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Electronic markets information systems with explainable artificial intelligence: A bibliometric analysis of publications from 2000 to 2024

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Abstract

Explainable Artificial Intelligence (XAI) plays a pivotal role in enhancing trust and technology acceptance in artificial intelligence applications, drawing significant interest across diverse fields. Despite this growing attention, limited research has focused on the application of XAI in improving customer experience within electronic markets. Addressing this gap, the present study investigates the landscape of XAI research in electronic markets through a bibliometric analysis of scholarly publications from 2000 to 2024. Sources were systematically retrieved from major academic databases including Google Scholar, Scopus, and Crossref. The analysis reveals that research interest in this domain is recent, with the earliest relevant publications emerging in 2023 and increasing in the following year. The study examines the temporal distribution of publications, identifies leading journals, highlights the most cited works, and analyzes frequently used keywords. These findings reflect the nascent yet growing academic engagement with XAI in electronic commerce settings. The study concludes by offering recommendations for future research, emphasizing the need for deeper exploration of customer-centric applications of XAI and the development of transparent models tailored to the dynamics of digital marketplaces.

Keywords: Artificial intelligence; customer satisfaction; electronic markets; electronic commerce; information systems.

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1. INTRODUCTION

The combination of a rather broad methodological and technological spectrum termed as Artificial Intelligence has been on the table of academics and practitioners for years (Alt, 2021). These advancements, particularly in Machine Learning (ML) and Artificial Intelligence (AI) have facilitated new applications that offer several benefits to different sectors (Dhiman et al., 2023) and at the same time struggle to comprehensively justify their decisions and actions to those who are not computers (Dhiman et al., 2023). This justification is one of the necessary explanations for AI systems as suggested by Adadi and Berrada (2018), which should be able to (I) explain to justify - the decisions made by utilizing an underlying model should be explained in order to increase their justifiability (II) explain to control - explanations should enhance the transparency of a model and its functioning, allowing its debugging and the identification of potential flaws; (III) explain to improve - explanations should help scholars improve the accuracy and efficiency of their models; (IV) explain to discover - explanations should support the extraction of novel knowledge and the learning of relationships and patterns

To address these, the Defense Advanced Research Projects Agency (DARPA) initiated a program in 2017 termed Explainable Artificial Intelligence (XAI) (Van Lent et al., 2004) based on a collection of methods that when combined with successful explanation procedures, allow end-users to grasp, correctly trust, and efficiently manage the next generation of AI systems (Dhiman et al., 2023). This program (XAI) has since then become an invaluable resource for scholars, industries, institutions, and strategists due to its accessible and logical methods and straightforward computational stages (Chen et al., 2023), and has advanced the adoption of AI in critical domains by making it more transparent (Saeed & Omlin, 2023).

Considering how businesses are highly profit-driven with the aim of covering as much customers as possible across the globe despite the time differences and peculiar business needs, the role Artificial Intelligence has become an indispensable (Sutiene et al., 2024; Kreiterling, 2023; Soni, 2020), and AI and Electronic Commerce (EC) have become inseparable (Alt, 2022). EC as characterized by Abdullah et al., (2021) utilizes computer, internet, and shared software technology to exchange merchandise descriptions and illustrations; offers and procurement details; as well as other information needed to be conversed to consumers, providers, staffs, or the community. EC has evolved over the years as the world economy is witnessing a transition into information-based operations through online technologies (Jain et al., 2021). EC is phenomenal and its powerful concept and processes have profoundly changed the present life (Taher, 2021; Soni, 2020). With a projected global cross-border market worth estimate of around US$4,820 billion by 2026 (AP News, 2020), EC is faced with several challenges amongst which trust is the most critical factor in EC electronic settlements (Jain et al., 2021). The lack of explainability in AI EC systems as a result of black-box nature of the Deep Learning (DL) has made understanding of the rationale for AI decision poor, thus highly restricting users' trust (Chaudhary et al., 2024) and adoption of AI in EC.

Exploring XAI in the Multi-category Electronic Commerce (MEC) industry is essential for ensuring ethical, transparent, and responsible AI use, which will improve EC and boost confidence in AI-driven decisions (Zhang & Xiong 2024). Furthermore, it aids in reducing transactions and commercial risks and ensures compliance with financial standards. With this in mind, the objective of this study is to evaluate a prior research-based analysis in order to obtain insight into the work performed and opportunities given by AI advancement, and the explainability feature of AI in the MEC sector. To accomplish this task, a comprehensive analysis of the existing literature was conducted in order to discover the most pertinent contribution in the EC that worked on XAI between 2000 and 2024.

1.1. Theoretical background

This section discusses the critical role of XAI in increasing the trust in and overall acceptance of AI systems in EC, which according to Aderibigbe et al., (2023) is important. XAI provides users with an

explanation of why a method produces a particular result. The outcome can then be understood in a particular context. The summary of reviewed literature is presented in Table 1.

Table 1

XAI in Ecommerce

S/N	Title & Author	Type	Description	Technique	Contribution/Outcome
1	Unlocking the Power of Explainable AI to Improve Customer Experiences in E-Commerce Ansari et al., (2023)	Original research	The authors explored the potential of XAI in improving customer experiences in e-commerce using: 1. Personalized recommendations 2. Automated decision-making 3. Improved customer service	In the study, the authors compared traditional AI transition to XAI for e-commerce by discussing the benefits and challenges of both approaches and potential solutions to overcome challenges.	They proposed a working model of XAI for e-commerce that can be used by businesses to better understand and implement the technology
2	Chatbot-XAI—The New Age Artificial Intelligence Communication Tool for E-Commerce Thapliyal and Thapliyal (2024)	Book Chapter – Narrative Review	The authors introduced the detailed technical aspects used to build XAI chatbots based on various techniques and approaches the explains decision-making process to customers		They produced a comprehensive chapter that provides an overview of XAI chatbots as a tool in ecommerce and its potential impact on the industry.
3	Explainable Recommendation: A Survey and New Perspectives Zhang and Chen (2020)	Survey Article	The authors provide a comprehensive review for the explainable recommendation research	They used the 5W, i.e., what, when, who, where, and why to highlight the position of explainable recommendation in recommender system research	The authors contributed structured classification taxonomy of existing explainable recommendation methods that would can help in understanding the state-of-the-art of explainable recommendation research.
4	Enhancing brick-and-mortar store shopping experience with an augmented reality shopping assistant application	Original Research	The authors developed an augmented reality shopping assistant application that is based on personalized recommendations and explainable artificial intelligence features on customer shopping experiences	Based on design scientific research approach, they evaluated by means of an online experiment (n = 252), providing both qualitative and quantitative data	The authors demonstrated that smartphone-based augmented reality shopping assistant applications have the potential to increase the competitive power of brick-and-mortar retailers.

S/N	Title & Author	Type	Description	Technique	Contribution/Outcome
	using personalized recommendations and explainable artificial intelligence Zimmermann et al., (2023)				
5	Customer Churn in Retail E-Commerce Business: Spatial and Machine Learning Approach Matuszelański and Kopczewska (2022)	Original Research	The authors presented an ML model to predict customer churn in of an e-commerce retail based on three different datasets: numerical data on orders, textual after-purchase reviews and socio-geo-demographic data from government census.	They used Latent Dirichlet Allocation (LDA), Dirichlet Multinomial Mixture (DMM) and Gibbs sampling for preprocessing; Extreme Gradient Boosting (XGBoost) and Logistic Regression for modelling.	The authors contributed a comprehensive e-commerce churn model based on a transaction's dataset from the Brazilian O-list e-commerce retail company
6	Measuring service quality based on customer emotion: An explainable AI approach Guo et al., (2024)	Original Research	Using XAI, the authors unveil the dynamic characteristics of consumer emotions that influence service quality.	They trained an ensemble model that uses six sub-categories of customer-emotion dynamic features to predict service quality	They developed a customer-emotion-based method to measure quality of service to customer, which outperformed two benchmarks for assessing service quality.
7	Which product description phrases affect sales forecasting? An explainable AI framework by integrating WaveNet neural network models with multiple regression Chen et al., (2024)	Original Research	The researchers presented model based explainable results of sales forecasting that provide guidance in designing product descriptions that aligns with market demand reflected using phrases that attracts more customers	The model combines text mining, WaveNet neural networks, multiple regression, and SHAP model.	The authors contributed an AI framework that explains the impact of product descriptions on sales forecasting.

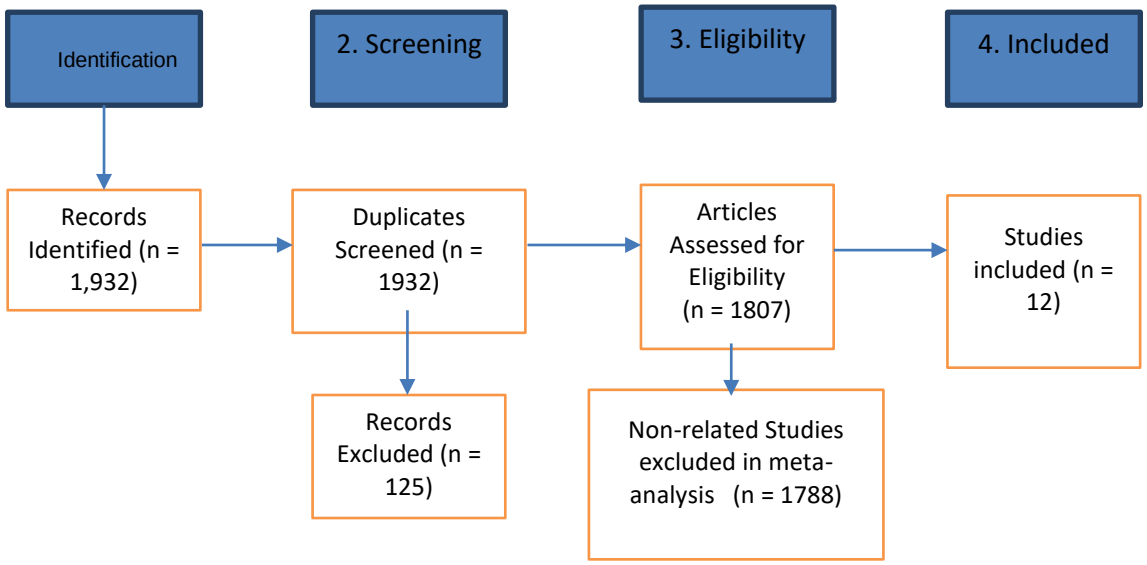
S/N	Title & Author	Type	Description	Technique	Contribution/Outcome
8	XAI for Churn Prediction in B2B Models: A Use Case in an Enterprise Software Company Marín Díaz et al., (2022)	Original Research	The authors proposed to use of a methodological process that contributes to analyzing the explainability of AI algorithm predictions, Explainable Artificial Intelligence (XAI) for customer churn	Partial Dependence Plot, Individual Condition Expectation, Feature Importance, Local Surrogate Model, and Shapley Values	They contributed a model to a B2B environment, for which the literature is scarce, in models that determine the prediction of abandonment, and consequently in the application of interpretability (XAI).

2. METHOD AND MATERIALS

This section describes the details of the methodology used in this study. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) technique which helps in standardizing the processes involved in bibliometric analysis was utilized in this research. As shown in Figure 1, the PRISMA technique is made of four steps which are; identification, screening, eligibility, and qualitative synthesis.

Figure 1

Literature selection process based on PRISMA model



Although the concept of XAI as a research field started in the 1970s, and only gained momentum in recent years (Mueller et al., 2019), we did not limit our literature search time frame to 5 or 15 years because. To identify relevant publications, we conducted a search spanning 24 years (i.e. 2020 – 2024) using different terms describing XAI and Electronic Markets on digital databases that contain the published journals articles and conferences proceedings. Our search is based on relevant terms that describe the research aspect of XAI and Electronic Markets in title, keywords, and abstract from which the following search strings were formulated: ("Explainable Artificial Intelligence" OR "XAI" AND "ecommerce" OR "electronic commerce"), ("Explainable Artificial Intelligence" OR "XAI" AND "emarket" OR "electronic market"). Table 2 shows an overview of our search process.

2.1. Identification of materials

Several materials such as conference papers, peer-reviewed articles, and other related documents were identified to be in relation to this study. These materials were identified by searching digital academic repositories and later on screened as shown in Figure 1. Searching as shown in Table 2 was done on Scopus, Crossref, and Google Scholar (GS) using relevant search text to retrieve relevant articles for download.

Search and result download in bib **format. Considering that Scopus, PubMed, and Web of Science allows the download of search results in formats such as CSV, Excel, and Latex. Usage of advanced search feature available in these websites, more targeted search criteria and additional search filters and options (such as filtering by publication date range and source) were used to narrow down the search results and find more relevant articles.**

Table 2

Search terms and results

Database	Search Terms	Year Range	Results	Data Format
Google Scholar	"Explainable Artificial Intelligence" OR "XAI" AND "ecommerce" OR "electronic commerce"	2000-2024	860	.ris
	"Explainable Artificial Intelligence" OR "XAI" AND "emarket" OR "electronic market"	2000-2024	64	.ris
Crossref	"Explainable Artificial Intelligence", "electronic Commerce" OR "electronic Market"	2000-2024	1000	.ris
Scopus	"Explainable Artificial Intelligence" AND "electronic Commerce" OR "electronic Market"	2000 -2024	8	.ris
Total			1,932	

2.2. Screening

The screening of identified materials was based on the following:

a. Relevance to XAI and EC: Materials that are not related to the XAI and EC were removed.

b. Duplicity Removal: Duplicated results were reduced to only one without by removing the duplicates and maintaining only one copy of such publications.

c. Removal of non-English language papers

2.3. Eligibility for inclusion

The eligibility of the screened materials was determined based on:

a. Publishing year of article must be from the year 2000 and above.

Only materials that meet the above eligibility criteria were included.

As presented in Figure 1, only 12 out of the 1,932 downloaded publications satisfied the eligibility criteria. These articles were analysed using VOSviewer software with version 1.6.20. Freely accessible,

VOSviewer is a visualization tool for creating bibliometric maps showing intended networks (Van Eck & Waltman, 2021). It constructs maps of the network encapsulating based on specified items of interest such as authors, publications, keywords, and links between them in terms of publications co-citation, co-occurrences or co-authorships.

2.4. Bibliometric analysis technique

Bibliometric analysis is grouped into two categories; performance analysis and scientific mapping. Performance analysis is carried out as a means of investigating elements of research contributions in a particular field which typically include the total citations received by an author, number of publications, and average article citations per year (Donthu et al., 2021). These elements serve as indicators to how influential a publication or an author is in a particular research domain, and how progressive the productivity or contribution on that domain is over the years. The scientific mapping on the other hand describes the intellectual structure and research evolution in the research field using visual representation. Furthermore, it provides insight on the interaction between research elements alongside the degree of relationships between them in terms of strength (Zupic & Čater, 2015). The scientific mapping according to Dede and Ozdemir (2022) contains various analysis techniques, such as: co-citation, co-authorship, citation, co-occurrence, and bibliographic coupling.

In this study, both performance analysis and scientific mapping are employed to examine academic contributions of XAI in Electronic Markets. The following are the specific Bibliometric Analysis task conducted:

- Temporal Distribution: Considering that the academic contributions are in a form series of events in which inter-event times are independently and identically distributed. We conduct the temporal distribution on the academic contribution on XAI in Electronic Markets over time.
- Citation Analysis: To determine the most prominent and valued publications, a citation analysis is conducted. This also reveals the most influential and top contributing authors, publishers and universities.
- Co-occurrence Analysis: This was conducted to reveal the promising and notable keywords used in analyzed publications. These keywords are used as the theme of the research in XAI in Electronic Markets.

3. RESULTS

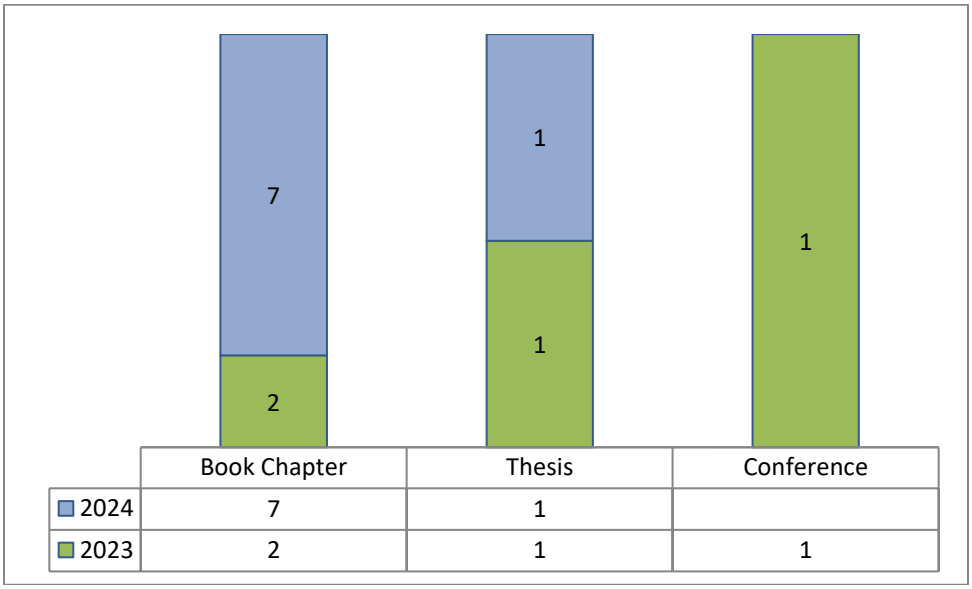
This section presents the results obtained from the bibliometric analysis. From the extracted data, we conduct bibliometric analysis to gain insights of temporal distribution, top journal journals, and most cited papers.

3.1. Temporal distribution

To examine the development of the academic contribution on XAI in Electronic Markets over time in form of temporal distribution, we evaluated the number of published articles over 24 years as outlined in section 3 and shown in Figure 2. Result of the temporal distribution show that publications related to XAI in e-market have become much more active in recent years globally. It can be clearly seen that attention on XAI in e-market started growing from 2020. Thereafter, a consistent growth trend was observed with the number of publications in 2023 being the sum of the previous 3 years (i.e. publications of 2020, 2021, and 2022). Furthermore, 2024 has so far doubled the number of 2023 publications. Thus, confirming the growing relevance of the subject matter.

Figure 2

Temporal distribution



3.2. Top journals

The top journals as presented in this section based on number of articles on the subject matter published by each journal. As shown in Table 3, based on the most important journals according to the number of papers published on the XAI and electronic commerce, Springer leads the list with a total of 7 publications, followed others each with 1 publication.

Table 3

Most relevant journals

#	Sources	Publisher	Publications
1	Book Chapters in: Role of Explainable Artificial Intelligence in E-Commerce	Springer Nature Switzerland	6
2	Lecture Notes in Electrical Engineering ((LNEE, volume 980))	Springer, Singapore	1
3	Explainable Artificial Intelligence (XAI): Concepts, enabling tools, technologies and applications	IET Digital Library	1
4	Journal of Interactive Marketing	Saje Journals	1
5	AI-Based Data Analytics	Taylor & Francis	1
6	Master's Thesis	Tilburg University	1
7	Master's Thesis	Vrije Universiteit	1

3.3. Most cited papers

The list the most influential papers including the authors, titles, publisher, total citations (TC), and citations per year (CY) as shown in Table 4 are presented and discussed in this section.

Table 4

Ranking by citation

Rank	Authors	Title	Publisher	TC	CY
1	Khan and Naim (2024)	XAI in Society 5.0 through the lens of marketing and HRM	Saje Journals	4	4
2	Ansari et al., (2023)	Unlocking the power of explainable AI to improve customer experiences in E-Commerce	Taylor & Francis	2	2
3	Kasimu et al., (2023)	Explainable Sentiment Analysis for Textile Personalized Marketing	Springer, Singapore	2	2
4	Thapliyal and Thapliyal (2024)	Chatbot-XAI—The New Age Artificial Intelligence Communication Tool for E-Commerce	Springer Nature Switzerland	1	1
5	Chaudhary et al. (2024)	Introduction to Explainable AI (XAI) in E-Commerce	Springer Nature Switzerland	0	0
6	Grilis (2024)	XAI methods for identifying reasons for low- and slow-moving retail items inventory in E-commerce: A Design Science study.	Tilburg University	0	0
7	Van Gennep (2023)	Leveraging XAI and Interpretable Artificial Intelligence (IAI) to comprehend email marketing	Vrije Universiteit	0	0
8	Hussain et al., (2024)	Demystifying Applications of Explainable Artificial Intelligence (XAI) in e-Commerce	Springer Nature Switzerland	0	0
9	Gaur (2024)	From Algorithms to Ethics: XAI's Impact on E-Commerce	Springer Nature Switzerland	0	0
10	Tejasvi et al. (2024)	Explainable Artificial Intelligence (XAI) for Managing Customer Needs in E-Commerce: A Systematic Review	Springer Nature Switzerland	0	0
11	Sahu and Gaur (2024)	Decoding the Recommender System: A Comprehensive Guide to Explainable AI in E-commerce	Springer Nature Switzerland	0	0
12	Azad (2023)	Exploring Customer Behavior and Enhanced Revenue Generation in E-Commerce using Interpretable and Explainable Artificial Intelligence.	IET Digital Library	0	0

3.4. Co-occurrence analysis

In this section, we present the result of the co-occurrence analysis conducted as a means of discovering the most highlighted keywords or topics in existing research on XAI in electronic markets. As shown in Table 5, the analysis ranked the most frequently occurring keywords as a means of identifying commonly studied keywords or topics in this research domain.

Table 5

Most used keywords in XAI in electronic markets

Keywords	Occurrence
Electronic Commerce	2
Explainable Artificial Intelligence	2
Artificial Intelligence	1
Customer Engagement	1
Customer Satisfaction	1
Decision Tree	1

Email Conversion	1
Interpretable Artificial Intelligence	1
Learning AI	1
Pattern Classification	1
Purchasing	1
Recommender Systems	1
Retention	1
SHAP	1
Social Networking	1
Top Management	1
Tree-based	1
Trustworthiness	1

The visualization of these keywords as shown in Figure 3 shows the keywords network that is frequented in XAI in electronic markets research. The following describe the network as presented in the diagram:

i. The network contains several nodes that each represents the various keywords.

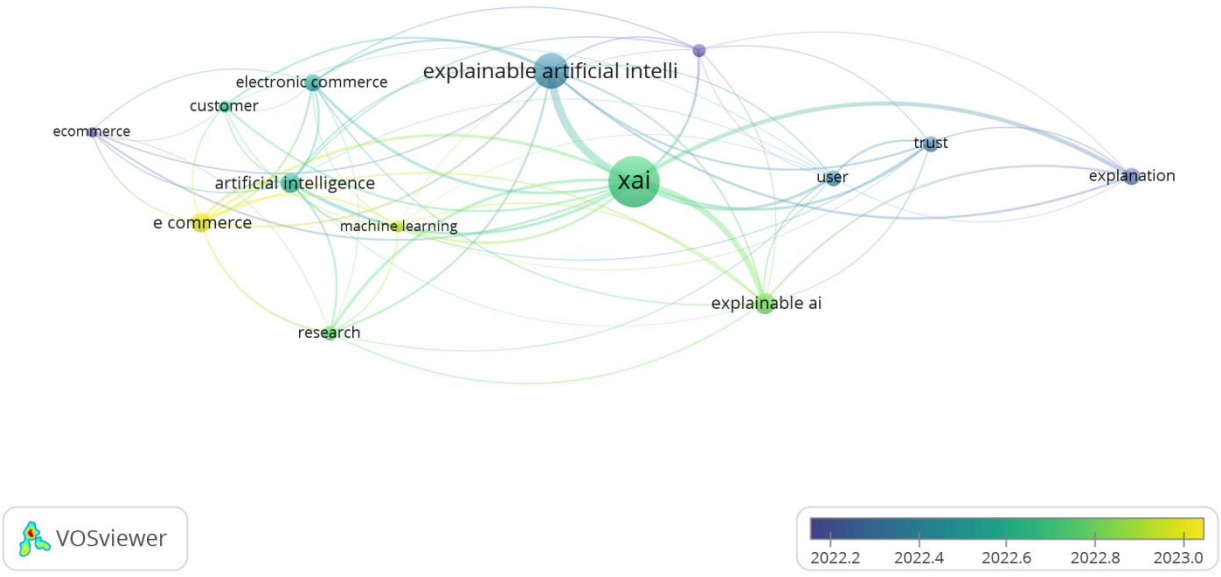
ii. The node size indicates the number of occurrences of a keyword across different studies. Thus, he bigger the node the more its number of occurrences across the collection of publications.

iii. The lines between the nodes (where they exist) show the relation between two-connected keywords that co-occurred in the publication collection. The thicker the line, the more the representation in terms the number of co-occurrences. Also, the line colors show the cluster each the nodes belong to.

With several clusters as shown in Figure 3, the visualization of keywords for XAI in electronic markets can be grouped into four major clusters. These clusters are each represented using a unique color.

Figure 3

Overlay visualization of keywords



4. DISCUSSION

In this study, a bibliometric analysis was conducted to examine academic contributions from publications and institutions related to Explainable Artificial Intelligence (XAI) in electronic markets,

utilizing performance analysis and scientific mapping techniques. The study also explored the keywords and topics frequently researched by authors and the future directions they recommended for further study. Additionally, a visualization was provided to illustrate the relationships between various keywords and their relative significance.

One key finding from this study is the publication trend from 2000 to 2024, presented as the Temporal Distribution. Although publications on XAI in other domains have existed for some time, it was only from 2023 that XAI began to be integrated into research on electronic markets. In 2023, there were four publications, including two book chapters, one conference paper, and one Master's degree thesis. The number of publications in 2024 doubled to eight, indicating a consistent and growing interest from researchers in XAI within electronic markets. This increase is partly attributed to scholarly contributions in the form of theses from students at universities in Amsterdam and the Netherlands, where broader experiments and results have been shared.

The second significant result of this study focuses on the top journals in the XAI and electronic markets domain. According to Table 3 in Section 4.2, out of the 12 publications that passed the screening for relevance, seven were published by Springer, while other journals such as IET Digital Publications, Sage, Taylor and Francis, Tilburg University, and Vrije Universiteit each published one article. This makes Springer the leading publisher, accounting for 58.33% of the total publications in the domain.

The third key result centers around the most cited studies among the 12 publications analyzed. Khan and Naim (2024) had the highest citation count with four citations. Meanwhile, Ansari et al. (2023) and Kasimu et al. (2023) each recorded two citations, and Thapliyal and Thapliyal (2024) had one citation. Despite being published earlier, Ansari et al. (2023) and Kasimu et al. (2023) have half the citations of Khan and Naim (2024), but they have double the citations of Thapliyal and Thapliyal (2024).

The study also explored the most commonly used keywords in existing research on XAI in electronic markets. As shown in Table 5, the top two keywords were "electronic commerce" and "explainable artificial intelligence." Other frequently used keywords included "trustworthiness," "purchasing," "customer engagement," and "customer satisfaction."

Based on the findings, XAI plays a critical role in African electronic markets, especially concerning transparency, which is key to gaining customer trust. This is particularly important in the African context, where customers, vendors, and regulators require a high level of assurance regarding digital transactions. Given the prevalent issues of fraud in cyberspace, some Nigerian customers view e-commerce platforms with skepticism. By incorporating XAI, these platforms can provide transparency in decision-making processes, such as recommendations, pricing, and search results, thereby making them more justifiable and understandable to customers (Samek et al., 2017). Moreover, XAI is valuable in detecting fraudulent activities, particularly in regions with limited access to banking services or digital literacy. By explaining suspicious actions, XAI enhances customer confidence in these platforms (Ogunleye et al., 2021).

Another area where XAI is making an impact in African electronic markets is in Customer Support Services (CSS). Due to the large population in Nigeria, CSS systems often face high volumes of inquiries with limited resources, making AI integration essential. In this context, XAI helps improve CSS services by facilitating clear and transparent interactions between customers and virtual assistants (Mochon et al., 2020), such as chatbots (Wang et al., 2023; Damar et al., 2024).

Future research directions identified in the study reveal several key themes for further exploration. One theme focuses on Textile Personalized Marketing. Kasimu et al. (2023) suggested the development of a standardized sentiment analysis API for e-commerce businesses. This API would be designed to explain, analyze, and interpret customer experiences through reviews and ratings, providing businesses

with insights into consumer perceptions. Additionally, they recommended promoting the adoption of Artificial Intelligence to guide innovative textile product development, tailored to both local and global markets based on customer preferences.

Another significant research theme is Retail Items Inventory, as discussed by Grilis (2024). One suggested direction involves finding a balance in terms of the number of features used in models to prevent overfitting. The goal is for these models to generalize patterns effectively from historical sales data. Another potential area of research involves exploring the effectiveness of Large Language Models (LLMs) in classifying products, specifically focusing on understanding the reasons behind low sales forecasts. This could provide valuable insights into inventory management and sales prediction strategies in retail.

5. CONCLUSION

In This study highlighted scholarly contributions to the field of XAI in electronic markets. Key findings from the study include the observation that publicly available research on this subject has only emerged in the past two years. As a result, the number of available publications is limited, with only 12 identified works, half of which are chapters from the book Role of Explainable Artificial Intelligence in E-Commerce. This limited number of publications presents a significant challenge for further exploration of the topic. Another challenge is the lack of published research focused specifically on the African region in the context of XAI in electronic markets and e-commerce, despite the continent's large population and growing e-commerce sector. Additionally, challenges arose such as the inability to access bibliometric data from the Web of Science (WoS) database and limited access to non-open access articles.

Despite these challenges, the findings underscore the enabling role of XAI in speeding up technology acceptance and building trust among customers in electronic markets. Based on these discoveries, suggested future research directions are presented in Table 5, which includes the following recommendations from the authors of the publications analyzed:

While the results of this study provide useful insights into publication trends, research gaps, popular concepts, and notable works in the field, it is encouraged that future studies expand by overcoming these limitations. In particular, focusing on specific topics such as predicting and explaining the relationship between user activities and price fluctuations across different platforms is suggested. This could be done using deep learning techniques, along with qualitative and quantitative methods such as meta-analysis and meta-synthesis, to provide a more in-depth and comprehensive understanding of the subject matter.**Conflict of Interest:** The authors declare no conflict of interest.

Ethical Approval: The study adheres to the ethical guidelines for conducting research.

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