

Examining the Incorporation of AI in Academic Research: The Instance of Higher Education in the Marrakech-Safi Region

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Abstract

This paper examines the incorporation of Artificial Intelligence (AI) technologies in academic research within the Marrakech-Safi region of Morocco, with a specific focus on their use by university academics. This research examines the prospects, challenges, and ethical considerations surrounding the adoption of AI in Moroccan higher education institutions, conducted through semi-structured interviews with academics at Cadi Ayyad University. The research indicates that AI is significantly enhancing research productivity, fostering interdisciplinary collaboration, and providing novel solutions to emerging academic challenges. Nonetheless, other challenges persist, including deficient infrastructure, poor training, and the absence of comprehensive policies to govern AI use. The article concludes with policy recommendations aimed at enhancing the efficient implementation of AI for the optimisation of research methods in the region.

Keywords: Artificial Intelligence, Education Policy, Higher Education, Research Methods

XXIII. INTRODUCTION

Artificial Intelligence (AI) is rapidly evolving as a transformative influence in higher education, offering solutions to persistent challenges in education, research, and administration globally. The incorporation of AI technology into academic research holds tremendous prospects for enhancing productivity, promoting diverse collaboration, and stimulating creativity in research methodologies. In Morocco, including within the Marrakech-Safi region, the adoption of AI in higher education is in its early stages. Although institutions in this region are beginning to explore artificial intelligence (AI) tools for improved studies, issues concerning faculty training facilities and policy development remain prevalent.

This research aims to investigate the integration of AI technology by academic researchers in higher education institutions within the Marrakech-Safi region. The article examines the use of AI, the opportunities it presents for enhancing research productivity and quality, and the challenges researchers encounter when employing these technologies. The study examines the ethical and policy

implications of using AI in academic research. It offers practical recommendations for its effective and responsible implementation in universities across the region.

Conceptual Background

From a global perspective, the use of AI in research has brought about a new revolution, driving new methods and breakthroughs in numerous fields. Here in Morocco, this technological shift is still pending. At universities like Cadi Ayyad University (Marrakech-Safi Region), scientists are adopting AI to enhance their research. Nonetheless, the local implementation of AI within these academic settings presents unique challenges, particularly regarding infrastructure, resource allocation, and the development of suitable regulations.

Research Problem

Although an increasing number of international studies examining the AI's contribution to enriching the academic research process exist, the interface of AI within Moroccan academic institutions, particularly in the Marrakech-Safi region, remains understudied. As a result, there are few studies regarding the unique challenges or opportunities within this regional context. This paper aims to close this gap by analyzing the current status of AI adoption in the country's universities, its effects on research practices, and the challenges that need to be addressed for its effective embedding.

Research Objectives and Questions

Hypotheses:

- **First hypothesis:** The use of AI tools in academic research in the Marrakech-Safi region has a significant influence on the research productivity and interdisciplinary collaboration among researchers.
- **Second hypothesis:** The integration of AI in universities within the Marrakech-Safi region encounters substantial obstacles, including limited infrastructure, insufficient faculty training, and a lack of comprehensive policies governing AI utilisation in academic research.

Research Question:

Based on the previously stated hypotheses, the main research question is:

- **How does Artificial Intelligence currently impact teaching and research at universities in the region of Marrakech-Safi, as well as the emerging opportunities, challenges, and ethical issues associated with its introduction?**

This study aims to elucidate the adoption of AI in higher education institutions within the Marrakech-Safi region and to propose policy recommendations for enhancing its incorporation into academic research.

LITERATURE REVIEW

AI in Higher Education: Global and Local Contexts

Artificial Intelligence (AI) technology has gradually become integrated into international higher education institutions, transforming various areas of academic research. The implementation of AI enables institutions to optimize procedures, enhance academic efficiency, and develop innovative study methods. Applications of AI in higher education include data analysis, personalised learning, digitisation of administrative tasks, and the promotion of substantial collaborative studies (Luckin et al., 2016). In addition, AI is enhancing the ability to quickly process and analyze large datasets, thereby increasing the speed and accuracy of research findings (Brynjolfsson & McAfee, 2014).

The global impact of AI on the academic sector is widely documented, with numerous studies highlighting its importance in enhancing productivity and promoting diverse approaches to addressing complex academic challenges. AI-driven methods in academic research have facilitated expedited data processing and enhanced prediction models, especially in disciplines such as healthcare, engineering, and social sciences (Chui et al., 2016). This global perspective on AI's influence underscores its potential to transform academic research and boost overall productivity.

The National Strategy for Digital Education (2018) in Morocco established the foundation for integrating AI tools into educational environments, emphasizing the enhancement of digital infrastructure and the deployment of AI in universities (El Khamlichi, 2019). Nevertheless, notwithstanding these endeavors, Moroccan institutions, particularly in less urbanized areas like Marrakech and Safi, persist in encountering difficulties. This encompasses limited access to sophisticated AI tools, inadequate infrastructure, and a deficiency in specialised training for teachers and researchers (Benmansour et al., 2021). Nonetheless, promising signs of progress are emerging. Institutions such as Cadi Ayyad University in Marrakech have begun integrating AI technologies into research methodologies, specifically to enhance research output and promote cross-disciplinary cooperation.

Global AI in Education Market, By Region, 2018-2022 (USD Million)

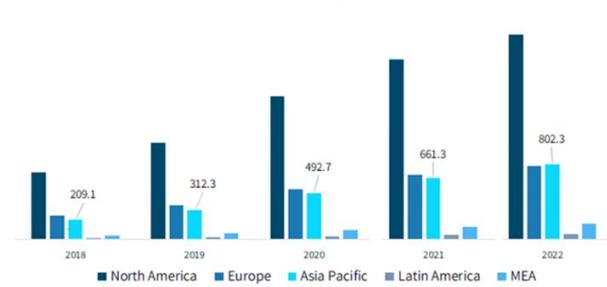


Figure 1: Global AI Adoption in Higher Education

Opportunities for AI in Academic Research

Artificial Intelligence presents numerous opportunities to enhance both the effectiveness and quality of research at Moroccan universities. Machine learning (ML), natural language processing (NLP), and data mining are essential AI technologies used to automate repetitive processes, analyze extensive datasets, and support literature reviews and data interpretation (Chui et al., 2016). These tools enable researchers to analyze complex datasets efficiently, reveal hidden patterns, and gain insights that would otherwise be laborious or challenging to identify through conventional methods.

Researchers across various disciplines, including engineering, economics, and social sciences, are utilising AI to achieve expedited insights and generate more dependable and significant study results. AI applications in economics facilitate the analysis of extensive economic data, thereby informing policy decisions. In the social sciences, AI is used to analyze sentiment in social media and historical data, providing valuable insights into community patterns. Furthermore, AI's capacity to break down disciplinary boundaries enables interdisciplinary collaboration, with AI technologies serving as bridges connecting diverse academic fields. Researchers are gradually implementing AI to tackle complex social issues, such as climate change, public health, and urbanization (Brynjolfsson & McAfee, 2014). By automating data analysis, AI systems liberate academics from mundane tasks, enabling them to focus on more intellectual and creative aspects of their work.

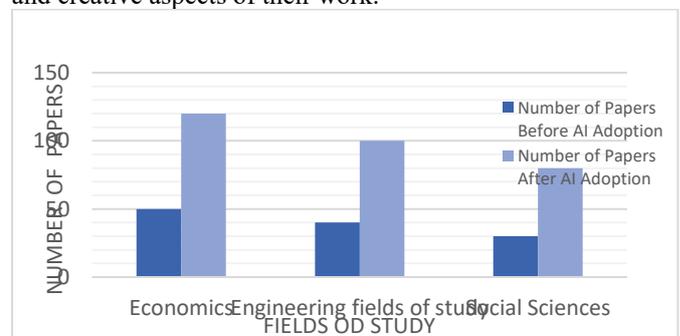


Figure 2: AI's Impact on Research Productivity and Collaboration

The diagram above illustrates the role of Artificial Intelligence (AI) in enhancing research productivity across various academic disciplines. The bar chart illustrates the quantity of academic articles published before and after the adoption of AI in disciplines such as economics, engineering, and social sciences. It illustrates a distinct rise in research productivity, particularly in economics and engineering, where AI tools have presumably facilitated more efficient data analysis, expedited research cycles, and enhanced collaboration. This visual depiction emphasises the revolutionary impact of AI on research productivity and illustrates its potential to foster innovation in academic disciplines.

Ethical and Social Implications of AI in Research

Although AI offers considerable advantages for academic research, it also presents various ethical and social challenges that require resolution to ensure its responsible use. A major issue is data privacy. Artificial intelligence tools often rely on extensive datasets, some of which may contain sensitive or personally identifiable information. Researchers employing AI must ensure that their data collection and processing methods adhere to ethical norms and privacy regulations, thereby preventing the potential misuse of personal data (O'Neil, 2016).

Another issue is the possibility of algorithmic bias, in which AI systems may inadvertently reinforce existing societal biases inherent in the data. AI techniques employed in social science research may yield biased outcomes if the training data is inadequate or distorted (O'Neil, 2016). This concern is especially critical in fields such as education and healthcare, where biased algorithms may yield substantial societal and policy consequences.

The necessity for ethical transparency and accountability in AI development is critical. Concrete standards must be developed for AI implementation to guarantee that research methodologies employing AI tools are both responsible and equitable. Researchers and entities must establish comprehensive frameworks to tackle issues such as bias, transparency, and the ethical utilisation of data (Gasser et al., 2018). Moreover, the enduring societal ramifications of AI-driven research necessitate ongoing scrutiny to ensure that the technology serves all stakeholders equally, without exacerbating existing gaps.

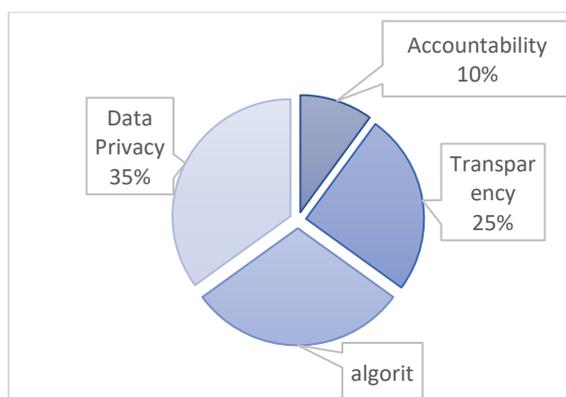


Figure 3: Ethical Concerns in AI-Driven Research

The pie chart above illustrates the allocation of principal ethical issues recognised in AI-driven research. Data privacy (35%) and algorithmic bias (30%) are the primary concerns, underscoring the growing emphasis on safeguarding sensitive information and promoting equity in AI systems. Transparency (25%) and accountability (10%) are significant concerns, underscoring the need for clear and accessible information on AI systems and the importance of ensuring accountability for AI-driven activities. These findings underscore the need to establish comprehensive ethical frameworks that govern the responsible application of AI in academic research.

XXIV. RESEARCH DESIGN AND METHODOLOGY

A. Research Approach

This study employs a qualitative research methodology, utilizing a case study design, to investigate the incorporation of Artificial Intelligence (AI) in academic research at two universities in the Marrakech-Safi region, specifically Cadi Ayyad University. This study's qualitative nature facilitates a comprehensive knowledge of the utilisation of AI technologies in academic research, highlighting both the benefits they offer and the limitations they confront. This method facilitates a detailed examination of the ethical and policy ramifications of AI implementation, as viewed by academic experts.

The semi-structured interview method served as the primary data collection instrument, providing participants with the flexibility to articulate their perspectives on AI integration in research while maintaining coherence with the study's central themes.

B. Data Collection

A defined questionnaire has been created and delivered over Google Forms to collect data. This approach enabled extensive access and the effective collection of both quantitative and qualitative data. A total of 204 respondents from Cadi Ayyad University and Sidi Mohamed Ben Abdellah University (formerly known as Safi University) completed the questionnaire. The comments offer a comprehensive analysis of AI implementation and its challenges within these institutions.

The questionnaire comprised eight theme components, detailed as follows:

1. General Information: This section collected fundamental demographic data, including gender, age category, academic level (undergraduate, master's, PhD, or university lecturer/researcher), and prior experience with AI training.

2. AI Adoption and Use: Participants were inquired about the AI tools employed in their research (e.g., ChatGPT, Google Bard/Gemini, Claude, Microsoft Copilot), their usage frequency, and the perceived advantages (e.g., data analysis, writing support). Challenges, including insufficient training, restricted access, and ethical dilemmas, were also analysed.

3. Opportunities for AI in Research: This section examined participants' perceptions regarding the potential of AI to enhance research productivity and quality in Moroccan universities.

4. Policies and Institutional Support: Participants inquired about the existence of AI-supportive policies and initiatives within their institutions, encompassing training, research funding, and access to AI tools.

5. Ethical and Social Implications: Participants emphasised their ethical apprehensions regarding AI in research, encompassing data privacy, algorithmic bias, and transparency challenges.

6. Future Prospects: This section examined participants' perspectives on the future of AI in Moroccan higher education and research, along with suggestions for enhancing AI integration.

7. Open Comments: Participants had the option to offer supplementary feedback, discuss experiences, or propose suggestions regarding AI in academic research.

Data were gathered electronically through Google Forms, facilitating an organised and efficient approach. The survey's voluntary and anonymous format encouraged honest feedback, while the broad representation of academic levels and disciplines ensured a diverse range of viewpoints on AI adoption.

Semi-Structured Interviews

In addition to the questionnaire, semi-structured interviews were conducted to explore further the key themes identified in the literature and from survey data. The semi-structured format allowed for flexibility, enabling participants to elaborate on their experiences and insights while addressing predetermined questions on:

- 1. AI Adoption and Use:**
 - What AI tools do you use in your research (e.g., ChatGPT, DeepSeek, Google Bard/Gemini)?
 - How do these tools enhance your research practices?
 - What challenges have you encountered in adopting AI tools?
- 2. Opportunities for AI in Research:**
 - Do you believe AI can improve research productivity and quality in Moroccan universities?
 - Can AI tools help solve specific research challenges in your field?
- 3. Policies and Institutional Support:**
 - Are there AI-supportive policies at your university?
 - What resources (e.g., training, funding, AI tools) does your university offer to support AI adoption?
- 4. Ethical and Social Implications:**
 - What ethical concerns do you associate with AI in research (e.g., data privacy, algorithmic bias)?
 - How do you address these ethical concerns in your own research?
- 5. Future Prospects:**
 - How do you envision the future of AI in Moroccan higher education and research?
 - What steps should universities take to promote responsible and effective AI integration?

C. Data Analysis

The data collected through interviews and the survey were subjected to thematic analysis, an approach appropriate for qualitative research. This study discovered reiterating concepts and trends, which have been divided into principal categories comprising AI adoption challenges, ethical considerations, and institutional support. The thematic analysis provided significant insights into the barriers and prospects associated with AI integration in Moroccan higher education, hence influencing the study's recommendations for improved AI adoption.

XXV. RESULTS AND DISCUSSION

AI Tools in Use

The findings indicate that researchers in multiple fields in the Marrakech-Safi region are steadily embracing artificial intelligence (AI) methods. Researchers at Cadi Ayyad University are employing machine learning algorithms and advanced data analysis platforms to analyze and interpret vast datasets, particularly in the fields of economics, engineering, and environmental sciences. At UCA University, artificial intelligence technologies are utilized for various administrative and academic purposes, including automating grading procedures, streamlining student exams, and efficiently handling research data.

Table 1 : Word Frequency

Word	Length	Count	Weighted Percentage (%)	Similar Words
training	8	243	4,62	training
research	8	225	4,28	research, researchers, researches
chatgpt	7	171	3,25	chatgpt
funding	7	158	3,00	funding
support	7	146	2,78	support, supportive
tools	5	139	2,64	tool, tools
centers	7	138	2,62	centers
access	6	134	2,55	access
software	8	134	2,55	software
offer	5	121	2,30	offer
create	6	117	2,23	create
help	4	116	2,21	help, helpful, helping, helps
writing	7	113	2,15	writing
saving	6	111	2,11	saves, saving
time	4	111	2,11	time
ethics	6	108	2,05	ethical, ethics
summarizing	11	108	2,05	summarizing
lack	4	105	2,00	lack
data	4	95	1,81	data
analysis	8	94	1,79	analysis

limited	7	93	1,77	limited, limites
faster	6	89	1,69	faster
deepseek	8	85	1,62	deepseek
gemini	6	81	1,54	gemini
improve	7	81	1,54	improve, improves, improving
bard	4	80	1,52	bard
google	6	80	1,52	google
results	7	72	1,37	result, results
accurate	8	71	1,35	accurate
copilot	7	71	1,35	copilot
microsoft	9	71	1,35	microsoft
workshops	9	66	1,26	workshops
collaborations	14	65	1,24	collaboration, collaborations
guidelines	10	63	1,20	guidelines
international	13	63	1,20	international
policies	8	63	1,20	policies
projects	8	61	1,16	project, projects
none	4	57	1,08	none
increase	8	52	0,99	increase, increasingly
institutional	13	52	0,99	institutional, institutions
cost	4	47	0,89	cost
issues	6	47	0,89	issues
legal	5	42	0,80	legal
concerns	8	41	0,78	concerns
challenges	10	33	0,63	challenges
technical	9	32	0,61	technical
focused	7	24	0,46	focus, focused
needs	5	24	0,46	need, needs
nothing	7	23	0,44	nothing
labs	4	22	0,42	labs
done	4	21	0,40	done
claude	6	20	0,38	claude
use	3	16	0,30	use, used, useful
academic	8	15	0,29	academic

The table above illustrates the frequency of essential terms identified in the study's data sources. These expressions highlight the key themes of the research, especially the relevance of Artificial Intelligence and AI within the realm of academic enquiry. The repeated use of terms such as 'data,' 'obstacles,' and 'adoption' underlines the study's primary focus on the integration of AI into research methodologies and the associated barriers to its implementation. This frequency analysis elucidates the principal problems and

focal points of interest within the academic community regarding AI in the Marrakech-Safi region.

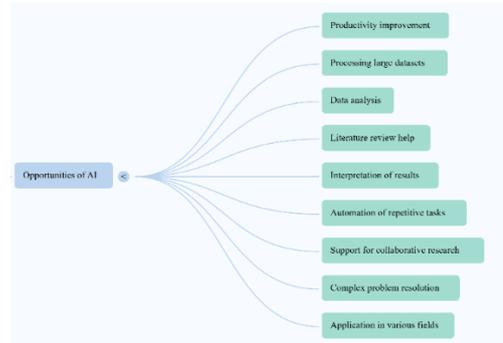


Figure 4: Textual Analysis of AI Opportunities in Research

The figure above illustrates one of the primary themes identified through the textual analysis of participants' responses regarding the potential of AI in academic research. The analysis identifies multiple persistent opportunities, including increased research productivity, interdisciplinary collaboration, and expanded data analytics skills. The graphic portrayal underscores the prevailing views of AI as a mechanism for expediting research processes, enhancing data management efficiency, and encouraging collaboration across diverse academic disciplines. The study highlights the increasing optimism regarding AI's capacity to foster innovation in research methods.

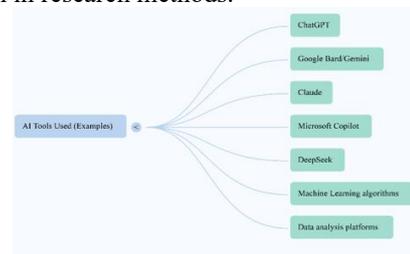


Figure 5 : AI Tools Used

The figure above shows an array of AI technologies commonly used by researchers in the Marrakech-Safi region. The apparent tools, including ChatGPT, Google Bard/Gemini, and Microsoft Copilot, illustrate a range of applications utilised for diverse academic functions, such as data analysis, writing support, and research administration. This picture illustrates the diversity of AI tools employed across several fields, showcasing the extensive functions these tools provide to facilitate academic research. The rising utilisation of these technologies highlights the escalating dependence on AI to improve productivity and effectiveness in studies.

Challenges in AI Adoption

Although there were positive effects, several issues were highlighted by the interviewees. The significant challenges are the lack of training programmes and knowledge about AI among instructors and researchers. A wide range of participants indicated a lack of formal education in AI, which impeded their ability to use these tools proficiently. Furthermore, the excessive expense of AI software and the

thereby enabling them to leverage these technologies to enhance their scholarly endeavours fully. These programmes must be tailored to support researchers of differing expertise, ranging from beginners to experienced researchers.

2. Establish Explicit Ethical Guidelines: In light of the ethical issues related to the integration of AI in research, Moroccan universities must formulate and enforce definitive ethical frameworks that regulate the proper use of AI tools. These rules must tackle essential concerns, including data privacy, algorithmic equity, and transparency in AI-driven research. Adopting these moral standards will mitigate potential hazards, including biased algorithms and privacy violations, while fostering trust in AI applications within the scientific community.

3. Allocate resources towards AI infrastructure: For the successful utilisation of AI tools, it is imperative that both the government and institutions invest in AI infrastructure. This entails enhancing access to advanced computing resources, supplying AI-specific software, and establishing research centres focused on AI. By fostering an enabling environment for AI research, institutions can equip researchers with the essential tools and resources necessary for making significant academic contributions. These investments will also facilitate the advancement of AI-driven advances that can enhance worldwide academic knowledge.

By focusing on these critical areas, Moroccan institutions can more effectively integrate AI technology into their research methodologies, thereby enhancing their research output and contributing to the global corpus of academic knowledge. The effective integration of AI would not only stimulate innovation in research but also establish Moroccan higher education institutions as leaders in the worldwide academic field.

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