online Tool	Online	Global	Tool active 2025	Researchers	AI-powered visualization	Accelerates discovery; limited customization
Paperpal	AI-assisted manuscript editing and clarity improvement	2025	AI-based platform offering grammar and clarity improvements in	Online Tool	Online	Global	Tool active 2025	Researchers, authors	AI-assisted editing	Improves clarity; premium subscription

			research writing.							
ResearchGate	Research collaboration and academic networking	2025	Enables academic networking and collaboration among researchers.	Online Platform	Online	Global	Ongoing	Researchers, institutions	Social networking	Enhances networking; limited project tools
LinkedIn Researcher Connect	Professional academic networking for collaboration	2025	LinkedIn's feature to enhance academic collaboration and networking.	Online Platform	Online	Global	Ongoing	Academics, professionals	AI-driven recommendations	Connects researchers; not research-specific
ORCID	Researcher identity and networking platform	2025	Provides persistent digital identifiers for researchers, linking publications and affiliations.	Online Platform	Online	Global	Ongoing	Researchers, institutions	Identity linking system	Improves visibility; lacks messaging
Google Scholar	Citation tracking and researcher networking	2025	Tracks research citations and allows users to follow other researchers' work.	Online Platform	Online	Global	Ongoing	Researchers	Citation tracking	Easy tracking; no direct messaging

SciSpace	AI-powered research summarization and citation analysis	2025	Offers automatic summarization and citation analytics for academic research.	Online Tool	Online	Global	Tool active 2025	Researchers, students	AI summarization	Quick insights; privacy concerns
Avidnote	AI-driven note-taking and literature review organization	2025	Supports structured note-taking and organizing research literature.	Online Tool	Online	Global	Tool active 2025	Academics, students	AI-powered notes	Improves organization; manual inputs needed
Jenni AI	AI-powered writing assistant for research drafts	2025	Generates academic writing drafts using AI for idea expansion and structure.	Online Tool	Online	Global	Tool active 2025	Researchers, authors	AI text generation	Speeds drafting; limited rigor
QuillBot	AI-powered paraphrasing and writing enhancement	2025	Provides grammar correction and paraphrasing for academic writing.	Online Tool	Online	Global	Tool active 2025	Writers, students	AI paraphrasing	Improves fluency; free version limited

Appendix 4. AI tools and platforms evaluation

Tool	Functionality	Key Features	Limitations	Sustainability Link
ResearchGate	Academic social network	Connect with researchers, share papers, discussions	Limited project management tools	Promotes open access sharing, reduces duplication of research efforts
Academia.edu	Research sharing and networking	Follow researchers, share research, collaborate	Some features are behind a paywall	Encourages knowledge sharing and collaborative research, reducing redundant studies
LinkedIn Researcher Connect	AI-powered academic networking	Collaboration recommendations, networking for research	Not designed specifically for research collaboration	Facilitates networking efficiency and potential interdisciplinary collaboration
ORCID	Researcher identity and networking	Persistent researcher profile, links projects and co-authors	No built-in messaging features	Improves transparency and credit attribution, supporting sustainable academic ecosystems
Google Scholar Profiles	Research visibility and networking	Tracks citations and publications, allows following researchers	No direct messaging or collaboration features	Enhances research discoverability, promoting wider access and reuse of scholarly works
Mendeley	Reference management & collaboration	AI-powered research suggestions, shared libraries	Some premium features require payment	Reduces paper use by promoting digital libraries and shared resources
Zotero Groups	Research collaboration & citation management	Share references with research teams, cloud storage	Limited real-time communication	Supports collaborative digital resource sharing, reducing duplication

Notion AI	AI-powered project and knowledge management	Create collaborative research spaces, AI-generated summaries	Not research-specific	Centralizes knowledge management, reducing redundant effort and paper usage
Slack (Research Communities)	AI-assisted team communication	Create research collaboration channels, AI-powered message summarization	Requires integrations for research-specific features	Enhances efficient communication, reducing need for travel and printed materials
Elicit AI	AI-powered literature review	Extracts key insights from academic papers	Limited integration with citation tools	Streamlines literature review process, reducing researcher time and resource use
Scite	AI-enhanced citation analysis	Smart citation context, identifies study quality	Requires paid access for full features	Supports quality-focused research, reducing waste on low-impact studies
ChatGPT	AI-based research assistant	Contextual text generation, summarization	Potential inaccuracies in complex topics	Speeds up writing and brainstorming, potentially reducing resource use and inefficiencies
Paperpal	AI-assisted manuscript editing	Grammar correction, clarity improvement	Subscription-based model	Reduces time and effort in manuscript preparation, enhancing sustainable academic productivity
Jenni	AI writing assistant	Generates research drafts	May lack deep academic rigor	Accelerates draft creation, reducing prolonged resource usage
Avidnote	AI-driven note-taking	Organized literature review notes	Requires manual input for categorization	Helps organize research materials digitally, reducing paper waste
SciSpace	AI-powered research summarization	Automatic literature insights, citation analysis	Data privacy concerns	Facilitates quick access to insights, improving efficiency and reducing redundant reading

Scholarcy	AI-generated article summaries	Summarizes papers, highlights key insights	Summaries may lack depth	Saves reading time and energy, contributing to efficient knowledge dissemination
Trinka	AI writing and grammar tool	Advanced grammar and style correction for academia	Expensive premium model	Enhances writing quality, reducing need for multiple revisions and wasted time
Writefull	AI-powered academic writing	Provides writing suggestions for clarity	Limited offline functionality	Improves writing efficiency, contributing to more sustainable research workflows
Grammarly	AI-powered writing assistant	Advanced grammar and clarity suggestions, plagiarism detection	Requires premium subscription for advanced features	Promotes clear, ethical writing, reducing revisions and wasted effort
Quillbot	AI-powered paraphrasing and writing enhancement	Paraphrasing, grammar correction, writing fluency improvement	Free version has limited features	Facilitates efficient writing processes, reducing excessive drafting and editing
TeamingForFunding	AI-assisted research funding collaboration	Connects researchers to form teams for funding applications	Limited to specific funding platforms	Promotes efficient team formation, increasing chances for sustainable project funding
Gemini	AI-powered multimodal research assistant	Advanced summarization, reasoning across text, code, and images; integrates with Google ecosystem (Docs, Drive, Scholar)	Academic-specific features still developing; requires internet connectivity	Enhances efficiency by unifying multiple research tasks in one platform, reduces redundancy, and supports sustainable knowledge workflows