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Decoding the Trends and Progress of Artificial Intelligence in E-Commerce Over the last Decade

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ABSTRACT

The purpose of this study is to presents a conceptual overview of artificial intelligence (AI) in E-commerce. This study utilized VOSviewer and R-bibliometrix to conduct data analysis and network visualization the scientific output of 811 research articles form Scopus, WoS and PubMed database from 2000 to 2024, including the number of publications, countries, journal, citations, authors, and keywords. The results of this research show that China and USA emerges as the country with the significant contributions to the development of research related to artificial intelligence in e-commerce, which is dominated by affiliations from Zhejiang University. In the analysis of the relationship between topics, two clusters were obtained, the most dominant topics with keyword "human" and "neural network". Neural networks are included in AI algorithms that has characteristics similar to the human brain and have the ability to operate more efficiently and profitably in e-commerce.

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1. INTRODUCTION

In recent years, e-commerce and artificial intelligence (AI) have all experienced significant growth and development in both industry and academia. The rise of e-commerce platforms has revolutionized the way that consumers shop and engage with businesses, creating new opportunities for entrepreneurs and transforming traditional industries such as retail [1]. AI has rapidly become a hot topic of discussion and has significantly disrupted various industries worldwide, including e-commerce. Technologies such as Machine Learning, Natural Language Processing (NLP), and Robotic Process Automation (RPA) are increasingly being implemented within e-commerce platforms to enhance business processes, and also customer engagement [2]. Such technologies benefit e-commerce organizations in managing the processes of sorting repetitive orders, stock management optimization and customizing strategies for clients, and also marketing campaigns. For instance, chatbots can effectively engage customers in conversations, whereas, recommendation systems can evaluate customer eyes and offeree ideal products in the market. Also, the processing of large amounts of information in real-time has benefits for embracing business decisions, addressing supply chains and estimating market trends. However, like all advancements, there are negative aspects as well when AI is applied to e-commerce, for instance, high initial investment costs, issue of privacy, and the need for expert personnel to manage and maintain AI systems [3].

Exploring the effects of AI in automating e-commerce is essential in understanding how businesses can harness the potential of AI technologies to meet the challenges of a rapidly evolving market [4]. AI is a technology that allows machines to replicate human intelligence and carry out activities such as decision making and solving problems. Electronic Commerce (e-commerce) is the process of selling, and also purchasing goods and services through the internet hence making shopping easier. It enables customers to buy products at their convenient time and place with the click of a button [5]. In addition, making use of advanced robotics and machine learning algorithms, AI streamlines daily processes, estimates consumer demand rates, and optimizes marketing

opportunities based on comprehensive customer information and predictive analysis. Accounting to real-time users and creating dynamic pricing to enhance competitiveness guarantee that firms receive optimum returns [6]. Besides, in addition, Machine Learning (ML) aids in the management of the inventory, so that perceived replenishment is made on time and products most in demand are in the store most of the time while controlling over-stock situations. Deep Learning (DL) and Machine Learning (ML) also underpin chatbots and virtual assistants that other e-commerce applications utilize. Often consumers can use these tools to ask questions, get support, and even make purchasing decisions on their own 24/7 due to the usage of artificial intelligence technologies [7]. It also benefits the company in delivering better customer relations while at the same time increasing organizational efficiency since self-checkouts do not require assistance from human staff. The application of Deep Learning and Machine Learning in e-commerce is changing the world.

The rapid shift of the digital era has caused significant changes in the business world and consumer behavior, opening up new opportunities and challenges. These changes impact various fields as well as artificial intelligence (AI), which provides businesses with great tools to improve operational efficiency and enhance consumer experience [8]. Conceptual models like the Technology Acceptance Model (TAM) and basic AI architecture diagram play a crucial role in bridging theoretical computer science, human-computer interaction (HCI), and applied artificial intelligence. TAM is widely used to assess how satisfied users are with new technologies and is a proven method for examining how AI is being adopted in e-commerce [9]. However, in order for AI to be more widely used, there are significant obstacles to its acceptance, especially when it comes to e-commerce. As artificial intelligence (AI) in e-commerce develops, it must continuously adjust to changing consumer expectations, and also trends in human-computer interactions (HCI), which is still a major challenge. Since AI is becoming more, and more integrated into everyday life, recent rapid advancements in the field have raised both excitement and concerns about the growing impact of human–AI interactions. As AI continues to evolve, its role in shaping various industries, especially e-commerce, becomes more pronounced [10].

The application of TAM is well established in analyzing the adoption of AI in e-commerce, and it is often used to assess user satisfaction with new technologies. Artificial intelligence, and automation systems, as we encounter in various fields today, can communicate with each other, understand each other and also identify needs through data analysis. This concept has begun to permeate all processes and systems of the company. Artificial intelligence technology is rapidly changing the structure of traditional markets and businesses. Many start-ups and e-commerce companies are competing to incorporate artificial intelligence technology into their investments. Despite the growing interest, integrating AI into businesses remains challenge [11]. Surveys by salesfloor.net/ in 2025 show that 85% of AI startups do not achieve their goals because there are many problems in implementing AI in running a business [12]. Artificial intelligence evolves alongside humans to enhance space efficiency, reduce errors, and improve other efficiencies. Business managers must ensure that they utilize the resources and capabilities they possess. One of the fields that uses artificial intelligence in its business is E-commerce [13].

E-commerce has a significant transformational impact on financial markets worldwide, which is extensive and profound, to changing the structure of conventional economies and the way businesses operate. A variety of online transactions are included in electronic commerce, or e-commerce, which is the buying and selling of goods and services via the internet [14]. This development has been driven by technological advancements, changing consumer behavior, and shifts in business models. E-commerce has provided customers with new opportunities and experiences. Besides being a platform used for buying and selling goods and services, it has gone further by incorporating music and video streaming features. E-commerce offers entertainment and convenience in shopping. The production, marketing, sales, insurance, distribution, and payment of goods and services through computer networks are the key components for the growth of e-commerce. This concept encompasses many aspects, such as customer service, payment systems, digital marketing and retail sales. 24-hour access, wide range of product choices, easy price comparisons, and access to global markets are some of the main advantages of e-commerce. Consumer behavior has changed dramatically due to the widespread adoption of e-commerce, which has also transformed business marketing strategies. The increasing amount of time users spend on online platforms has made data analytics and digital advertising increasingly important [6].

In order to tackle particular issues in recommender systems, recent studies have investigated AI approaches. According to Wang et al. (2022), one solution to the recommendation problem in cold start scenarios on e-commerce platforms is a recommender system built on deep neural networks [16]. A hierarchical recommendation system that takes into account online user opinions was introduced to improve e-commerce recommendations. Researchers have looked into ways to enhance e-commerce recommendation systems by combining various AI techniques. A customer-focused system that combines sentiment analysis with other methods is one example [17]. This entails employing AI to recognize, extract, and examine sentiments, viewpoints, and attitudes that are expressed in online text. An image recommendation system that is comparable to those used in e-commerce has been developed using an unsupervised machine learning technique. The research community is very interested in this topic. In online business settings, these systems are crucial for enhancing user experience, and also decision-making [18].

Awal & Chowdhury (2024) demonstrate how e-commerce recommender systems can be enhanced through collaborative machine learning [19]. The selection of features in recommender systems is impacted by artificial

intelligence. The significance of using conditional entropy to select features in automated e-commerce recommender systems. Smart search algorithms have increased e-commerce efficacy and efficiency. One such system that has shown value in optimizing complicated issues is the gravitational search algorithm [20]. The inclined plane system algorithm's effectiveness in solving problems involving multiple local optima was assessed. Intelligent optimization algorithms can be improved by integrating these advancements to make recommendations that are more precise and adaptable, which will boost e-commerce customer satisfaction and loyalty. There is still much to learn despite recent developments in AI and recommender systems in e-commerce [21]. In e-commerce, the application of AI has become important because it has changed the way businesses interact with customers and operate. Integrating artificial intelligence with e-commerce means using smart systems, tools, or algorithms to enhance, and also simplify online transactions in buying and selling goods or services, as well as personalizing the consumer experience through product recommendations and data analysis [22].

Previous research has demonstrated that the application of AI and machine learning to e-commerce marketing has enhanced operational effectiveness, improved customer relationship management, and produced more customer-focused advertising strategies [23]. Furthermore, by offering interactive and customized shopping experiences, technologies like visual search, virtual personal shoppers, and real-time product targeting have transformed the e-commerce scene. Large volumes of consumer data are analyzed by artificial intelligence and machine learning algorithms to find patterns, preferences, and trends. This allows e-commerce companies to optimize their product offerings and run focused marketing campaigns [24]. By employing cutting-edge technologies, businesses can increase customer satisfaction, optimize operations, and keep a competitive edge in the digital marketplace. Businesses can gain a competitive edge, boost sales, and improve customer engagement by incorporating machine learning, and also artificial intelligence into their e-commerce marketing strategies. A strong AI infrastructure, access to high-quality data, and continual monitoring and optimization are necessary for a successful deployment in order to maintain relevance in a changing marketplace [25].

Although there are many benefits to integrating AI across e-commerce domains, serious concerns about its potential to dehumanize people and compromise privacy are becoming more widely acknowledged [26], [27]. Labib (2024) claimed that data leaks, profiling, microtargeting, hacking, and also surveillance are examples of organizational privacy failures that should be the main focus of research. A disparity between firm interest in AI and its actual adoption was noted in prior studies [5], [28], [29]. Despite the significant expansion of AI research, there is still a significant gap in thoroughly examining the present and potential applications of AI techniques in e-commerce [30]. Even though AI is widely used in e-commerce, little research has been done on the topic. This disparity is troubling because it restricts knowledge and useful suggestions for businesses looking to use AI to boost e-commerce. Even though SLR and interpretive analysis have been used in the past to summarize AI and e-commerce research, these methods may not be objective and may be influenced by author bias. Furthermore, the need for a thorough and impartial examination of this important subject is highlighted by the inadequate use of the bibliometric method in conjunction with other methodologies in AI and e-commerce study. Therefore, using bibliometric analysis in conjunction with other methods, the current study tried to review and evaluate the body of literature already available on AI and e-commerce. Given the ever-evolving nature of this topic, the current study comprehensively outlined current trends, and also emerging research avenues.

2. RESEARCH METHOD

This study is the outcome of bibliometrics, and also Systematic Literature Review (SLR) combined efforts [31]. Numerous bibliometric studies are conducted after the bibliographic data is obtained using the contextualized SLR method. Key research gaps found in the systematic literature reviewed, and also recommended by the author are included in framework-based SLRs, which synthesize the body of knowledge already existing in the field. This method has been applied in numerous social science fields, including management, business, and entrepreneurship, according to scholarly literature. The guidelines for Scientific Procedures and Rationale for Systematic Reviews of the Literature (SPAR-4-SLR) were followed in conducting this review. This protocol was created especially for the social sciences, which is where entrepreneurial research is carried out, as opposed to other options like the Preferred Reporting Items for Systematic Reviews (PRISMA) [32]. More significantly, the best practice for systematic literature reviews is to follow a review protocol since it encourages openness and replication of review results [33].

We performed a systematic search through the Wos database during in 2025 according to PRISMA. PRISMA is a minimum database of items required for reporting in meta-analyses and systematic reviews. PRISMA is mostly used for reporting reviews that assess the results of interventions. It can also serve as a foundation for publishing systematic reviews whose goals are different from assessing therapies, like assessing the cause, prevalence, diagnosis or prognosis [18], [34]. PRISMA is a tool created to help writers report metaanalyses and systematic reviews more effectively. In general, the data quality of the Web of Science (WoS) is superior (standardized reference items, keywords plus availability, minimal missing data, etc.). However, Scopus is a better option if you need to look at journals or conference proceedings in the humanities, and also arts. Numerous academics [13], [22] assert that WoS remains one of the best databases, even though Scopus is another important one. The Web of Science was developed by Thomson Reuters as a web-based tool. For a few more reasons, the

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Web of Science Core Collection database was selected to collect data for this study. Across more than 250 scientific disciplines, the Web of Science Core Collection comprises more than 20,000 items. With more than a dozen peer-reviewed scientific journals, it is an important database. For bibliometric research, the most important data sources are the scientific citation indexes SCI, SSCI, and HCI, which include the Web of Science Core Collection database. Furthermore, the Web of Science Core Collection was utilized in a large number of highly cited bibliometric studies in the business domain that were indexed by SSCI and ESCI [14].

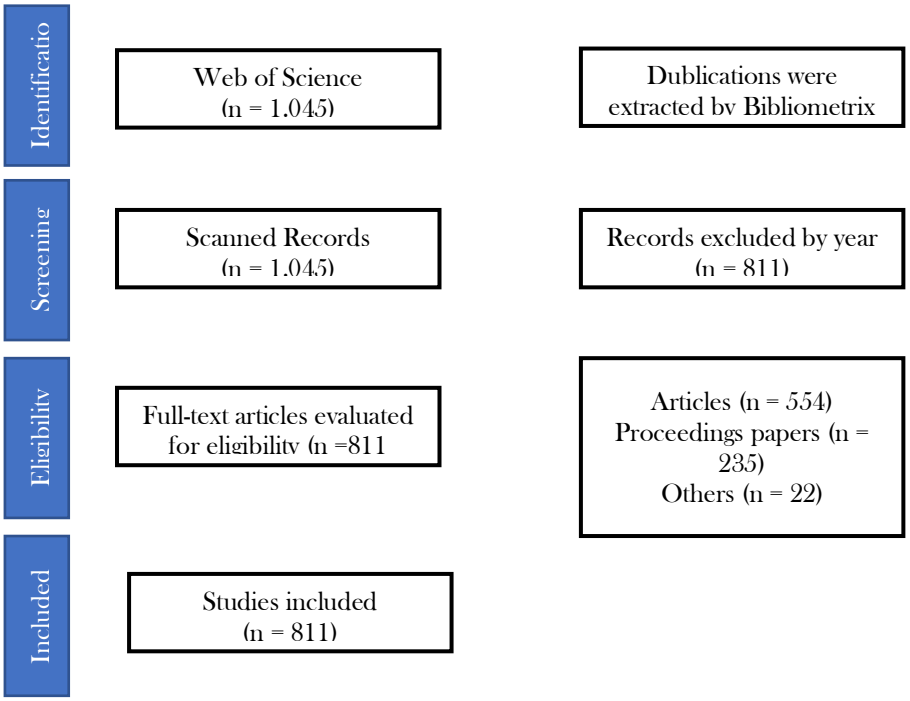


Figure 1. The flow chart of preferred reporting items for systematic review and meta-analysis (PRISMA)

Additionally, research contributions that serve as the cornerstones of studies on artificial intelligence in e-commerce were identified through the use of Reference Publication Year Spectroscopy (RPYS) and citation analysis. These methods were also employed to determine which changes in the research area were the most significant. The Louvain clustering algorithm was utilized to perform co-word network analysis on author-provided keywords in order to comprehend the conceptual structure of the research area. This algorithm compares the density of links within communities with links between communities in order to find communities in large networks using greedy optimization. This study employed it to analyze keywords supplied by the authors in order to identify important research themes.

Table 1. Main Information Data

Description	Results
Timespan	2000:2025
Sources (Journals, Books, etc)	260
Documents	811
Annual Growth Rate %	1,9
Document Average Age	4,84
Average citations per doc	0
References	0
Document Contents	
Keywords Plus (ID)	1587
Author's Keywords (DE)	1587
Authors	
Authors	2890
Authors of single-authored docs	102
Authors Collaboration	
Single-authored docs	109
Co-Authors per Doc	4,41
International co-authorships %	27

Table 1 shows that the development of scientific publication data related to Artificial Intelligence in E-commerce worldwide over the period from 2000 to 2024. The primary information found includes the duration of documents analyzed each year, the number of scientific publications by source, the average citations per year, and the authors. The data entered into the R-Bibliometrics software yielded results showing that the number of documents found on the Scopus, WoS, and also PubMed scientific article publication website was 811 documents with 260 sources from journals, books, and so on. The number of keywords in all articles is 1587 with 2890 authors, 102 authors of single-authored documents, 109 single-authored documents, resulting in an international co-authorship rate of 27%.

The three stages of a systematic literature review, namely gathering, organizing, and also evaluating academic literature based on the SPAR-4-SLR protocol.

2.1 Assembling

Scopus, WoS, and PubMed are used in this study to gauge the quality of the sources. Scopus is a major database in the scientific community that provides the same analytical tools as other popular databases like Web of Science (WoS), and PubMed [35]. In order to accommodate potential differences in these terms, an asterisk is placed next to search terms associated with AI-based technologies, and entrepreneurship, the search terms are entered in the titles, abstracts, and keywords that contain terms associated with "Artificial Intelligence*" OR "Algorithms*" OR "Neural Networks Computer*" OR "Machine Learning*" OR "Deep Learning*", "Commerce*", OR "Forecasting*" and OR "Consumer Behavior*". Our search was limited to articles in particular subject areas, like "Artificial Intelligence, AI Capacity, Business Strategy, IT Strategy, Business Value, Digital Transformation". After gathering the initial dataset, records not meeting the inclusion criteria, such as non-English articles, articles in press, and trade journal publications, were removed. A total of 1.045 records were screened, and 811 documents were excluded based on relevance. The timeframe from 2000 to 2024 was chosen to cover the foundational years of ecommerce and the latest AI advancements. The beginning of 2000 captures the early integration of AI in e-commerce, and also extending the analysis to December 2024 provides a comprehensive view of recent innovations, highlighting AI role in shaping industry trends and enhancing operational efficiency [36], [37].

2.2 Arranging

In Scopus, WoS, and PubMed, business study is covered by the umbrella disciplines of accounting, and management, or social sciences which are the only fields in which this study contains English-language papers and reviews. Three exclusion criteria were then used to filter the retrieved contributions: (i) have no direct connection to the study topic (i.e., contributions that do not discuss AI-based technologies or E-commerce); (ii) have no connection to the scope of this research (i.e., irrelevant reports that do not discuss AI-based technologies or E-commerce); and (iii) have no connection to the study focus (i.e., records that do not discuss the practice of E-commerce or AI-based technologies). The collected articles titles, abstracts, and keywords were examined independently by the authors, who then weeded out any that didn't fall into one of the three categories. The final dataset consists of 811 articles with pertinent and noteworthy contributions following a decision by the authors to remove 234 articles after this independent filtering process.

2.3 Assessing

Using VOS viewer, this study examines publication performance and trends, as well as the leading journals, articles, authors, nations, and academic institutions in the field. It also makes use of bibliometrix package for R to assist with science mapping through co-citation analysis, keyword co-occurrence analysis, and a network of collaboration between authors and nations. We divided our statistical analysis into two sections, based on the research on bibliometric analysis and network analysis by Xiaorong & Yan (2024), which are presented in sections 4 and 5, respectively. It should be noted that a range of software tools are used to perform bibliometric analysis of the corpus of existing literature. These includes: Gephi, Leximancer, VOSviewer, the Biblioshiny tool in R-Studio, CiteSpace and SciVal software, among others, have proved extremely useful in recent bibliometric research [38].

3. RESULT AND ANALYSIS

3.1 Annual Publication Trends

Trend analysis is used to see an overview of the data of articles published in Scopus. The trend of scientific journal publications is presented in the following graph.

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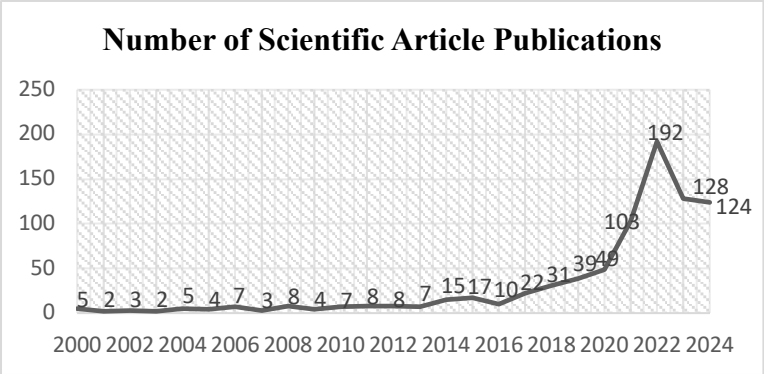


Figure 2. Yearly Trends in AI and E-commerce Publications

Figure 2 shows a significant increase in the number of publications over 25 years of scientific production. This likely indicates that more and more people are becoming aware of the importance of understanding and solving AI problems in E-commerce. It should be noted that from the year 2000 to 2013, the trend of publishing scientific articles experienced fluctuations and remained stable. During this period, the use of AI in the implementation of E-commerce. From 2004 to 2011, research entered a growth phase due to the rapid development of E-commerce platforms and the increasing demand for logistics system innovations. The following years continued to see gradual increases over the years until experiencing significant and peak growth in 2022. At this stage, there has been a moderate increase in publications. This indicates that interest in the application of AI and machine learning to e-commerce has grown, and it is likely that professionals and researchers are beginning to realize how this technology can impact marketing and E-commerce efforts. At this stage, there is a significant increase in publications. This indicates that interest and research have increased in the convergence of artificial intelligence, machine learning, digital marketing, and E-commerce [39]. The year 2023 to 2024 experienced a gradual decline but remained stable in Scopus publications.

3.2 Most Relevan Source

Journals are an important tool in disseminating knowledge and serve as a primary indicator of the quality of studies in a field. Scientific researchers can benefit from studies on the proper dissemination of literature, which can provide them with advice on how to quickly filter important information and choose the right platform to publish their research results. The authors who publish journals come from various sources, and by using graphs from different papers related to the research theme, the most relevant sources can be identified [40]. Here are sources from various countries.

Table 2. Top 10 Journals Productivity

Sources	Articles
Plos One	123
Computational Intelligence and Neuroscience	113
Sensors (Basel, Switzerland)	53
Scientific Reports	23
Environmental Science and Pollution Research International	20
International Journal of Environmental Research and Public Health	19
Nature	18
Neural Networks the official Journal of the International Neural Network Society	17
Heliyon	12

Based on table 2, a search using the keyword "Artificial Intelligence in E-Commerce" from Scopus, WoS and PubMed yielded 811 articles. The most relevant source for that keyword is from *Plos One,* with a total of 123 articles. Next, in second place among the most relevant sources is *Computational Intelligence and Neuroscience* with a total of 113 articles. The third source is from *Sensors (Basel, Switzerland)* with 53 articles. Likewise, with other article sources, each with their respective number of articles. The quantity of articles published in each journal can be used to identify literature sources. This can make it easier for subsequent researchers to find literature or source references when conducting research and data processing.

3.3 Leading Authors

The top writers in AI and e-commerce research are highlighted in table 3. Relevant authors are identified based on the highest number of article publications, as this indicates that these authors have made significant contributions and impacts in expanding the understanding of this topic.

Table 3. Top 10 Most Prolific Authors

Authors	Number of Publications	Articles Fractionalised
Wang J	20	4.90
Zhang Y	16	3.30
Dhiman G	15	2.81
Wang C	14	3.61
Li J	12	3.63
Wang S	12	2.68
Wang X	12	3.46
Wang Y	12	3.11
Elazab A	11	2.02
Zhang L	11	2.10

Based on the table 3, Wang J is the most prolific with 20 article, and significant contribution with a fractionalized article count of 4.90. The second place with 16 articles by Zhang Y, and the third place with 15 articles by Dhiman G [41]. Most authors are from China, indicating the country's significant role in this field. The top 10 authors have produced 10 or more publications, reflecting their substantial contribution to this research area.

3.4 Productivity of Scientific Articles by Country

Analysis of scientific article production by country is used to see the contribution of countries to the publication of articles on the topic of Artificial Intelligence.

Table 4. Leading Countries with High Productivity

Country	Number of Publication	Total Citations
China	1326	2143
USA	525	2876
India	238	714
Germany	107	676
UK	97	468
Australia	88	108
Spain	87	181
Japan	87	29
Italy	82	136
Indonesia	71	24

Based on the table 4, an analysis of AI implementation in E-commerce across 82 countries identifies the top 10 performance. China leads with 1.326 published articles, followed by USA with 525 and the India with 238 published articles. However, the USA ranks first in total citations with 2.876, followed by China with 2.143. Germany, UK, Australia and Spain also significantly contribute in this field. Interestingly, while most research originates from development nations, China and India are at the forefront of AI integration in E-commerce. According Lundvall & Rikap (2022) China has become a world leader in artificial intelligence, demonstrating the evolution of national and corporate innovation systems. In addition, they also briefly state that AI is very important for China because the ongoing process of catching up in China is evidence of the increasing strength of AI [42].

3.5 Leading Institutions and Countries

During the development of scientific publications worldwide, the role of active institutions that have contributed is necessary. Researchers conducted an analysis using the PubMed database with the top 10 most active institutions in the development of scientific publications related to Artificial Intelligence and E-Commerce worldwide.

Table 5. Leading Institutions in the Domain of AI and E-commerce

Affiliation	Articles	Countries
Zhejiang University	67	China
University of California	57	USA
Tianjin University of Commerce	56	China
Shenzhen University	42	China
Jiangnan University	30	China
Tianjin University	25	China
Waseda University	24	Japan
Stanford University	23	USA
Imperial College London	22	UK
University of Castilla-La Mancha	21	Spain

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Table 5 highlights the leading institutions in AI and e-commerce research. Zhejiang university and University of California lead with 67 and 57 articles, respectively. Notable contributions also come from Tianjin University of Commerce, Shenzhen University, Jiangnan University, and Waseda University, all making substantial impacts in this field. A notable concentration of these studies hails from developed nations, with China standing out prominently. Five of the top ten institutions are from China, highlighting the country's dominance in AI and e-commerce research.

3.6 Keyword Analysis

According to Akay et al. (2022), the thematic map analysis of keywords discovered by "biblioshiny" software algorithm is presented in this subsection along with the cluster networks to which the keywords belong [43]. Topic trends are used to analyze topic trends from year to year. This topic trend's objective is to evaluate the trends and content of a group of articles by counting the number of keywords that emerge from the research and gauging the strength of the terms [44]. This data is presented from the year 2000 to 2024 from various items and frequencies.

Table 6. Top 10 Most Frequent Words

Word	Total Occurrences
Humans	51
Commerce	43
Algorithms	37
Neural Networks Computer	36
Artificial Intelligence	27
Machine Learning	19
Deep Learning	15
Forecasting	10
China	9
Consumer Behavior	9

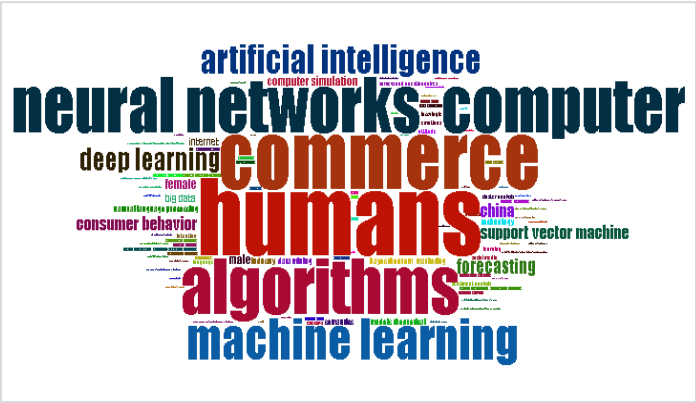


Figure 3. WordCloud

Table 6 and figure 3 showcases the top 10 keywords based on their frequency and also total link strength, selected from 97 keywords found. Only keywords with at least 5 occurrences were included in the analysis. The leading keywords are "Humans" (51 occurrences), "Commerce" (43 occurrences), "Algorithm" (37 occurrences), "Neural Network Computer" (36 occurrences), and also "Artificial Intelligence" (27 occurrences). These keywords are crucial in shaping the research landscape in this field. Among the keywords, "e-commerce" and "artificial intelligence" have the highest link strengths, respectively, indicating their strong associations with other terms in the literature. Other top keywords include "Machine Learning", "Deep Learning", "Forecasting", "China", and "Consumer Behavior", reflecting the diverse topics and techniques explored in e-commerce and AI research. This analysis underscores the prominence and interconnectedness of these keywords, offering valuable insights into key focus areas and trends in the field.

3.7 Co-occurrence Network

Co-occurrence network explains the network or relationship between terms. The author analyzes digital data on the topic of applying artificial intelligence in e-commerce into a conceptual structure that will be visualized by a co-occurrence network. Author keywords are used in the network visualization to highlight recent developments in AI and e-commerce research. Each bubble represents a keyword, with color denoting the average publication year (darker colors for older, warmer for newer) and size indicating keyword frequency.

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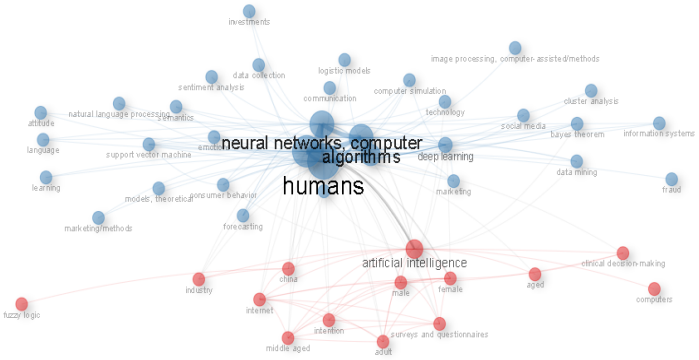


Figure 4. Co-Word Network Bibliometrics

Table 7. Cluster of Keyword

Cluster	Color	Keyword
1	Red	Artificial Intelligence, China, Female, Male, Internet, Industry, Fuzzy Logic, Intention, Survey and Questionnaire, Adult, Cinical Decision Making, Computers, Middle Aged
2	Blue	Algorithm, Humans, Commerce, Neural Networks, Computer, Machine Learning, Deep Learning, Consumer Behavior, Forecasting, Support Vector Machine, Computer Simulation, Big Data, Bayes Theorem, Data Mining, Models Theoretical, Natural Language Processing, Semantics, Technology, Attitude, Cluster Analysis, Emotion, Language, Learning, Sentimen Analysis, Social Media, Communication, Data Collection, Fraud, Image Processing, Computer-Assisted/Methods, Information Systems, Investments, Logistic Models, Marketing/ Method

Table 7 shows the visualization of the bibliometric analysis network using Biblioshiny. Based on the table, the number of clusters formed is 6 clusters. The first cluster is marked in red with the keywords Artificial Intelligence, China, Female, Male, Internet, Industry, Fuzzy Logic, Intention, Survey and Questionnaire, Adult, Clinical Decision Making, Computers, Middle Aged. The keywords in the first cluster are interconnected with each other. For example, Natural Language Processing. The use of AI in e-commerce can be researched in various ways, such as through survey techniques and by asking questions to respondents. In addition, the application of AI in the economic field is not without the role of users. For instance, in order to achieve statistical parity, users chosen by AI would need to receive digital coupons in order to establish an equal distribution between male and female users in e-commerce. So that both male and female users receive equal treatment [45]. Currently, the country with the highest number of scientific articles related to artificial intelligence is China. This indicates that China is capable of advancing through AI-based technological progress, especially in the field of trade.

In the cluster 2 marked in blue. The keywords in the second cluster are Algorithm, Humans, Commerce, Neural Networks, Computer, Machine Learning, Deep Learning, Consumer Behavior, Forecasting, Support Vector Machine, Computer Simulation, Big Data, Bayes Theorem, Data Mining, Models Theoretical, Natural Language Processing, Semantics, Technology, Attitude, Cluster Analysis, Emotion, Language, Learning, Sentiment Analysis, Social Media, Communication, Data Collection, Fraud, Image Processing, Computer-Assisted/Methods, Information Systems, Investments, Logistic Models, Marketing/Method. There is a correlation between several items in the cluster, namely in research related to the exponentially increasing amount of data becoming more valuable for the organizations that collect it, such as various sources, e-commerce including shipping data, text messages, financial transactions, the Internet of Things, and other sources. In such conditions, deep learning can analyze big data to extract insights and data environments [46]. Because it performs functions similar to the human brain, artificial intelligence is a relatively new technology that helps address economic problems. Artificial intelligence (AI) can be made more efficient and profitable in e-commerce and how entrepreneurs can leverage it to achieve business goals such as online marketing. For example, the use of the Technology Acceptance Model (TAM) method as a theoretical framework and exploring how artificial intelligence (AI) has become important for e-commerce technology [47].

In addition, Natural Language Processing (NLP) techniques are well-known methods for evaluating and extracting information using algorithms from written or spoken text. Over the past ten years, with the development of the internet and e-commerce websites, consumers now have a vast array of product choices within the same industry. Natural Language Processing (NLP) plays an important role in classifying products based on evaluations [48]. Additionally, the relationship between other keywords can be seen in the keyword Support Vector Machine (SVM) with Neural Network in the use of AI. According Li (2022) the data layer combines data collected from the original data layer, integrates and analyzes it, and performs preprocessing. Specifically, AI text classification (AI)

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falls under supervised learning and requires training, such as Bayesian algorithms, support vector machines (SVM), and neural network algorithms (NNA) used to identify occurrences of fraud and minimize financial risks in e-commerce.

3.8 Future Research Frontiers in AI for E-commerce Sector

The application of the theory, context, characteristics, and methodology (TCCM) framework is essential for comprehensively exploring the multifaceted impact of AI in e-commerce, especially as this field continuously evolves with new technologies and consumer demands. By structuring the study around the TCCM elements, this approach allows for an organized analysis of AI's role in transforming online commerce, enhancing both academic insight and practical implications for industry stakeholders [7]. Rapid advancements in AI and e-commerce are providing creative approaches to improve the customers experience, personalize interactions, and drive business growth. However, this rapid growth also brings challenges that require critical examination, particularly concerning consumer trust, ethical considerations, and sustainable engagement. This objective seeks to explore future research prospects in AI-driven e-commerce through the TCCM framework, which provides a comprehensive structure to address existing research gaps and propose novel insights.

Each dimension within the TCCM framework serves a distinct purpose: Theory encompasses foundational and emerging theories like cognitive load theory, ethical AI theory, and expansions of the technology acceptance model, which can help us better understand how customers behave and how satisfied they are with AI applications. The Context element highlights the diverse influences of cultural, sectoral, and post-pandemic factors on AI adoption, helping to identify how AI might be adapted to varying consumer expectations across regions and industries.

Characteristics focus on specific AI-driven features, such as personalization, transparency, and ethical considerations, which directly impact consumer perception, and also experience. Finally, methodology underscores the need for diverse research methods, such as mixed-method approaches, longitudinal studies, and experimental designs, to gain nuanced insights and test AI applications efficacy over time and across demographics. In essence, the TCCM framework enables this study to provide a well-rounded understanding of AI's transformative potential in e-commerce. By identifying theoretical insights, contextual applications, unique AI characteristics and methodological approaches, this study establishes a strategic foundation for advancing research and practice in AI-driven e-commerce. This comprehensive perspective ensures that future developments in AI can be both consumer-centric and ethically aligned, fostering trust and innovation within the digital marketplace.

4. CONCLUSION

The number of publications in AI and e-commerce research has consistently increased in recent years, according to the annual publication trend, which reflects the growing interest and understanding of AI's importance in the e-commerce industry. This growing volume of research underscores the fields evolving nature and the persistent drive to explore and innovate. Active contributors in this domain, including authors, institutions, and countries, are identified by analyzing publication records, citation counts, and author affiliations. Wang J from China stands out as a prolific author, underscoring China prominence in AI research. The countries, and institutions with the most publications and citations also stand out as important contributors, demonstrating their key role in the field's advancement. China is a country that has made significant contributions to development of articles related to AI in e-commerce, which are dominated by affiliates from Zhejiang University.

Examining the connection between AI and e-commerce can help one better understand the consequences and effects of AI adoption in the e-commerce industry. The amount and breadth of academic research on e-commerce, as well as the leading authors, organizations, and publications in this field, can all be found through bibliometric analysis. Additionally, researchers can find new trends, unmet research needs, and chances for innovation and expansion in the e-commerce space by integrating bibliometric analysis with other research techniques like surveys and case studies. In addition to offering insights for legislators and regulators to support the expansion of the e-commerce industry, this can help shape the creation of new business models and strategies. Studies that assess e-commerce collectively can make a substantial contribution to the body of literature. By looking at how these two domains interact, researchers can find new avenues for innovation and expansion in the e-commerce industry while also illuminating the risks and difficulties of e-commerce adoption.

This study, like many prior investigations, has inherent limitations. The literature review set specific criteria for selecting academic sources, thereby narrowing the findings to articles that align with these specifications and restricting the study broader relevance within the AI and ecommerce field. Certain pertinent keywords, such as Cross-Border Electronic Commerce (CBEC), were omitted from the initial selection criteria, potentially narrowing the study scope and excluding research that could provide a comprehensive understanding of AI applications. This dependence on a single database may limit data inclusiveness, as studies indexed solely in other repositories were not incorporated. The study emphasis on English-language publications may also have led to the exclusion of valuable research in other languages. Furthermore, the research highlights general themes of AI applications across e-commerce without a platform-specific focus (e.g., B2B or B2C), which could offer more targeted insights. Addressing these limitations could enhance the breadth and depth of understanding regarding AI's role in e-commerce.

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