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Contact / İletişim

Address/Adres: Isparta Uygulamalı Bilimler Üniversitesi, Turizm Fakültesi, Eğirdir, Isparta - Türkiye

Tel: +90 (246) 2147100
E-mail: ijsser.contact@gmail.com
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Research article/Araştırma makalesi

The impact of AI-supported marketing capabilities and analytics on SMEs' customer agility and marketing performance

Fatma Demirağ

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The impact of AI-supported marketing capabilities and analytics on SMEs' customer agility and marketing performance

Fatma Demirağ[1]

[1] *Corresponding author, Kütahya Dumlupınar University, Electronic Commerce and Management, Kütahya, Türkiye, Email: fatma.demirag@dpu.edu.tr, ORCID: https://orcid.org/0000-0001-7520-6706*

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Abstract

This research examines the impact of marketing analytics and artificial intelligence applications on customer agility and marketing performance in businesses that adopt e-commerce. In this quantitative study, data were collected through a questionnaire. Data collected from 227 managers online were analyzed using the Smart PLS method. The study concluded that marketing analytics and AI-supported marketing capabilities affect customer agility and marketing performance. It is also concluded that customer agility has an impact on marketing performance. In addition, the results show that customer agility is a mediator of the effects of AI-supported marketing capabilities and analytics on marketing performance. It offers concrete suggestions for businesses, facilitating decision-making processes, and demonstrates how digital marketing strategies can be employed more effectively. The study also makes an academic contribution by analyzing the relationship between digital transformation and marketing capabilities, thus guiding future research.

1. Introduction

Businesses focus on data to optimize performance and make informed decisions. Because data is driving the economy by providing meaningful insights into today's business world (Hossain et al., 2022: 239), businesses are increasingly turning to big data to gain a deeper understanding of their customers, competitors, and markets to achieve success (Lin & Eng, 2024: 418). SMEs, which are small and medium-sized enterprises, are businesses that need to grow further and gradually expand their activities in the markets. The success of SMEs depends on effective coordination and communication that can be improved through advanced solutions such as CRM systems, data analytics, and digital platforms (Baabdullah et al., 2021: 254).

SMEs often use various technologies to analyze marketing data and gain market insights. For practitioners, digital technologies can be used to make informed decisions about the most efficient use of marketing resources, identify and retain customers who are likely to be profitable and coordinate demand and supply (Rizvanovi´c et al., 2023: 2). Factors such as the development of AI-powered marketing capabilities and the collection, maintenance, analysis and application of data through marketing analytics, an innovative culture, are methods used in the contemporary digital environment (Agag et al., 2024: 2). Marketing analytics and AI-supported capabilities development is a vital tool for SMEs seeking to reach new heights (Hossain et al., 2022:239). These factors affect the efficiency of SMEs' marketing strategies and e-commerce adoption.

E-commerce refers to a firm's ability to interact with its customers and business partners and conduct business over the Internet (Madanchian, 2024: 2). It allows firms to share information, increase effective communication, strengthen supply chain integration, and accelerate decision-making, thus increasing agility and gaining competitive advantage (Lin et al., 2020:1267). E-commerce organization SMEs are considered as capability. The conceptual framework is based on a resource-based view (RBV) and dynamic capability (DC) theory. Utilizing VRIO (valuable, rare, inimitable, and organized) resource theories. Dynamic capability theory provides an appropriate framework to analyze the impact of e-commerce capabilities on agility and performance gains. The theoretical

** The study received approval from the Kütahya Dumlupınar University's Social and Human Sciences Scientific Research and Publication Ethics Committee under protocol* number 290130, dated *27.05.2024. It adhered to the guidelines outlined in the Declaration of Helsinki for human subjects research. All responsibility belongs to the author.*

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framework of dynamic capabilities theory provides a foundation for our study, which aims to identify strategies organizations can use to develop dynamic capabilities and improve their performance through marketing initiatives (Lin et al., 2020 :1267). The Resource-Based View (RBV) is widely used to understand a firm's operational, supply chain, and marketing analytics capabilities and their impact on performance.

Dynamic capability (DC) theory. Dynamic capability (DC) theory, although introduced mainly in strategic management, also plays a vital role in different business contexts such as marketing, operations, innovation and international business. Dynamic capabilities aim to increase a firm's agility and gain competitive advantage, and it does so by focusing on the most significant change in the existing resource base (Hossain et al., 2022:239; Akter et al., 2022:1473). The theory shows the ability and skills of businesses to respond and adapt to constantly changing environments and processes due to macro and micro environmental conditions (Agag et al., 2024:4). It shows how the capabilities and skills of businesses adapt to the changing and evolving environment through dynamic capabilities (Hossain et al., 2022: 239; Wahab & Radmehr, 2024: 3). Dynamic capabilities also promote transformation through a proactive approach that differentiates and determines a firm's decision-making process from regular operational-level decisions (Ali et al., 2024: 27). This allows the firm to quickly and effectively adapt to changing conditions and gain a competitive advantage (Hossain et al., 2022: 239).

Resource-based view (RBV) The resource-based view (RBV) is considered a theory often used to analyze the performance of a business. Achieving a sustainable competitive advantage depends on the uniqueness of the firm's products, services, and brand equity. The combination of tradable and non-specific firm assets and resources requires the development of capabilities. Businesses achieve superior performance by acquiring and utilizing valuable, rare, inimitable, and irreplaceable resources. The resource-based view (RBV) explains how a company can use its resources best to achieve a sustainable competitive advantage (Khan et al., 2022: 3).

RBV is the heterogeneity of resources that enables a business to differentiate itself over time and offer distinctive products or services through practical use. Companies may face many uncertainties in gaining and sustaining competitive advantage in a highly competitive business environment. To achieve long-term competitive advantage, companies may need to create new resources and capabilities to differentiate themselves from their competitors (Weng et al., 2024: 3). Businesses' marketing analytics capability can also be important in achieving sustainable competitive advantage. Businesses can expand and differentiate themselves by using transferable internal capabilities such as marketing analytics. In this process, they can increase the chances of sustaining competitive advantage by flexibly adapting their decision-making processes and seizing new opportunities (Hossain et al., 2022:239).

Utilizing VRIO (valuable, rare, inimitable, and organized) resources differs from RBV in that valuable, rare, inimitable, and irreplaceable firm-specific resources focus on the processes by which firms integrate, build, and reconfigure internal and external capabilities to solve rapidly changing problems. Using valuable, rare, inimitable, and organized resources enables a firm to offer its buyers a unique product or service and thus gain a competitive advantage. Versatile resources are significant because they limit opportunities for the appropriate use of valuable, rare, inimitable, and organized resources (Wamba, 2022:3).

The theories discussed explain how firms can use their resources and capabilities more effectively to succeed in competitive environments. In particular, it emphasizes how analytical capability is essential based on firms' access to big data and artificial intelligence. In today's dynamic digital environment, analytical and technological capabilities such as big data and artificial intelligence and related capabilities such as marketing analytics are essential. It is stated that it is difficult for companies that do not have these capabilities to approach the market effectively. Especially in the digital market, data and AI capabilities provide unexplored opportunities by offering valuable decision-making insights. This can help firms gain a competitive advantage (Hossain et al., 2022:239; Zahoor & Lew, 2022: 1262).

This study assumes that marketing analytics capability is a firm's dynamic capability that can be further strengthened by adopting artificial intelligence and that it is a valuable, rare, inimitable, and organized resource. It enables businesses to identify, leverage, and adapt their processes to gain competitive advantage. When the studies in the literature are examined, Uğurlu et al., (2019) strategic agility, firm performance, Lin et al., 2020 e-commerce capabilities, business agility and performance, Hadjielias et al., (2022) customer value of digitalization, Tseng et al., (2022) data analysis tools agility and new product success, Chen et al., (2022) firm performance of digital technologies, Hossain et al., (2022) Marketing analytics and artificial intelligence adaptation to sustainable competitive advantage, Khan, et al, (2022) business analytics capabilities, firm agility and firm performance, Wamba (2022) artificial intelligence simulations on customer agility, performance, Çetinbaş (2023) knowledge

sharing, performance, agility, Zahoor and Lew (2023) adaptation to digital capabilities, international marketing capabilities, export performance, Liv et al, (2023) performance of artificial intelligence, Cetinbas (2023) agility in the impact of knowledge sharing on performance, Agag et al. (2024) marketing analytics, customer agility and customer satisfaction, Weng et al, (2024) IT capabilities on innovation and firm performance, Salah and Ayyash (2024) e-commerce adoption by SMEs and marketing performance, Zhan et al., (2024) IT marketing capabilities on Shareholder Reaction, Peretz-Andersson et al, (2024) AI application in manufacturing SMEs, Lin and Eng (2024) marketing analytics on business performance and new product innovation, Baabdullah et al. (2024) AI application in SMEs on performance, Wahab and Radmehr (2024) AI simulations on customer agility and business performance, Masialeti et al, (2024) agility and performance in business processes, Shukla et al., (2024) IT capabilities of enterprises, business capacity and operational performance and innovation, Özdemir et al., (2024) Customer analytics and new product performance, Arslan et al., (2024) marketing agility in entrepreneurship, Alghamdi and Agag (2024) marketing agility in competitive advantage.

In addition, Lin et al. (2020) state that new organizational capabilities should be examined by adding new organizational capabilities to businesses adopting e-commerce, Hossain et al. (2022) state that future studies should also define marketing analytics capability and artificial intelligence performance measures in different B2B sector contexts. Çalıl and Çallı (2021) the effects of digital maturity, Khan, et al., (2022) the study should be replicated in different countries Weng et al., (2024) the study should be applied to SMEs in different sectors such as service sector businesses, finance or professional services that use different technologies to develop and expand, Salah et al. (2024) how it can change or influence the link between other factors in the adoption of e-commerce, Zhan et al. (2024) the need to examine different variables that can affect performance, Zahoor and Lew (2023) the need to explore other concepts related to the study that can be effective, Chen et al, (2022) the necessity of studies on the impact on firm performance, Lin and Eng (2024); Masialeti et al. (2024) the need for more comprehensive studies on marketing analytics on marketing performance, Baabdullah et al, (2024) there is a need for studies in different areas of the application of artificial intelligence in SMEs towards performance, Wamba (2022) better understanding of the real impact of performance and its application in developed and less developed countries, Wahab and Radmehr (2024); Agag et al, (2024) Due to cultural and technological differences between countries, the study should be applied to different countries and developing economies, Shukla et al. (2024) suggest that other digital criteria should be adopted and primary data should be collected in different cultures, Arslan et al. (2024) indicate that the relationship between marketing agility performance in entrepreneurship should be examined.

Bawack et al. (2022), Fonseka et al. (2022), Kumar et al. (2023), Zhong (2023), and Barata at al. (2024) stated that there is a dearth of research on the adoption of AI in e-commerce for SMEs. They stated that more data on e-commerce and digitalization should be collected and analyzed to meet the needs and provide support to SMEs. Aljarboa (2024) noted that the limited understanding of how SMEs can use AI tools in e-commerce significantly affects their development and ability to gain a competitive advantage. He stated that more in-depth studies are needed to address the challenges, evaluate the opportunities, and provide recommendations through AI tools. Hokmabadi et al. (2024) highlight the lack of research on the role of digital transformation, especially for SMEs. Therefore, there appears to be a theoretical and practical gap in how analytical capability can be accelerated using AI to sense, capture, and reconfigure the market, especially for SMEs. Based on the research gaps, the research aims to determine the impact of AI-supported marketing capabilities and analytics on customer agility and the marketing performance of SMEs adopting e-commerce.

This research will contribute extensively to both theory and practice. The research contributes to the relationships between marketing analytics capabilities and AI. In addition to the work done in the literature, this study will show the impact of AI adoption. Furthermore, the study reveals ways the business can move toward e-commerce. In practice, managers of firms will learn from the research findings the key mechanisms of marketing analytics capability and AI adoption. They will be able to see the impact of marketing analytics strategies and AI on marketing performance to predict AI and sustainable competitive advantage.

To address these complex dynamics, this study aims to answer the following research questions:

- How AI-powered marketing capabilities impact customer agility in e-commerce adopters

- How does marketing analytics impact customer agility in e-commerce adopters?

- How does customer agility affect marketing performance in e-commerce adopters?

- Is there a mediating effect of customer analytics on the impact of AI-supported marketing capabilities and marketing analytics on marketing performance in e-commerce adopters?

2. Literature review

AI-Supported Marketing Capabilities: Businesses need marketing capabilities to increase their performance. Companies with strong marketing capabilities are better equipped to direct their marketing activities flexibly and effectively to adapt to evolving market needs. A firm with strong marketing capabilities can effectively utilize digital applications and transform its resources and insights into products with the most appropriate resources (Shukla et al., 2024: 125). AI technologies facilitate controlled and dynamic learning, enabling firms to adapt and thrive in competitive business environments (Drydakis, 2022: 1225). The adoption of AI can help businesses mitigate challenges and improve overall firm performance (Dwivedi et al., 2023: 2). AI capabilities are defined as the ability of a business to accurately interpret external data and achieve specific goals and tasks through learning and flexible adaptation (Baabdullah et al., 2021: 256).

It can strengthen marketing capabilities by facilitating the use of other resources through artificial intelligence operations. It is stated that AI can enable, facilitate or enhance high-level capabilities by combining with marketing capabilities (Manis and Madhavaram, 2023: 7). Businesses are investing in developing various capabilities, including artificial intelligence, to optimize their operations and maximize return on investment. By investing in AI and developing robust IT capabilities, firms can improve their performance, gain competitive advantage and achieve operational excellence (Peretz-Andersson et al., 2024: 11). The integration of AI into business strategies is not only a trend but also a necessity for firms aiming to succeed in a modern, data-rich business environment (Hossain et al., 2022:239).

These capabilities are critical enablers of firm agility by facilitating rapid response to changes in highly competitive environments. They play an essential role in developing the competence required for organizational agility, which is the ability to perceive and seize operational opportunities and respond to urgent internal and external changes (Wamba, 2022:4). The role of AI in e-commerce marketing capabilities is diverse. First, it plays a key role in processing data accurately and efficiently. Second, it increases website satisfaction by helping customers meet their needs and preferences. Third, it supports various aspects of e-commerce, including product marketing, payments, and shipping. Finally, it benefits the marketplace, customer behavior, and business performance by enabling seamless and effortless transactions. Therefore, the e-commerce space can benefit from AI in many ways. These include increased sales, sales forecasting, enhanced security, fraud prevention, business management, and essential services. As a result, it helps SMEs improve their capabilities and achieve optimum value and competitive advantage (Aljarboa, 2024:3).

Marketing Analytics requires new methodologies and applications to analyze large and complex datasets that are difficult to process with traditional techniques (Khan et al., 2022: 6). Within business analytics, marketing analytics enables businesses to collect, manage, and analyze the data necessary to make effective marketing decisions. This process supports gaining competitive advantage by using the information obtained from customer and market data (Agag et al., 2024: 3). Marketing analytics enables businesses to make data-driven decisions by using model-supported methods to improve marketing decision-making (Ashrafi et al., 2019:2). This technology helps companies to improve decision-making processes and increase business performance by organizing and managing marketing-oriented data from a data-rich environment. Marketing analytics provides businesses with enhanced visibility and decision-making capabilities by developing appropriate metrics and analytical methods (Akter et al., 2019: 86; Hossain et al., 2022:239).

Marketing analytics provides information about market changes and insights into market data. It emphasizes that businesses should strengthen data-driven decision-making processes (Khan et al., 2022: 6). These skills can be gained through various means or tacit knowledge from real-life experiences. Marketing models and statistical applications are essential in developing marketing analytics skills. By determining a data-driven approach, businesses can gain a competitive advantage by interpreting the data obtained through marketing analytics and making the right decisions (Lin & Eng, 2024: 421).

Customer agility: The ability of a system to meet customer needs quickly, efficiently, and consistently is a critical factor in maintaining competitive advantage (Agag et al., 2024: 3). Agility is the organization's ability to handle and respond to unexpected changes quickly and efficiently (Uğurlu et al., 2019: 94; Bozkurt, 2022: 102). The concept was first addressed as processes adopted in production in the 1990s (Dinç & Kazan, 2023: 765). Customer agility is defined as the ability to recognize the ever-changing demands of customers, respond to them quickly and effectively, and meet these demands effectively (Ashrafi et al., 2019:3). It is also defined as an organization's ability to perceive and respond quickly to customer-oriented opportunities (Khan et al., 2022: 5). Customer agility also allows organizations to gain valuable market insights and analyze competitive opportunities. By

leveraging customer feedback, businesses can better understand customer needs and tailor their products and services accordingly. This makes businesses' survival and growth easier (Wahab & Radmehr, 2024: 4).

Hokmabadi et al. (2024) express the trending topics of recent times as the acceptance of agility as the basic strategic response to market uncertainties. This capability supports businesses' innovation and competitive actions because companies need to quickly understand customer expectations and adapt to changing market conditions (Khan, 2020:2). Customer agility stands out as the ability of companies to quickly identify customer preferences and behaviors by analyzing customer interactions and make quick decisions based on this information (Akter et al., 2022: 87-88). Organizations can increase customer experience, ensure customer satisfaction, and gain a competitive advantage (Wamba 2022: 4).

Marketing Performance: Marketing performance is critical due to its scope. It is seen as the driving force of today's businesses' productivity, returns, future sales, and thus profit growth. Marketing performance and its determinants, which are also seen as an essential criterion in the general evaluation of business performance, are critical (Clark, 1999: 712). Marketing performance is the marketing activity that affects variables such as revenue growth, profitability, customer loyalty, interaction, and communication. Examining the variables that affect these concepts is essential for businesses (Schramm-Klein & Morschett, 2006: 280).

3. Conceptual framework and hypotheses development

3.1. AI-supported marketing capabilities and marketing analytics on customer agility

Customer agility is crucial for firms aiming to increase competitiveness and drive innovation. By leveraging customer insights and maintaining a flexible and responsive approach to market opportunities, firms can achieve sustained success and resilience in a dynamic business environment. Organizations increasingly rely on information technologies to perceive and respond effectively to customer opportunities and threats (Giacosa et al., 2022:2). To effectively implement customer agility, companies must invest in technology. They must leverage advanced analytics, big data, and artificial intelligence to collect and analyze customer data in real time (Wamba, 2022: 5).

When the studies in the literature on artificial intelligence, marketing analytics, and customer agility are examined, some researchers highlight the following: the relationship between the use of artificial intelligence in marketing and consumer acceptance (Kamran, 2021), the effect of marketing analytics and artificial intelligence adaptation on sus-tainable competitive advantage (Hossain et al., 2022), the impact of digital technologies on firm performance (Chen et al., 2022), the effect of artificial intelligence on performance (Liv et al., 2023), the impact of market analytics on knowledge and innovation (Cadden et al., 2023), the business value of marketing analytics success (Akter et al., 2023), the impact of marketing analytics on new product development (Cheng & Shiu, 2023), the mediating effect of adaptation to digital capabilities on the impact of strategic comfort on international marketing capabilities and export performance (Zahoor & Lew, 2023), the impact of new product innovation (NPI) for the effects of marketing analytics on business performance (Lin & Eng, 2024), the impact of IT capabilities on innovation and firm performance (Weng et al, 2024), the impact of IT capabilities on adaptation and marketing performance in e-commerce adoption by SMEs (Salah & Ayyash 2024), the impact of IT marketing capabili-ties on Shareholder Reaction (Zhan et al., 2024), the impact of artificial intelligence practice in SMEs on performance (Baabdullah et al., 2024), the impact of customer analytics capacity on business performance (Mehrabi et al., 2024), the impact of IT capabilities of enterprises on business capacity and operational performance and innovation (Shukla et al., 2024), the relationship between customer analytics and new product performance (Özdemir et al., 2024).

Based on the studies conducted in the literature, H1 and H2 hypotheses were established.

H1a: AI-supported marketing capabilities affect customer agility

H1b: AI-supported marketing capabilities affect marketing performance

H1c: AI-supported marketing capabilities affect customer agility and marketing performance

H2a: Marketing analytics affects customer agility

H2b: Marketing analytics affects marketing performance

H2c: Marketing analytics affects customer agility and marketing performance

3.2. Customer agility on marketing performance

Customer agility is a critical organizational capability that significantly affects firm performance. By leveraging artificial intelligence and other advanced technologies, firms can increase their agility, better meet customer demands and achieve superior business results (Akter et al., 2022: 88). Customer agility enables firms to continuously adapt to customer-driven opportunities by responding proactively and launching new promotions and services/products to increase profitability, industry position and competitive advantage (Hadjielias et al., 2022:2). Previous research has also shown that customer agility can predict the success of new products and accelerate the way and speed at which organizations identify and exploit innovative opportunities to create a new product/service that improves organizational performance (Wahab & Radmehr, 2024: 5).

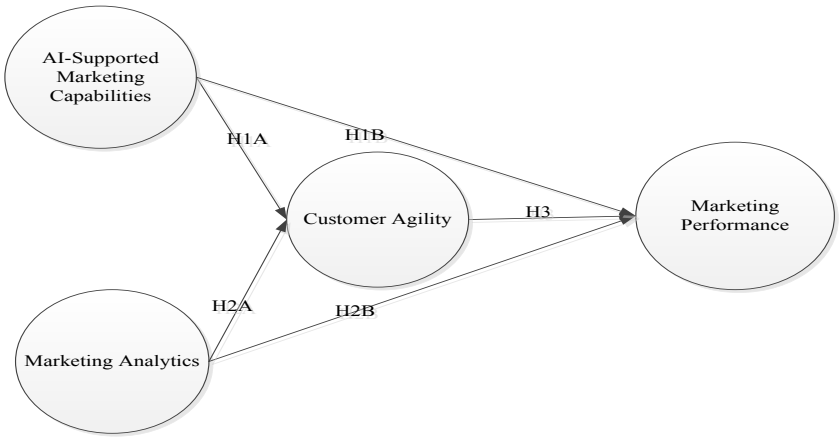
When the studies in the literature are examined; Lin et al., (2020) the effect of e-commerce capabilities on business agility and performance, Khan (2020) the relationship between marketing agility and firm performance, Çalıl and Çallı (2021) the effect of business agility on firm performance, Khan, et al, (2022) the impact of business analytics capabilities on firm agility and firm performance, Hadjielias et al., (2022) the mediating role of agility in customer value creation of digitalization, Liang et al., (2022) the impact of market analytics on market agility and business performance, Tseng et al, (2022) the use of data analysis tools agility and new product success, Wamba (2022) the impact of artificial intelligence simulations on business and customer agility and the impact of agility on performance, Alghamdi and Agag (2024) the relationship between marketing agility and competitive advantage, Masialeti et al, (2024) the impact of artificial intelligence applications on business processes agility and performance, Wahab and Radmehr (2024) the effect of artificial intelligence simulations on customer agility and business performance, Arslan et al. (2024) marketing agility in entrepreneurship, Tarn and Wang (2023) the relationship between data analysis, marketing knowledge and marketing agility. Based on the studies conducted in the literature, hypothesis H3 was constructed.

H3: Customer agility affects marketing performance.

4. Methodology

The study received approval from the Kütahya Dumlupınar University's Social and Human Sciences Scientific Research and Publication Ethics Committee under protocol number 290130, dated 27.05.2024. It adhered to the guidelines outlined in the Declaration of Helsinki for human subjects research. Figure 1 below depicts the research model showing the hypotheses.

Figure 1. Research model



4.1. Research design, sampling, and data collection

The study was designed using a quantitative research method. To determine the universe of the study, e-commerce sites registered in the ETBIS system in Turkey were taken as a basis. It is seen that 37,546 businesses registered in the ETBIS system at the beginning of 2024 when the data was collected (www.eticaret.gov.tr/). Small and medium-sized enterprises were taken into account in the study. SMEs are considered the backbone of economies due to their ability to adapt to cyclical changes, innovative frameworks, and contributions to local markets. Research shows that SMEs in Turkey significantly contribute to the economy, making up 99.8% of total businesses,

72% of employment, 49.4% of total turnover, 42.7% of production value, and 41.3% of added value (Yılmaz & Uçkun, 2025: 25). In the study, convenience sampling sampling was used as a data collection method. SMEs were reached by querying the site registered in the Etbis system without restrictions on the province, district, sector, or geographical borders.

A survey was chosen as the data collection tool. The survey mainly targets marketing department managers or business managers who are thought to know the concepts discussed in the study. The respondents' positions in the organization are business owners, business partners, sales managers, and senior managers. The questionnaires were sent to the respondents online. The online survey was e-mailed to approximately 1000 participants registered in the Etbis system. The ten-fold rule for each statement used to measure the construct is a method applied to a specific latent construct in the model (Hair et al., 2011). In terms of sample size requirements, it is seen that a total of 180 participants is sufficient. In the study, SmartPLS 4.0 software was used to analyze the data using the PLS-SEM method.

4.2. Measures

A literature review examined the impact of marketing analytics and artificial intelligence applications on customer agility and marketing performance in e-commerce adopters. A questionnaire was used to obtain the data, divided into two sections. The first section includes the demographic characteristics of the participants, and the second section consists of the statements of the selected variables. The items were measured using a five-point Likert scale. The measurement questions were adapted through an extensive literature review. The items were slightly modified to fit the context. The scale was constructed by taking four statements from Salah and Ayyash (2024), four statements from marketing analytics Hossain et al., (2022), five statements from Agag et al., (2024), four statements from customer agility Khan et al., (2022), Agag et al., (2024), five statements from marketing performance Khan et al., (2022); Salah and Ayyash, 2024). Three statements from marketing performance, two from AI-supported marketing capabilities, and three from marketing analytics were excluded from the analysis due to very low factor structures.

4.3. Data analysis and results

4.3.1. Descriptive statistics

Table 1 shows the demographic values of the participants. It is seen that 30% of the participants are female and 70% are male. In the distribution of the participants by age, 34.4% were between 30 and 40 years old. The distribution of the participants in terms of their level of education shows that 42.3% of the participants have a bachelor's degree. Regarding the number of employees in the enterprises of the participants, it was seen that 51.1% were between 1 and 51 people. Participants operate in the service sector at a rate of 35.7%. 54.7% of the participants continue their activities on a national scale.

Table 1. Participant information

		Frequency	Percent
Gender of the participant	Woman	68	30
	Male	159	70
Age of the participant	Under 30 years old	77	34
	30-40 years old	78	34,4
	40 years and over	72	31,7
Training of the Participant	High School	80	35,3
	Licence	96	42,3
	Postgraduate	51	22,5
Number of employees of the enterprise	1-50 people	116	51,1
	51-250	39	17,2
	250 and more	72	31,7
Sector in which the business operates	Service	81	35,7
	Production	75	33
	Service and production	71	31,3
Market structure of the business	National	124	54,7
	International	47	20,7
	National and international	56	24,7
Total		227	100

4.3.2. Assessment of the measurement model

Values that meet the construct, convergent, and discriminant validity criteria were examined for the measurement model. Cronbach's alpha and composite reliability (CR) values are considered to evaluate construct validity and are expected to be 0.70 and above (Hair et al., 2012). Among the results, only the marketing analytics value was 0.602. Cronbach's alpha values are 0.800, 0.805, and 0.932. CR values are between 0.768 and 0.952, higher than the recommended value of 0.70. Therefore, as shown in Table 2, it can be said that the measurement model meets the internal reliability criterion.

Examining the AVE and item loading values is recommended to evaluate the convergent validity of the structures. AVE values are expected to be 0.50 and above, and item loading values are expected to be 0.70 and above (Fornell & Larcker, 1981). When Table 2 is examined, it is seen that AVE>0.50. The loading values of the variables were determined to be 0.598 for an expression containing marketing analytics. The fact that the other expressions were >0.7 indicates that all the items showed reliability (Fornell & Larcker, 1981).

Table 2. Measurement scale's psychometric properties

Items/ Factor	Loadings	Cronbach's alpha	rho_a	rho_c	AVE
VAR00010 <- AI- Supported _Marketing Capabilities	0,891	0,800	0,829	0,908	0,832
VAR00012 <- AI- Supported _Marketing Capabilities	0,932				
VAR00014 <- Marketing Analytics	0,981	0,602	1,577	0,786	0,660
VAR00015 <- Marketing Analytics	0,598				
VAR00022 <- Customer Agility	0,839				
VAR00024 <- Customer Agility	0,942	0,932	0,938	0,952	0,833
VAR00025 <- Customer Agility	0,927				
VAR00026 <- Customer Agility	0,939				
VAR00030 <- Marketing Performance	0,907	0,805	0,810	0,911	0,837
VAR00031 <- Marketing Performance	0,923				

The HTMT criterion was used to assess discriminant validity. As shown in Table 3, all HTMT values are below the threshold value of 0.85, indicating discriminant validity (Henseler et al., 2016).

Table 3. Heterotrait-monotrait ratio (HTMT) – Matrix

	AI-supported marketing capabilities	Customer agility	Marketing analytics	Marketing performance
AI- supported marketing capabilities	1			
Customer agility	0,567	1		
Marketing analytics	0,385	0,396	1	
Marketing performance	0,614	0,589	0,653	1

Furthermore, in Table 4, the Fornell-Larcker criterion is used to test the discriminant validity of the measurement model. For a good discriminant validity of the measurement model, we consider the square root of the AVE for each variable and the corresponding correlation coefficients with other variables (Fornell & Larcker, 1981).

Table 4. Fornell-Larcker criterion

	AI-supported marketing capabilities	Customer agility	Marketing analytics	Marketing performance
AI- supported marketing capabilities	0,912			
Customer agility	0,501	0,913		
Marketing analytics	0,113	0,288	0,812	
Marketing performance	0,494	0,520	0,620	0,915

4.3.3. Assessment of the structural model

The beta (β), R^2, and corresponding t-values of the structural model should be evaluated using a bootstrapping procedure with 5,000 samples. It is also recommended to interpret the values of effect sizes (f^2) and VIF ratio (Hair

et al., 2017). Table 5 shows the structural model evaluation. Hypothesis H1A is supported. AI-supported marketing capabilities affect customer agility (β = 0.474 t = 11,343). The data also supported hypothesis H1B. AI-supported marketing capabilities affect marketing performance (β = 0.343, t = 12.575). Similarly, the data supported hypothesis H3. Customer agility impacts marketing performance (β = 0.202, t = 2.925). The analysis results also supported hypothesis H2A, that marketing analytics impacts customer agility (β = 0.234, t = 4,053). Finally, the data also supported hypothesis H2B. Marketing analytics impacts marketing performance (β = 0.524, t = 16,310).

Table 5. Hypotheses testing and structural model results

	β	f2	VIF	LLCI	ULCI	t	P	Result
H1a:AI Supported marketing capabilities -> Customer agility	0,474	1,013	0,319	0,388	0,553	11,343	0,000	Supported
H1b: AI Supported marketing capabilities -> Marketing performance	0,334	1,336	0,206	0,358	0,492	12,575	0,000	Supported
H3: Customer Agility -> Marketing performance	0,202	1,438	0,070	0,063	0,332	2,925	0,003	Supported
H2a:Marketing Analytics -> Customer agility	0,234	1,013	0,078	0,117	0,343	4,053	0,000	Supported
H2b: Marketing analytics -> Marketing performance	0,524	1,092	0,622	0,504	0,641	16,310	0,000	Supported

In addition, when the R-square ratios are analyzed, the ratio of customer agility is 0.305, and the ratio of marketing performance is 0.595.

In addition to testing the direct effects in the proposed research model, various mediation effects were also tested in the study. The mediation test used multiple techniques (Baron & Kenny, 1986). The study analyzed indirect effects first, followed by direct effects. Table 6 shows that two specific indirect effects and the direct impact are significant. When Table 6 is examined, it is seen that hypothesis H1C is confirmed. It is seen that AI-supported marketing capabilities affect customer agility and marketing performance. (β = 0.096 t = 2,919). The data also supports the H2C hypothesis. Marketing analytics impacts customer agility and marketing performance (β = 0.047 t = 2,592).

Table 6. Mediating effects

		β	LLCI	ULCI	SD	t	P	Result
H1c	AI- Supported _Marketing Capabilities -> Customer Agility -> Marketing Performance	0,096	0,030	0,160	0,033	2,919	0,004	Supported
H2c	Marketing Analytics -> Customer Agility -> Marketing Performance	0,047	0,014	0,085	0,018	2,592	0,010	Supported

5. Discussions and conclusions

This study examines the impact of AI-supported marketing technologies and marketing analytics on customer agility and marketing performance. The results obtained support all hypotheses. According to the research results, AI-supported marketing capabilities affect customer agility and marketing performance. This result is similar to other research results in the literature. In the studies conducted in the literature, Liv d., (2023), artificial intelligence has an impact on performance, Salah and Ayyash (2024) IT capabilities affect adaptation and marketing performance in the adoption of e-commerce by SMEs, Baabdullah et al., (2024) Artificial intelligence practice in SMEs has an impact on performance, Zhan et al., (2024) concluded that IT marketing capabilities have Shareholder Reaction effect, Kamran (2021) *concluded that* the use of artificial intelligence in marketing has a relationship with consumer acceptance, Zahoor and Lew (2023) concluded that strategic comfort has a mediating effect of adaptation to digital capabilities in the impact of international marketing capabilities and export performance. The findings show how AI-supported marketing capabilities affect business performance and customer agility. In light of these conclusions, e-commerce businesses will be able to capture the consumer's imagination more easily by monitoring consumer behavior through artificial intelligence applications. In addition, with the artificial intelligence-supported applications used, they will be able to benefit by transferring the information about the product and the value it provides to their consumers more quickly. For practitioners, AI-powered marketing applications

can also be used to monitor and manage the inventory of an online retailer. Practitioners will also be able to improve their marketing performance when they manage the processes correctly.

According to the research results, marketing analytics affect customer agility and marketing performance. This result is similar to other research results in the literature. In the studies conducted in the literature, Hossain et al. (2022) found that marketing analytics and artificial intelligence adaptation have an impact on sustainable competitive advantage, Cheng and Shiu (2023) found that marketing analytics has an effect on new product development, Akter et al. (2023) found that marketing analytics success has an impact on business value, Lin and Eng (2024) found that marketing analytics has an impact on new product innovation for its effects on business performance, Cadden et al, (2023) that market analytics has an effect on knowledge and innovation, Tarn and Wang (2023) that data analysis has a relationship with marketing knowledge and marketing agility, *Chen et al. (2022) that digital technologies have an impact on firm performance,* Tseng et al. (2022) that the use of data analysis tools has an impact on agility and new product success, Özdemir et al. (2024) that customer analytics and new product performance are related, Mehrabi et al. (2024) that customer analytics capacity has an impact on business performance. In today's digital age, marketing analytics performed by e-commerce businesses can help the manager make the right decision at the right time. It can help to predict the appropriate actions to be taken for the betterment of the business. Marketing analytics is also essential in realizing all the advantages of the business. Therefore, the positive impact of data-driven cultures on businesses' customer agility and marketing performance should be considered necessary for all businesses.

According to the research results, customer agility affects marketing performance. This result is similar to other research results in the literature. In the studies conducted in the literature, Lin et al. (2020) concluded that e-commerce capabilities have an impact on business agility and performance, Wamba (2022) concluded that artificial intelligence simulations affect business and customer agility and agility has an effect on performance, Hadjielias et al. (2022) concluded that agility has a mediating role in digitalization in creating customer value, Alghamdi and Agag (2024) concluded that marketing agility is related to competitive advantage. The study defined customer agility as a determinant of marketing performance. It also shows that customer agility is a partial mediator of marketing performance. Through marketing analytics and AI-powered marketing applications, businesses can quickly discover additional needs of our customers that they are unaware of. Customer agility is critical in processes such as continuously anticipating customers' needs without them realizing it, predicting key trends to gain insight into what users in the current market will need in the future, and developing new ways of looking at customers and their needs. These processes increase business performance.

According to the results of the study, customer agility has a mediating effect on AI-supported marketing capabilities and marketing analytics in affecting marketing performance. The results obtained from the survey are similar to those of the literature. In the studies conducted in the literature, Liang et al., (2022) market analytics have an impact on market agility and business performance, Khan et al., (2022) business analytics capabilities have an effect on firm agility and firm performance, Shukla et al., (2024) IT capabilities of businesses have an impact on business capacity and operational performance and innovation, Weng et al., (2024) concluded that IT capabilities affect innovation and firm performance, Wahab and Radmehr (2024) concluded that artificial intelligence simulations affect customer agility and business performance, Masialeti et al., 2024 concluded that artificial intelligence applications have an impact on agility and performance on business processes.

The study shows that businesses' AI-supported applications and marketing analyses mediate agility processes such as sensing our customers' needs before they realize it, responding quickly when something important happens to them, and increasing marketing performance. Dynamic capabilities address the ability of businesses to adapt to changing environmental conditions, capture opportunities, and gain competitive advantage (Demir & Demir, 2023). As the dynamic capabilities theory expresses, companies can achieve tremendous marketing success when AI and analytical systems are combined with customer agility. This relationship has significant strategic implications, especially for companies in the digital transformation process. According to the RBV perspective, customer agility is a critical resource that provides companies with a competitive advantage. However, customer agility is also an intermediary mechanism that increases the impact of AI-supported marketing capabilities and analytics on marketing performance. AI and analytics alone do not bring high marketing performance; companies that can quickly implement the insights provided by these technologies benefit more. Therefore, businesses should view customer agility as a strategic resource from the RBV perspective and achieve a competitive advantage using AI and marketing analytics technologies. As a result, with the support of the theories discussed in this study, It is thought that businesses can benefit from developing the necessary capabilities, strategies, and collaboration mechanisms to anticipate, adapt, and develop when faced with disruptions due to the rapid pace of technological change,

evolving customer expectations and changing market conditions. This study can respond to the need for a comprehensive understanding of the challenges and solutions SMEs or newly established companies face.

5.1. Theory, practice, economic and social implications

The research results have theoretical, practical, economic, and societal implications. Theoretically, this study contributes to the Resource-Based View (RBV), Dynamic Capability (DC) Theory literature. VRIO (valuable, rare, inimitable, and organized) resource theories contribute to the literature on marketing analytics and AI-enabled marketing capabilities. The study better explains how customer agility integrates with technology-based marketing approaches. It has been revealed that customer agility plays a transformative role in data-driven marketing and AI. Based on the theories, the explanatory power and generalizability of the model have been further improved. The study is considered to help identify different research topics for future AI and marketing analytics studies and develop effective research.

Practically, the study provides insights into the importance of using AI-enabled marketing applications and marketing analytics for businesses adopting e-commerce. It includes information on using AI marketing applications and customer analytics for real-time monitoring and analysis of customer data and provides information to identify and respond to market changes and customer needs quickly. It emphasizes the importance of AI-powered marketing capabilities and marketing analytics in increasing business customer agility. Practitioners should focus on the resources required for effective AI assimilation to improve their capabilities. Practitioners should prioritize creating and developing AI assimilation capabilities to enhance customer agility. It will enable practitioners to benefit from customer agility and achieve more excellent value for themselves and their customers. This will also facilitate the improvement of marketing performance.

When the study results are considered from an economic perspective, It will encourage the spread of customer-centric business models with data analytics and AI-powered solutions. Digital transformation investments will contribute to sustainable growth by increasing the economic efficiency of companies. As a result, the results obtained from the study regarding the increase in growth and profitability rates of businesses can help businesses increase their revenues and reduce their costs. More effective market forecasting and demand management can reduce inventory costs and marketing waste. In addition, adopting new marketing technologies will create new job opportunities for data analysts, AI experts, and digital marketers. Finally, when the study results are evaluated from a social perspective, customer agility and AI-based analytics enable faster, more personalized, and more efficient service to consumers. Better customer experiences can increase customer loyalty and facilitate long-term customer relationships. AI-enabled marketing can help small businesses compete with larger companies, further balancing economic opportunities.

5.2. Limitations of the study and future research opportunities

This study has some limitations that should be considered in future studies. First of all, while the use of convenience sampling in the study allowed the research to be conducted quickly and cost-effectively, it created limitations such as sector limitations, narrow geographical scope, digitalization differences, and limited company size in generalizability. The sample size should be increased in future studies using different sampling and data collection methods (Surveys, in-depth interviews, case studies, etc.). Statistically, significant results should be obtained by working with more businesses. Second, the sample is limited to enterprises in a specific geographical region. Research findings may vary depending on geographic, regional, and cultural contexts. Regarding geographic scope, firms' investment levels in AI-supported marketing capabilities and marketing analytics, as well as the usage rates of technologies, will create differences in research results. The concepts covered in the study may gain importance in different ways in different regions. For example, in markets with intense competition, customer agility may be a critical factor for marketing performance. However, in less competitive markets, the impact of customer agility may be lower. Culturally, dimensions such as cultural differences in consumer behavior, cultural effects on data privacy and AI use, individualism or collectivism orientations, and uncertainty avoidance behavior create differences. Therefore, to generalize the research results, they must be examined in different geographic, regional, or cultural contexts. Third, a further longitudinal study could be conducted to provide more insights into the causal relationship between AI-supported marketing capabilities, market analytics and customer agility.

Fourth, this study reveals that e-commerce adoption can directly impact marketing performance by increasing customer agility. Therefore, further research on the effects of variables such as industry, process, time, or relevant technology is recommended for businesses that adopt e-commerce or want to incorporate it into their processes. To generalize the effect of the variables discussed in the study on marketing performance, SMEs in different

sectors (service, manufacturing, retail information, etc.) should be examined. Since each industry will have different dynamics, the effect of the variables discussed in each can be studied comparatively. Fifth, this study proposes to address concepts such as the impact on customer agility or business performance by including different capabilities of businesses other than AI-supported marketing capabilities and marketing analytics. In future studies, comparisons can be made by selecting a certain number of SMEs per sector, by including businesses of different sizes (micro, small, and medium-sized enterprises), or by analyzing firms adopting different marketing technologies (firms with high and low use of artificial intelligence).

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Evaluating lecturer satisfaction towards learning management systems in private universities

Htin Kyaw Lin[1]

[1]*Corresponding author, Department of Management Studies, Myanmar Imperial College, Yangon, Myanmar, Email: htinkyawlin48@gmail.com, ORCID: https://orcid.org/0009-0004-4033-7879*

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Abstract

This study investigates lecturer satisfaction with Learning Management Systems (LMS) in private universities in Myanmar, a context where digital learning adoption is relatively recent. This study employs the Stimulus-Organism-Response (S-O-R) model as a theoretical framework, examining how external stimuli (system quality, information quality, self-efficacy, and technical support) influence internal cognitive processes (perceived usefulness and perceived ease of use), ultimately affecting lecturer satisfaction. A quantitative approach using a survey questionnaire was administered to 135 lecturers from private universities in Yangon. According to the results, self-efficacy and technical support significantly positively influence perceived usefulness and ease of use. System quality also positively influences perceived usefulness. Furthermore, perceived usefulness and ease of use significantly influence lecturer satisfaction. The findings provide valuable insights for universities and IT developers seeking to optimize LMS implementation and support, ultimately enhancing teaching effectiveness and lecturer satisfaction in Myanmar's evolving digital landscape of higher education.

1. Introduction

Higher education institutions, particularly universities, have been urged to adapt their course offerings to keep up with the development of information and communication technologies, making educational activities increasingly reliant on the internet and online applications. These recent developments have given rise to a new idea known as e-learning within education. E-learning is technology-based learning in which lecturers electronically distribute course materials to distant students across a computer network (Zhang et al., 2004). Due to this recent transition, universities are increasingly promoting online courses to increase student participation, create new revenue streams, and reduce the time and place limits associated with traditional education. These e-learning activities are supported by several technical advancements, including course websites, accounting systems, learning and student administration systems, and content production tools (Paulsen, 2003). Among these, the Learning Management System (LMS) is a widely adopted tech innovation in advanced education that facilitates course activities in a digital setting.

Higher education institutions use LMS to support their course curriculum with various tools, including discussion boards, forums, chat, online grade posting, online exams, file sharing, assignment management, syllabi, schedules, announcements, and course plans (Fındık Coşkunçay & Özkan Yıldırım, 2013). LMS platforms allow lecturers to administer tests, distribute information, and track students' progress in an organized and easily accessible online setting (Lassoued et al., 2020). As a result, LMS has transformed contemporary education by acting as a centralized platform that combines administrative, instructional, and learning tasks. By providing lecturers and students access to educational resources at any place and moment, these systems aim to increase educational flexibility.

Additionally, LMS facilitates collaborative tools, including group projects, video conferencing, and discussion boards, all promoting interactive learning (Martin et al., 2020). Therefore, LMS are digital platforms that have

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revolutionized contemporary education by offering a centralized setting for communication, performance monitoring, and material distribution. Dhawan (2020) asserts that the efficient use of this technology is critical to enhancing learning quality, expanding access to training and education, delivering cost-effectiveness, and lowering educational expenses. LMS has become essential in both conventional and digital learning environments because it can improve flexibility, accessibility, and engagement. While students benefit from self-paced learning and access to various resources, lecturers can create interactive courses, track student progress using analytics, and give timely feedback (Lassoued et al., 2020).

The global shift toward digital education, spearheaded by significant events like the COVID-19 pandemic and rapid technological advancements, has further highlighted the significance of LMS in higher education. LMS became a lifeline for educational institutions at this time, allowing learning to continue even in the face of disturbances brought on by physical distance (Adedoyin & Soykan, 2020). This change has sped up the global adoption of digital learning platforms, underscoring their critical function in guaranteeing innovation and continuity in education. As these platforms become essential for delivering education in the digital era, LMS use has gradually increased in universities worldwide, including private universities in Myanmar. Due to increased competition and the need for updated teaching methods, private universities in Myanmar are increasingly using LMS to improve academic delivery and student engagement.

To successfully implement and effectively use these platforms in higher education, universities must understand lecturers' perceptions of LMS. Since lecturers are one of the main stakeholders in adopting and integrating LMS, their views and involvement with the technology directly influence how well it enhances teaching and learning. Research indicates that perceptions of lecturers influence how they utilize LMS features such as content delivery, assessment, and student engagement tools (Kite et al., 2020). To overcome obstacles and challenges when adjusting to new technology, address the training they need, and successfully integrate into daily practices, it is essential to understand how lecturers perceive the adoption of LMS in the context of private universities in Myanmar, where the shift towards digital learning is still relatively new. Therefore, understanding these elements enables universities to support their faculty better, enhance the effectiveness of LMS implementation, and create a more supportive and effective teaching environment that empowers lecturers and improves educational outcomes. The current research focuses on the following two objectives. The first is to describe the satisfaction of lecturers towards LMS, and the second is to analyze the effect of influencing factors on the satisfaction of lecturers towards LMS.

2. Literature review

This section discussed the concept of a learning management system (LMS), lecturer satisfaction towards LMS, theoretical background based on the stimulus-organism-response (S-O-R) model, research framework, and hypothesis development.

2.1. Learning management system (LMS)

LMS is becoming a crucial component of higher education, especially at universities where online learning systems simplify training delivery, communication, and assessment. LMS is one of the most popular web-based programs, and its usage at universities is growing (Dutta et al., 2013). Accordingly, it is a technology-based solution that gives students access to educational resources and learning content to help them learn more. It also allows lecturers to produce personalized learning materials utilizing various pedagogical models in an online modality (Goh et al., 2014). Zanjani et al. (2013) identified three primary functions of LMS. Firstly, LMS provides lecturers and students an interactive interface in a reliable digital networking environment. Secondly, it offers curricular materials and tests in an electronic format for learning objectives. Finally, it integrates specific tools for monitoring classroom activity.

LMS includes diverse features that facilitate remote learning, such as course management, lecture scheduling, student learning assessment, educational content dissemination, learning progress monitoring, support for virtual social communities, communication tools, and robust system security (Borabo et al., 2024). Selecting an appropriate LMS is contingent upon several criteria, including desired technical features, financial constraints, and educational objectives. According to Katsaris and Vidakis (2021), it can be either cloud-based or installed, open-source or proprietary, and come in both free and paid versions. Users have a variety of LMS choices. Blackboard, Moodle, Google Classroom, Schoology, Canvas, Brightspace, Edmodo, Absorb LMS, and Talent LMS are several well-known LMS platforms (Katsaris & Vidakis, 2021). Lecturers frequently use LMS to create online course

materials, assess students' progress, and help them enhance their critical thinking while collaborating on university assignments (Zanjani et al., 2016).

According to Walker et al. (2016), LMS offers learning modules, course assessments, and grading that can all be tailored to fit teaching and learning requirements. Lecturers and students benefit from non-traditional teaching and learning methods supported by online learning strategies (Anshari et al., 2017). LMS has emerged as a crucial instrument for managing e-learning and can raise educational standards. Using technology, LMS allows users to make learning accessible and autonomous, customize training programs and courses, centralize learning materials, and simplify tracking learning outcomes (Bradley, 2021). LMS integration in education has a positive effect. However, some issues still need to be resolved, including improved pedagogical approaches, better integration with other systems, better support for lecturers and students, IT infrastructure, system-related problems, and policy issues (Bervelly & Umar, 2017). Additionally, the lack of parental involvement in LMS makes it more difficult for parents to oversee the academic development of their children (Xin et al., 2021).

2.2. Lecturer satisfaction towards LMS

Satisfaction is generally an individual's joy or despair about something resulting from comparing the actual results with expectations (Alkhateeb & Abdalla, 2021). According to DeLone and McLean (2016), user satisfaction related to information systems should encompass the entire customer experience cycle, from information search to purchase, payment, receipt, and service. Adayemi et al. (2024) further state that user satisfaction is the degree to which consumers are pleased with reports, websites, and support services. Additionally, DeLone and McLean (2016) note that user satisfaction is crucial for assessing how customers feel about web-based commerce. In e-learning, user satisfaction refers to the extent to which users – including lecturers and students – believe that an online learning environment meets their needs and expectations (Sun et al., 2008). It contains several elements, such as platform usability, the quality of course materials, instructional design effectiveness, user engagement, and the overall experience of using the platform. A Learning Management System (LMS) is the e-learning digital platform most commonly used by universities to conduct online courses (Simelan-Mnisi, 2023).

One of the key considerations in evaluating the efficacy and broad adoption of these digital platforms in educational institutions is lecturer satisfaction with LMS. Al-Fraihat et al. (2020) define lecturer satisfaction with LMS as the extent to which lecturers are satisfied with the features, functionalities, and general experience of utilizing the LMS in their instructional activities. This includes essential components like the convenience of use, the efficiency of the tools offered, the caliber of support, and the influence of LMS on improving teaching and learning outcomes. An excellent LMS enables instructors to upload materials, design interactive classes, administer tests, and keep track of students' progress (Kite et al., 2020). Furthermore, if an LMS is simple to use, straightforward, and doesn't need a lot of technical expertise, lecturers are more inclined to be satisfied with it (Cantabella et al., 2018). Consequently, a favorable user experience is facilitated by usability qualities, including easy navigation, understandable displays, and few technological issues. Lecturer satisfaction can be significantly increased by support from the administration, particularly when it comes to acknowledging efforts made to teach online and matching LMS features with instructional objectives (Martin et al., 2020). A satisfied lecturer is more likely to incorporate the LMS completely into their teaching methods, which will improve student involvement and the quality of instruction. (Cantabella et al., 2018).

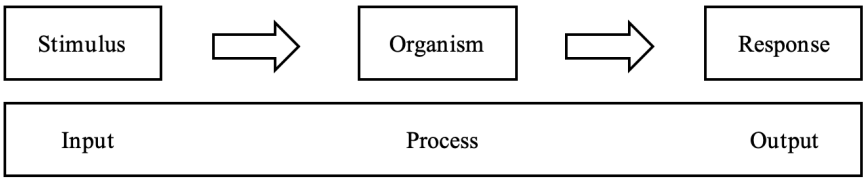
2.3. Theoretical background: Stimulus-Organism-Response (S-O-R) model

The S-O-R model is a popular theoretical framework that explains how people interpret outside stimuli and how they influence their actions and reactions. Mehrabian and Russell (1974) initially established the model, which has since been modified in various domains to examine how people behave in response to technological and environmental stimuli. The S-O-R model highlights the emotional or emotion-evoking aspects of environments regarded as visual indicators (Wohlwill, 1976). Bitner (1992) extended the application of the S-O-R model to servicescapes by integrating cognition and physiology, whereas Mehrabian and Russell (1974) concentrated solely on emotional reactions.

The cognitive and emotional processes of an integrated S-O-R model, which was introduced more recently, consider all prior experiences, including long-term memory (Jacoby, 2002). Kim and Lennon (2013) expanded the S-O-R model to incorporate both external and internal information sources (stimuli) that influence customer intention (response) through emotions and thoughts (organism). Besides offering a traditional basis for research on consumer behavior, nowadays, the S-O-R model is used to examine information technology utilization (Lee & Chen, 2021). In comprehending how lecturers perceive LMS, the S-O-R model can provide a useful understanding

of how lecturers respond to the technological aspects of LMS and how their cognitive and affective responses influence their reactions.

Figure 1. Conceptual framework of S-O-R model



Source: Kim et al. (2020)

2.4. Research framework and hypothesis development

Fiore and Kim (2007) explained that external stimuli influence an individual's interior moods. An organism connects stimuli and behavior, controlling the final behavior in reaction to the input. The summary of the outcomes for regulating an organism is called the response. In the context of education technology, especially in LMS usage, the S-O-R framework offers a theoretical basis for comprehending how external stimuli (system-related factors) influence the internal cognitive processes of users (perceived usefulness and perceived ease of use), eventually influencing the behavioral responses of users (satisfaction). The hypotheses for the study are generated and grounded in the relationship between these components.

2.5. Stimulus factors and organisms

Based on the S-O-R model, stimuli are elements of the external environment that cause emotional and cognitive reactions. The primary stimuli in the current study are system quality, information quality, self-efficacy, and technical support.

System quality, perceived usefulness, and perceived ease of use: DeLone and McLean (2016) define system quality as the performance of the information system. In the current study, system quality reflects LMS's overall technical performance, dependability, and efficiency. Lecturers are likely to find a system that is helpful and easy to use when it operates well (DeLone & McLean, 2016). It has been demonstrated by Fathema et al. (2015), and the study emphasized that system quality had favorable effects on LMS usage of lecturers at universities in terms of perceived usefulness and perceived ease of use. Therefore, a more favorable opinion of the perceived usefulness and ease of use is influenced by good system quality, including features like quick loading times and smooth integration.

H1a: System quality has a positive influence on perceived usefulness.

H1b: System quality has a positive influence on perceived ease of use.

*Information quality and perceived usefulness, perceived ease of use:*According to DeLone and McLean (2016), information quality encompasses the desired qualities of the outputs of a system, including completeness, correctness, timeliness, relevance, usability, and accessibility. The material's correctness, applicability, and comprehensiveness in the LMS are considered aspects of information quality in the current study. According to several scholars, perceived usefulness and ease of use are determined mainly by information accuracy (Alshurideh et al., 2021; Cheng, 2012). Information quality is positively correlated with perceived usefulness and perceived ease of use, according to research by Suleiman et al. (2023). Therefore, lecturers are better equipped to provide effective teaching when they can access top-notch resources.

H2a: Information quality has a positive influence on perceived usefulness.

H2b: Information quality has a positive influence on perceived ease of use.

Self-efficacy, perceived usefulness, and perceived ease of use: According to Trinidad (2020), self-efficacy is the conviction that an individual can plan and carry out the actions necessary to achieve specific performance goals. When it comes to using an LMS, self-efficacy pertains to the judgment or confidence of a lecturer in his or her ability to use, navigate, and operate the LMS. Perceived usefulness and perceived ease of use are often stronger among users with higher levels of self-efficacy. According to earlier studies, users' self-efficacy significantly im-

proves their perceptions of perceived usefulness and ease of use. (Ashraf et al., 2020; Park et al., 2012). Furthermore, Fathema et al. (2015) investigated how faculty members in post-secondary institutions used LMS. According to that study, the perceived self-efficacy of faculty members significantly enhances their view on the system's usefulness and ease of use. As a result, lecturers who have greater self-efficacy are more prone to think the LMS is practical and easy to use.

H3a: Self-efficacy has a positive influence on perceived usefulness.

H3b: Self-efficacy has a positive influence on perceived ease of use.

Technical support, perceived usefulness, and perceived ease of use: Technical support includes help from IT experts and others to resolve hardware and software issues, to offer technical services to users, and to make technology use easier (Sulaiman et al., 2023). The accessibility of technical assistance can significantly influence how lecturers see LMS. Aparicio et al. (2017) found that sufficient support increases perceived usefulness and ease of use by improving system usability and lowering annoyance. Through technical assistance, Alshammari (2020) found that students' adoption of LMS is influenced by perceived usefulness and ease of use. In addition, according to research conducted by Zheng et al. (2018), technical support influences perceived usefulness and ease of use.

H4a: Technical support has a positive influence on perceived usefulness.

H4b: Technical support has a positive influence on perceived ease of use.

2.6. Organism factors and response

Based on the S-O-R model, the organism components in this study represent internal cognitive processes that influence behavioral reactions, especially lecturer satisfaction. These cognitive processes are viewed as perceived usefulness and perceived ease of use.

Perceived usefulness and satisfaction: According to Sulaiman et al. (2023), perceived usefulness is the subjective likelihood that a prospective user would feel more satisfied and perform better at work when utilizing a specific application system. In this study, perceived usefulness measures how much a lecturer thinks utilizing an LMS improves the efficacy of their instruction. Studies have pointed out that users are more prone to be satisfied with a system's performance when they believe it to be helpful (Motaghian et al., 2013; Wang & Wang, 2009). According to the study by Fathema et al. (2015), perceived usefulness and ease of use considerably impact the actual utilization of LMS, especially among academicians.

H5: Perceived usefulness has a positive influence on lecturer satisfaction.

Perceived ease of use and satisfaction: The extent to which a potential user anticipates the intended system to be effortless is known as perceived ease of use (Sulaiman et al., 2023). Perceived ease of use in this study relates to how simple lecturers find the LMS to use and navigate. Like any other information system, an LMS will be more appropriate and used by lecturers if it is user-friendly, has advantages, and gives them academic tools (Taylor & Todd, 1995). According to several research studies, LMS utilization is significantly influenced by perceived ease of use. The significance of the connected route between perceived ease of use and LMS use was demonstrated by Ngai et al. (2007). Furthermore, a study by Sulaiman et al. (2023) focused on identifying factors influencing university lecturers' use of LMS. According to that study, LMS utilization and perceived ease of use correlate positively.

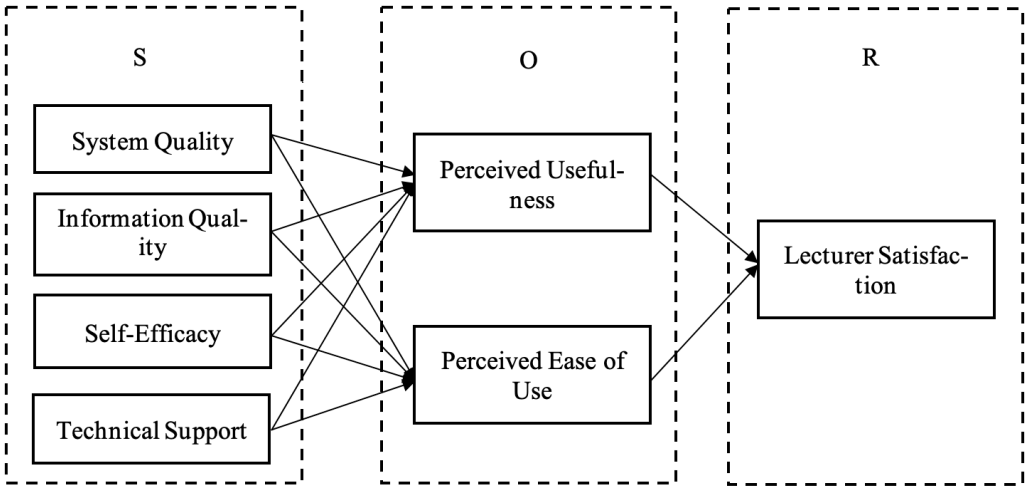
H6: Perceived ease of use has a positive influence on lecturer satisfaction.

3. Methodology

This research has ethics committee approval from the Myanmar Research Synergy Association (MRSA) with 10/08/2024 and ethical number MRSA20240807.

Two main objectives direct the present study. The first is to describe lecturers' satisfaction with LMS and analyze the factors influencing this satisfaction. This study organizes the research techniques using the research onion model developed by Saunders et al. (2019). It uses a positivist research philosophy to objectively quantify lecturers' satisfaction with LMS in private universities. Using a deductive method, empirical data is gathered to assess current hypotheses on LMS satisfaction.

Figure 2. Research framework



Source: Author (2025)

The study uses a quantitative and survey research method, with self-administered questionnaires as the main data-gathering instrument. Primary data is gathered from 135 lecturers employed by private universities in the Yangon area, while secondary data is collected from scholarly publications and pertinent literature. A simple random sampling method is employed to reduce prejudice and guarantee fairness. Data is collected using a cross-sectional time horizon from August 2024 to January 2025 to capture present satisfaction with LMS.

There are four sections on the survey form: A, B, C, and D. Section A concentrates on the demographic profile of respondents to obtain some background information. The stimuli factors, including system quality, information quality, self-efficacy, and technical support, are described in section B. Section C discusses the organism factors – perceived usefulness and perceived ease of use –. As a response factor, lecturer satisfaction is explicated in section D. To align the context of LMS implications in private universities, all measuring items are selected from prior research and slightly modified.

The measurement items of the stimuli factors, including system quality, information quality, self-efficacy, and technical support, are adopted by Sulaiman et al. (2023), Alshammari (2020), and Alshibly (2014). The measurement items of perceived usefulness and perceived ease of use are amended from Pan et al. (2024) and Ashrafi (2022). The measurement items for lecturer satisfaction are adopted from Alzahrani and Seth (2021). Every measurement item is scored on a five-point Likert scale, with 1 denoting strongly disagree, 2 (disagree), 3 (neutral), 4 (agree), and 5 (strongly agree). With SPSS software, the gathered data will be examined using descriptive and inferential statistical techniques to investigate the study's objectives.

3.1. Data analysis and findings

This section provides a concise analysis of the collected data. It begins with an overview of the respondents' demographic characteristics, followed by descriptive statistics summarizing key variables. The reliability test is discussed to ensure the validity of the research instrument. The regression analysis then examines the relationships between variables. The section concludes with the results of hypothesis testing, determining the support for the proposed hypotheses.

3.2. Demographic information of respondents

Table 1 presents the demographic information of respondents, which provides valuable insights into the characteristics of the respondents in this research study.

According to Table (1), the sample consists of 135 participants, with a gender distribution of 32% male and 68% female, indicating a higher representation of female respondents. In terms of age, the majority fall within the 25–34 age group (50%), followed by 35–44 years (28%) and 45–54 years (22%), with no respondents above 55 years. Regarding educational qualifications, most hold a master's degree (81%), while 19% have a PhD, reflecting a highly educated group. Academic ranking reveals that most respondents are lecturers (58%), with smaller proportions of senior lecturers (19%), assistant lecturers (15%), and professors (8%). Teaching experience varies,

with 38% having over eight years of experience, followed by 21% with 6.1–8 years, 18% with 4.1–6 years, 16% with 2–4 years, and 7% with less than two years, suggesting a relatively experienced teaching workforce. Subject specialization shows a predominance in business, economics, and finance (62%), followed by STEM (19%), languages (15%), and other disciplines (4%). Regarding the LMS used, Google Classroom is the most widely utilized platform (58%), followed by a customized LMS developed by the university (25%) and Moodle (17%), indicating a strong preference for Google Classroom as a primary teaching tool.

Table 1. Demographic information of respondents (n = 135)

No.	Demographic variable		Frequency (*f*)	Percentage (%)
1	Gender	Male	43	32
		Female	92	68
2	Age	25–34 years	68	50
		35 – 44 years	38	28
		45 – 54 years	29	22
		Over 55 years	-	-
3	Education	Master degree	109	81
		PhD degree	26	19
4	Academic Ranking	Assistant lecturer	20	15
		Lecturer	79	58
		Senior lecturer	25	19
		Professor	11	8
5	Teaching Experience	Below 2 years	9	7
		2 – 4 years	21	16
		4.1 – 6 years	24	18
		6.1 – 8 years	28	21
		Above 8 years	53	38
6	Teaching Subject	STEM	25	19
		Languages	20	15
		Business, Economics, and Finance	84	62
		Other	6	4
7	Type of LMS used	Moodle	23	17
		Google Classroom	78	58
		Customized LMS by University	34	25

Source: Survey Data (2025)

3.3. Descriptive statistics and reliability test

The following table presents the reliability analysis and descriptive statistics for key constructs measured in the study, including system quality, information quality, self-efficacy, technical support, perceived usefulness, perceived ease of use, and lecturer satisfaction.

According to Table (2), system quality recorded an overall mean of 3.96 with a strong Cronbach's Alpha of 0.851, indicating good internal consistency. The highest-rated item (SQ5 = 4.22) suggests a positive perception of system functionality. Information quality had an overall mean of 3.67 with a reliability score of 0.910, demonstrating high consistency. The highest score (IQ4 = 3.92) indicates that respondents value the accuracy and relevance of information. Self-efficacy showed a strong perception with an overall mean of 4.04 and a Cronbach's Alpha of 0.788, reflecting confidence in users' ability to utilize the system effectively, with SE3 receiving the highest mean (4.22).

Technical support was rated at 3.92 overall, with a reliability coefficient of 0.857, highlighting the importance of accessible support services. Perceived usefulness emerged as the highest-rated construct with an overall mean of 4.27 and a reliability score of 0.884, reinforcing the system's effectiveness, particularly PU5 (4.51), which suggests strong agreement on its practical benefits. Perceived ease of use scored 4.09 overall with a Cronbach's Alpha of 0.771, demonstrating ease of system interaction. At the same time, lecturer satisfaction recorded an overall mean of 4.05 with a strong reliability score of 0.894, confirming positive user experiences, particularly in satisfaction with the system's overall performance (LS5 = 4.22). These findings suggest a well-functioning system with strong user engagement, usability, and technical support, contributing to overall lecturer satisfaction.

Table 2. Cronbach's alpha value and descriptive statistics of measurement model

No.	Constructs	Measurement items	Mean	Overall mean	Cronbach's alpha
1	System quality	SQ1	3.96	3.96	.851
2		SQ2	3.68		
3		SQ3	3.88		
4		SQ4	4.05		
5		SQ5	4.22		
6	Information quality	IQ1	3.41	3.67	.910
7		IQ2	3.83		
8		IQ3	3.63		
9		IQ4	3.92		
10		IQ5	3.56		
11	Self-efficacy	SE1	4.02	4.04	.788
12		SE2	3.93		
13		SE3	4.22		
14		SE4	4.03		
15		SE5	4.02		
16	Technical support	TS1	3.89	3.92	.857
17		TS2	3.92		
18		TS3	3.82		
19		TS4	3.91		
20		TS5	4.04		
21	Perceived usefulness	PU1	4.19	4.27	.884
22		PU2	4.24		
23		PU3	4.17		
24		PU4	4.26		
25		PU5	4.51		
26	Perceived ease of use	PEU1	4.17	4.09	.771
27		PEU2	4.03		
28		PEU3	4.15		
29		PEU4	4.06		
30		PEU5	4.05		
31	Lecturer satisfaction	LS1	3.88	4.05	.894
32		LS2	4.01		
33		LS3	4.07		
34		LS4	4.07		
35		LS5	4.22		

Source: Survey Data (2025)

3.4. Regression analysis

The regression analysis results presented in the following tables illustrate the influence of influencing factors – system quality, information quality, self-efficacy, and technical support – on the dependent variables, perceived usefulness, and perceived ease of use, and the influence of influencing factors – perceived usefulness and perceived ease of use – on lecturer satisfaction towards LMS. The statistical significance of each influence is assessed based on unstandardized coefficients (B), standard errors (SE), standardized beta coefficients (β), and significance values (Sig.). Additionally, the explanatory power of the models is evaluated using R square, adjusted R square, and the F-value.

Table 3. Influencing factors on perceived usefulness and perceived ease of use

Model	Perceived usefulness				Perceived ease of use			
	B	SE	β	Sig.	B	SE	β	Sig.
System quality	.176**	.078	2.263	.026	-.043	.055	-.782	.436
Information quality	.095	.061	1.550	.125	-.080	.041	-1.968	.152
Self-efficacy	.265***	.086	3.075	.003	.436***	.056	7.732	.000
Technical support	.180**	.086	2.098	.039	.328***	.056	5.838	.000
R Square	.643				.758			
Adj: R Square	.626				.747			
F - Value	39.574 (p = 0.000)				68.995 (p = 0.000)			

Source: Survey Data (2025), *** means 1% significant level, ** means 5% considerable level

The regression model demonstrates a strong explanatory power for perceived usefulness with an R square value of 0.643 and an adjusted R square of 0.626. The F-value of 39.574 is statistically significant (p = 0.000), indicating the model's overall effectiveness in explaining the variance in perceived usefulness. Among the independent variables, system quality significantly positively affects perceived usefulness (B = 0.176, β = 2.263, p = 0.026), suggesting that improving system quality enhances the perceived usefulness of the LMS. Similarly, self-efficacy exhibits a highly significant and strong positive influence (B = 0.265, β = 3.075, p = 0.003), indicating that lecturers with higher confidence in using the LMS are likelier to perceive it as applicable. Technical support also contributes significantly to perceived usefulness (B = 0.180, β = 2.098, p = 0.039), emphasizing the importance of adequate support services in increasing lecturers' perception of system utility. In contrast, information quality does not show a statistically significant relationship with perceived usefulness (B = 0.095, β = 1.550, p = 0.125), suggesting that the quality of information provided by the system may not directly influence lecturers' perception of its usefulness.

The model exhibits an even higher explanatory power regarding perceived ease of use, with an R square value of 0.758 and an adjusted R square of 0.747. The F-value of 68.995 is statistically significant (p = 0.000), confirming the model's robustness in explaining the variance in perceived ease of use. Among the independent variables, Self-efficacy demonstrates the most substantial positive influence (B = 0.436, β = 7.732, p = 0.000), indicating that individuals with higher self-efficacy find the LMS easier to use. Technical support also has a significant positive effect (B = 0.328, β = 5.838, p = 0.000), highlighting the role of technical assistance in enhancing lecturers' ease of LMS use. Conversely, system quality (B = -0.043, β = -0.782, p = 0.436) and information quality (B = -0.080, β = -1.968, p = 0.152) do not exhibit significant relationships with perceived ease of use, suggesting that these factors do not directly contribute to lecturer's perception of the usability of the LMS.

Table 4. Influencing factors on lecturer satisfaction

Model	B	SE	β	Sig.
Perceived usefulness	.711***	.157	4.532	.000
Perceived ease of use	.412**	.177	2.321	.023
R Square		.620		
Adj: R Square		.612		
F - Value		73.560 (p = 0.000)		

Source: Survey Data (2025), *** means 1% significant level, ** means 5% significant level

The results presented in Table 4 highlight the key factors influencing lecturer satisfaction, focusing on perceived usefulness and perceived ease of use. The regression model demonstrates a strong explanatory power, with an R-square value of 0.620 and an adjusted R-square of 0.612, indicating that these independent variables can explain approximately 61.2% of the variance in lecturer satisfaction. The overall significance of the model is confirmed by an F-value of 73.560 (p = 0.000), suggesting that the predictors collectively contribute to lecturer satisfaction. Perceived usefulness exerts the most substantial positive influence on lecturer satisfaction (B = 0.711, β = 4.532, p = 0.000), indicating that lecturers who perceive the LMS as applicable are significantly more likely to report higher satisfaction. Perceived ease of use also significantly influences lecturer satisfaction (B = 0.412, β = 2.321, p = 0.023), although its effect is comparatively lower than perceived usefulness. This suggests that while ease of use is an essential factor, lecturers place greater emphasis on the usefulness of LMS when evaluating their overall satisfaction.

3.5. Results of hypothesis testing

The following table presents a summary of hypotheses based on the results obtained from the testing process.

Table 5. Results of hypothesis testing

Hypothesis	Results
H1a: System quality → perceived usefulness.	Supported
H1b: System quality → perceived ease of use.	Not Supported
H2a: Information quality → perceived usefulness.	Not Supported
H2b: Information quality → perceived ease of use.	Not Supported
H3a: Self-efficacy → perceived usefulness.	Supported
H3b: Self-efficacy → perceived ease of use.	Supported
H4a: Technical support → perceived usefulness.	Supported
H4b: Technical support → perceived ease of use.	Supported
H5: Perceived usefulness → lecturer satisfaction.	Supported
H6: Perceived ease of use → lecturer satisfaction.	Supported

Source: Survey Data (2025)

4. Discussions and conclusions

This section comprehensively discusses the theoretical contributions and managerial implications derived from the study's findings. By examining the relationships among the components within the LMS context, this study extends existing theoretical frameworks and offers practical recommendations for private universities and IT developers.

4.1. Theoretical contribution

According to the findings from data analysis, this study enhances the theoretical framework in technology adoption and user satisfaction by clarifying the hierarchical structure of influencing factors and the importance of perceived usefulness and ease of use in determining lecturer satisfaction. Specifically, within the context of LMS implementation in higher education, particularly in private universities in the Yangon region, Myanmar, this research introduces a new model grounded in the S-O-R framework, establishing a well-supported theoretical link between perception and lecturer satisfaction. The results of this study are beneficial for improving models from the field of educational technology adoption, such as the Information Systems Success Model and the Technology Acceptance Model.

By illustrating the effect of certain external aspects on perceived usefulness and ease of use, the findings support and broaden the research on the Technology Acceptance Model (TAM) and ultimately shape lecturer satisfaction. According to the regression analysis, self-efficacy and technical support are the most critical antecedents affecting perceived usefulness and ease of use. This result is consistent with Bandura's Social Cognitive Theory (1986), which highlights that people with a better sense of their abilities are more inclined to embrace and effectively use technology. Moreover, this finding also aligns with the study conducted by Venkatesh and Bala (2008), which highlights the function of institutional support in promoting technical adoption.

Additionally, the results show that system quality strongly influences perceived usefulness, whereas perceived ease of use is not statistically significant with system quality. This implies that although a solid system quality in an LMS improves opinions of its usefulness, it does not enhance its ease of use. This outcome contributes to the Information Systems Success Model developed by DeLone and McLean (2003), clarifying how system quality shapes user perceptions through distinct mechanisms. Furthermore, the result that shows the lack of a substantial correlation between perceived usefulness and perceived ease of use suggests that lecturers may place greater importance on how well the LMS functions and the level of support it provides rather than the quality of the information it delivers.

The second regression model provides additional support for the S-O-R model by showing that lecturer satisfaction is strongly influenced by perceived usefulness and perceived ease of use, with perceived usefulness having the most decisive influence. According to these results, the Expectation-Confirmation Theory developed by Oliver (1980) is extended by this research, which shows that lecturers' perceptions about the effectiveness of LMS significantly influence lecturer satisfaction. Furthermore, the fact that perceived usefulness has a more significant influence than perceived ease of use suggests that lecturers are results-driven and focus more on whether the LMS improves their teaching ability than on how easy it is to use.

4.2. Managerial implications for universities and IT developers

The findings of this study offer several managerial implications for both responsible persons of private universities and IT developers aiming to improve teaching effectiveness through the use of LMS in private universities.

For those responsible in private universities, the results emphasize how important it is for organizations to give faculty support systems as a top priority in enhancing LMS adoption and satisfaction. Since self-efficacy and technical support are essential factors in determining perceived usefulness and ease of use, universities should provide focused training programs, practical workshops, and ongoing professional development to increase the confidence of lecturers in using the LMS. To guarantee a flawless digital teaching experience, specialized technical support teams should be set up to offer prompt troubleshooting and direction. University administrators should collaborate with IT developers to maintain high-performance standards, ensuring the LMS is stable, reliable, and seamlessly integrated with academic tools to enhance its usefulness and support digital learning.

Furthermore, responsible individuals in universities should concentrate on integrating LMS features that directly improve teaching effectiveness, such as data analytics for tracking student performance, interactive content creation tools, and AI-driven feedback mechanisms, since perceived usefulness is the strongest determinant of lecturer satisfaction. Universities should also enhance system functioning and technical support rather than content

quality because information quality does not significantly influence perceived usefulness and ease of use. Therefore, improving the capacity of LMS to support improved learning outcomes and ensuring that these tools align with the instructional objectives of lecturers could significantly increase lecturer satisfaction.

For IT professionals who have developed LMS to commercialize them in the education industry, this study emphasizes how crucial it is to create LMS platforms that highly value system quality and offer extensive technical assistance. To satisfy the diverse demands of lecturers in many academic fields, developers should concentrate on developing an LMS that is not only reliable and functional but also adaptable. Regular upgrades and maintenance should be carried out to keep the system up to date with user expectations and technical improvements. Developers should also consider incorporating features that boost self-efficacy, such as intuitive user interfaces and helpful onboarding guides, making it easier for lecturers to adopt and feel confident using the system.

Since the study highlights self-efficacy and technical support as key factors in lecturer satisfaction with the LMS, IT developers should work closely with universities to establish strong support systems. This includes designing user-friendly platforms with built-in troubleshooting tools, self-help resources, and direct support options. By focusing on usability and technical reliability, IT developers can facilitate smoother LMS adoption, ultimately enhancing teaching effectiveness and lecturers' overall satisfaction. Finally, universities and IT developers are key to improving the effectiveness of LMSs in teaching. Responsible persons and IT developers can create a more supportive and efficient learning environment that empowers lecturers and enhances educational outcomes by focusing on self-efficacy, technical support, system quality, and perceived usefulness.

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The author self-conducted the research design and implementation, analysis, and article writing without using AI applications.

Disclosure statement

The author reported no potential competing interest.

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This research has ethics committee approval from the Myanmar Research Synergy Association (MRSA) with 10/08/2024 and ethical number MRSA20240807. It adhered to the guidelines outlined in the Declaration of Helsinki for human subjects research. All responsibility belongs to the author.

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Ali Dalgıç, Kemal Birdir

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The relationship between festival key success factors and experience perception: The case of Orange Blossom Festival*

Ali Dalgıç[1] and Kemal Birdir[2]

[1]*Corresponding author, Isparta University of Applied Sciences, Faculty of Tourism Isparta/Türkiye, E-mail: alidalgic@isparta.edu.tr, ORCID: https://orcid.org/0000-0002-5575-4825*
[2]*Mersin University, Faculty of Tourism Mersin/Türkiye, ORCID: https://orcid.org/0000-0003-1353-3618*

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Abstract

This study aims to identify the key success factors perceived as successful or unsuccessful by the Orange Blossom Festival participants in Adana. Another goal is to explore the relationship between these factors and participants' experience perceptions. Non-probability sampling, specifically convenience sampling, was used. Data were collected via face-to-face surveys between April 3 and 9, 2017, with 923 completed forms. Analysis revealed higher averages for statements related to "food", "security", and "staff and volunteers" while "convenience" scored lower. Key success factors were found to have a significant positive relationship with experience perceptions. Based on these findings, it is recommended that festival organizers carefully manage these factors from the planning phase through the event's conclusion.

1. Introduction

Events are an essential attraction factor that can directly and indirectly influence a destination's promotion, tourism development, and visitor attraction. Among the most frequently organized events worldwide are festivals, which fall under cultural celebrations. Festivals are events held within a specific theme and time frame, where participants engage to share common emotions and achieve particular objectives. It is possible to state that such events have various physical, social, cultural, commercial, political, and tourism-related impacts. Additionally, from the perspective of event participants, these events can foster socialization, facilitate learning about new cultural values, provide opportunities to meet new people, offer unique experiences, and allow for exploring new places. For both the host destination and the participants, achieving positive outcomes depends on the successful execution of the event. This can be accomplished by providing necessary inputs and an effective management process from the pre- and post-event stages. Focusing on key success factors and integrating them effectively is crucial in this process.

Key success factors can be defined as the essential elements required for the successful execution of an event. These factors influence the event's overall success and, consequently, impact participant satisfaction. In the context of festivals, key success factors may include elements such as "food and beverages" (Getz, 1997; Taylor & Shanka, 2008; Lee et al., 2008; Özdemir & Çulha, 2009; Anil, 2012; Kong, 2015), "facilities/infrastructure" (Getz, 1997; Lee et al., 2008; Özdemir & Çulha, 2009), "festival area" (Lade & Jackson, 2004; Taylor & Shanka, 2008; Anil, 2012), "festival program" (Lade & Jackson, 2004; Lee et al., 2008; Özdemir & Çulha, 2009; Lee & Chang, 2017), "convenience" (Lee et al., 2008; Özdemir & Çulha, 2009; Anil, 2012), "staff/volunteers" (Lee et al., 2008; Özdemir & Çulha, 2009), "activities" (Lade & Jackson, 2004; Cole & Illum, 2006; Kong, 2015), "security" (Getz,

** This study is derived from the doctoral dissertation titled "Analysis of Factors Affecting Festival Visitors' Loyalty: The Case of Adana Orange Blossom Festival", which was presented and approved at Mersin University, Institute of Social Sciences, Department of Tourism Management by Ali Dalgıç.*

*** This study has complied with the Research Publication Ethics stated in "Wager E & Kleinert S (2011) Responsible research publication: international standards for authors. A position statement was developed at the 2nd World Conference on Research Integrity, Singapore, July 22-24, 2010. Chapter 50 in Mayer T & Steneck N (eds) Promoting Research Integrity in a Global Environment. Imperial College Press / World Scientific Publishing, Singapore". For this reason, the author states that he conducted the research within the framework of ethical principles. All responsibility belongs to the author.*

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1997; Kong, 2015), "souvenirs" (Lee et al., 2008; Özdemir & Çulha, 2009) and "information/communication" (Lee et al., 2008; Özdemir & Çulha, 2009). Each of these factors, considered as inputs in the festival context, plays a crucial role in ensuring the continuity, promotion, and marketing of the organized event.

Key success factors can directly influence the experiences of festival participants. Individuals attend such events to escape from daily life and engage in unique experiences. Through effective planning and organization, key success factors can enhance both the cognitive and emotional experience perceptions of participants (Mason & Paggiaro, 2012; Ayob, Wahid & Omar, 2013; Jung et al., 2015; Lee & Chang, 2017). In this research, the primary objective is to identify the key success factors that stand out and exhibit relatively low averages. Another goal is to examine the relationship between key success factors and visitor experience perceptions. The study first presents relevant concepts and the relationships between variables under the conceptual framework section. Subsequently, details regarding the research purpose, sample, data collection process, participant information, and measurement scales are provided under the methodology section. The analysis of data are presented in the findings section. Finally, the study concludes with theoretical and practical implications, limitations, and recommendations for future research.

2. Literature review

The successful execution of a festival requires the fulfillment of multiple essential factors. Certain fundamental elements must be ensured for the event's overall success. The relevant literature defines these factors as "key success factors" (Getz, 1997; Cole & Illum, 2006; Taylor & Shanka, 2008; Marais & Saayman, 2011). Getz (1997) identified key success factors such as "a suitable area for the event", "food and beverage services", "facilities/infrastructure", "accessibility", "crowd management," and "high-quality service". Similarly, Lade and Jackson (2004) emphasized the importance of "high-quality facilities", "festival area", "festival program", "planning and activity management," and "marketing strategies". Cole and Illum (2006) highlighted "entertainment", "socialization", "activities," and "facilities" as crucial for festival success. Taylor and Shanka (2008) considered factors such as "crowd control", "security services", "attractions", "atmosphere", "festival area", "festival timing", "parking areas", "food and beverage services," and "accommodation services" as key success factors. Lee et al. (2008) identified "information services," "staff", "program", "facilities", "convenience", "food," and "souvenirs" as influential elements in festival success. Özdemir and Çulha (2009) also classified "information/communication," "convenience", "festival program", "facilities", "staff", "food and beverage services", and "souvenirs" under key success factors. Anil (2012) found that "festival area", "food," and "convenience" were the most critical factors for a festival's success. Kong (2015) emphasized elements such as "food and beverage services and their prices", "restrooms", "parking areas", "security", "cleanliness," and "activities". Finally, Lee and Chang (2017) identified the most significant key success factors for festivals as the "festival program" and "facilities".

Key success factors are among the most critical elements shaping festival participants' perceptions of the event. These factors can meet participants' expectations and enhance their satisfaction when effectively integrated. One of the most significant determinants of festival attendees' satisfaction levels is their overall experience (Mason & Paggiaro, 2012; Wu, Wong & Cheng, 2014). The essence of an experience is formed when extraordinary events occurring during exceptional times leave a lasting impression on individuals' minds (Geus, Richards & Toepoel, 2016). Experience can be described as the sum of cognitive and emotional states influenced by occurrences during an event (Biaett, 2013). Given that festivals are held periodically for a limited duration and offer participants diverse cognitive and emotional states, one of the primary objectives of attendees is the pursuit of unique experiences. Considering previous research findings, it can be concluded that key success factors significantly influence festival participants' experiences (Ayob et al., 2013; Mason & Paggiaro, 2012; Jung et al., 2015; Lee & Chang, 2017).

It is possible to explain the influence of key success factors on festival success and their relationship with participants' experience perceptions within the systems theory framework. Systems theory is based on input, process, and output principles. Inputs may include human resources, financial resources, equipment and materials, and facilities. The process encompasses components like planning, organization, and supervision. Additionally, systems theory suggests combining these factors with environmental influences can lead to various outcomes (Getz & Frisby, 1988, p. 24). From a systems theory perspective, the successful execution of a festival requires the integration of multiple key success factors, and achieving success depends on effective process management (Mallen & Adams, 2008, p. 27). Each key success factor can be considered an input, and through efficient process management, these inputs can enhance the festival participants' experiences. Within this context, the following research question has been formulated:

RQ1: Are there positive and significant relationships between festival key success factors and festival participants' experiences?

3. Methodology

This study has complied with the Research Publication Ethics stated in "Wager E & Kleinert S (2011) Responsible research publication: international standards for authors. A position statement was developed at the 2nd World Conference on Research Integrity, Singapore, July 22-24, 2010. Chapter 50 in Mayer T & Steneck N (eds) Promoting Research Integrity in a Global Environment. Imperial College Press / World Scientific Publishing, Singapore". For this reason, the author states that he conducted the research within the framework of ethical principles.

This study aims to identify the key success factors perceived as successful and unsuccessful by the participants of the Orange Blossom Festival and to examine the relationship between these factors and participants' experience perceptions. The research was conducted in the context of participants attending the Orange Blossom Festival held in Adana. A sample was determined since it was not feasible to reach all participants due to time and financial constraints. The research sample consists of individuals aged 18 and above who attended the Orange Blossom Festival in Adana. The "convenience sampling method" was chosen for this study. The survey was conducted between April 3 and April 9, 2017, and 923 survey responses were collected. After processing the data obtained from the survey forms into the dataset, analyses for "missing data", "outliers", and "multivariate normal distribution" were performed. As a result of these analyses, it was determined that the study was conducted with a valid dataset consisting of 891 observations.

The collected data were analyzed using the SPSS statistical software package. The findings related to the demographic characteristics of the participants are presented in Table 1. It was determined that 540 participants (60.6%) were female, 452 participants (50.8%) were between the ages of 18 and 29, 392 participants (44.0%) were high school graduates, and 497 participants (55.8%) were single.

Table 1. Participants' demographic characteristics

Gender (n=891)	Frequency	%	Education (n=891)	Frequency	%
Male	351	39.4	Primary School	156	17.5
Female	540	60.6	High School	392	44.0
Age (n=890)			College	115	12.9
18-29 years	452	50.8	University	189	21.2
30-39 years	232	26.1	Postgraduate	39	4.4
40-49 years	94	10.6	*Marital status (n=891)*		
50-59 years	84	9.4	Married	394	44.2
60 years and above	28	3.1	Single	497	55.8

The Festival Key Success Scale was developed based on the studies conducted by Anil (2012), Lee and Chang (2017), Yoon, Lee, and Lee (2010), Lee et al., (2008), Wu and Ai (2016), and Saayman, Kruger, and Erasmus (2012). The Cronbach's Alpha (α) coefficient of the Festival Key Success Factors Scale was 0.947. The Festival Experience Perception Scale was developed based on the studies conducted by Akyıldız (2010), Geus, Richards, and Toepoel (2016), and Lee and Chang (2017). The α coefficient of the Festival Experience Perception Scale was 0.940. The response categories for the items included in the scales were structured using a 5-point Likert scale ("1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree").

4. Findings

The Festival Key Success Factors Scale assessed participants' perceptions of festival attributes. The findings of the descriptive analysis are presented in detail in Table 2. Considering the mean scores of the statements, it can be noted that the following statements had relatively higher means compared to others: "Local foods were available among the foods sold at the festival area", "The food sold at the festival area was of good quality", "The emergency response team at the festival area was adequate", "Festival staff and volunteers were willing to help", "The number of security personnel at the festival area was sufficient", "The security measures taken at the festival area were adequate" and "The variety of food sold at the festival area was sufficient". On the other hand, the following statements had lower mean scores: "Parking spaces were sufficient", "Restrooms were clean", "Rest areas were sufficient," and "The food sold at the festival area was reasonably priced".

Table 2. Descriptive analysis findings of the festival key success factors scale

Statements	Mean	Standard Deviation
Local foods were available among the foods sold at the festival area.	4.27	0.6644
The food sold at the festival area was of good quality.	4.25	0.6405
The emergency response team at the festival area was adequate.	4.24	0.7787
Festival staff and volunteers were willing to help.	4.21	0.6020
The number of security personnel at the festival area was sufficient.	4.19	0.8206
The security measures taken at the festival area were adequate.	4.18	0.8171
The variety of food sold at the festival area was sufficient.	4.17	0.7052
The festival area was well organized.	4.16	0.8607
Festival staff and volunteers responded quickly to our inquiries.	4.16	0.6120
Festival staff and volunteers had sufficient knowledge about the festival.	4.15	0.6107
The festival schedule was appropriate.	4.14	0.9042
The festival atmosphere was good.	4.14	0.8385
Transportation to the festival area was easy.	4.14	0.8793
The festival area was clean.	4.13	0.8757
The festival area was spacious enough.	4.12	0.8497
Festival staff and volunteers were courteous.	4.12	0.6944
The facilities around the festival area (cafes, restaurants, markets, etc.) were sufficient.	4.12	0.8599
Transportation options to the festival were sufficient.	4.10	0.9571
The festival program was well managed.	4.10	0.8591
The festival program was satisfying.	4.08	0.8294
The festival program was well planned.	4.07	0.8543
The festival program was rich in content.	4.07	0.8624
The quality of souvenirs sold at the festival was high.	4.07	0.7899
There was a variety of souvenirs available at the festival.	4.06	0.8369
The festival program was entertaining.	4.04	0.9097
Through festival events, I gained knowledge about local culture.	4.04	0.8323
The prices of souvenirs sold at the festival were reasonable.	4.00	0.8650
Festival brochures provided sufficient information.	4.00	0.7774
Pre-festival announcements (date, time, events, etc.) were adequate.	3.97	0.8390
The price of souvenirs sold at the festival was affordable.	3.96	0.9061
Festival information boards provided sufficient details.	3.94	0.8124
Directional signs at the festival area provided sufficient guidance.	3.94	0.7898
Sufficient information was provided via social media regarding the festival.	3.88	0.8492
The prices of food sold at the festival area were reasonable.	3.81	0.9961
Rest areas were sufficient.	3.79	1.0510
Restrooms were clean.	3.72	1.0324
Parking spaces were sufficient.	3.72	1.1178
Overall	4.06	0.4828

An exploratory factor analysis (EFA) was conducted on the Festival Key Success Factors Scale. Before performing the factor analysis, certain assumptions were considered. These assumptions included: (1) factor loadings of items being 0.40 or above (Şencan, 2005, p. 779), (2) items loading on two dimensions having a cross-loading difference of at least 0.100, (3) communality values being 0.50 or higher, and (4) the use of the Varimax rotation technique (Hair, Black, Babin, & Anderson, 2010). As a result of the factor analysis, six items were removed from the analysis due to cross-loading (i.e., loading on two dimensions with a difference smaller than 0.100). The remaining 30 items were grouped under seven dimensions: program dimension (five items), festival area and accessibility dimension (five items), information dimension (five items), staff and volunteers dimension (four items), souvenirs and convenience dimension (six items), security dimension (three items), and food dimension (two items). The total explained variance was approximately 70%. Additionally, the KMO value was around 0.90, and the Bartlett's Test of Sphericity was found to be significant.

An exploratory factor analysis was also conducted for the Festival Experience Perception Scale, considering the same assumptions. The KMO value was approximately 0.92, and Bartlett's Test of Sphericity was significant. The 11 items in the scale were grouped under two dimensions: emotional experience (seven items) and cognitive experience (four items), with a total explained variance of approximately 73%.

Table 3 presents the correlation matrix showing the relationships between the variables. Upon examining the table, it can be stated that all variables identified as key success factors of the festival have a positive and significant relationship with both emotional and cognitive experience perception variables.

Table 3. Correlation matrix

	1	2	3	4	5	6	7	8	9
1-Program	1								
2-Festival Area & Accessibility	.648**	1							
3-Information	.410**	.448**	1						
4-Staff & Volunteers	.306**	.348**	.316**	1					
5-Souvenirs & Convenience	.543**	.541**	.415**	.275**	1				
6-Security	.470**	.541**	.380**	.309**	.407**	1			
7-Food	.411**	.436**	.392**	.494**	.335**	.390**	1		
8-Emotional Experience Perception	.604**	.609**	.497**	.339**	.499**	.496**	.411**	1	
9-Cognitive Experience Perception	.511**	.515**	.431**	.265**	.424**	.394**	.320**	.700**	1

P<0.01

5. Discussions and conclusions

This study aimed to examine participants' perceptions regarding key success factors at the Orange Blossom Festival in Adana and to analyze the relationships between these key success factors and participants' experience perceptions. When evaluating the findings related to key success factors as input elements, it was observed that statements related to "food", "security", and "staff & volunteers" had higher mean scores. Furthermore, the results of this study indicate a significant and positive relationship between key festival success factors and participants' experience perceptions (both cognitive and emotional). It has been observed that the dimensions of "program", "festival area and accessibility", "information", "staff and volunteers", "souvenirs and convenience", "security", and "food" are all significantly and positively related to both "emotional experience perception" and "cognitive experience perception".

5.1. Theoretical implications

Firstly, in the evaluation of findings concerning key success factors as input elements, it was found that statements regarding "food", "security", and "staff & volunteers" exhibited higher mean scores. In this context, the availability of local food and the quality of food were perceived positively by participants in this festival. Additionally, the adequacy of emergency medical teams, security personnel, and safety measures were other aspects that participants perceived favorably. Lastly, another highly rated aspect was the willingness of staff and volunteers to assist attendees. On the other hand, despite being part of the festival experience, factors related to "convenience"—such as rest areas' availability, restrooms' condition, and parking facilities—had lower mean scores than the overall average. When comparing these results with findings from previous studies in the literature, the "food" dimension identified by Getz (1997), Taylor & Shanka (2008), Lee et al. (2008), Özdemir & Çulha (2009), Anil (2012), and Kong (2015) was also found in this study. Furthermore, the significance of the "security" factor in this study aligns with the findings of Taylor & Shanka (2008) and Kong (2015). The importance of "staff" mentioned by Lee et al. (2008) and Özdemir & Çulha (2009) is also supported by the results of this study. However, the key success factor referred to as "convenience" in studies by Lee et al. (2008), Anil (2012), and Kong (2015) appears to be relatively lacking in this study. This shortcoming could affect the festival's success, image, participant satisfaction, and experience perception. From a systems theory perspective, each key success factor can be seen as a cog in a machine. If one or more of these cogs are faulty, the system may experience disruptions or failures.

Secondly, it has been determined that the dimensions of "program", "festival area and accessibility", "information", "staff and volunteers", "souvenirs and convenience", "security", and "food" all have significant and positive relationships with both "emotional experience perception" and "cognitive experience perception". When comparing these findings with previous studies in the literature (Mason & Paggiaro, 2012; Ayob, Wahid & Omar, 2013; Jung et al., 2015; Lee & Chang, 2017), similar conclusions can be drawn. In this context, key success factors can enhance festival participants' ability to acquire new knowledge while also providing them with an enjoyable escape from daily life. From a systems theory perspective, the proper management of inputs—namely, key success

factors and environmental factors—through an effective process will increase cognitive and emotional experience perceptions among participants.

5.2. Practical implications

Festival organizers should carefully manage the "convenience" dimension to enhance the attendee experience. Ensuring adequate and well-maintained restrooms, parking spaces, and comfortable rest areas can increase visitor satisfaction. Addressing these factors effectively may also positively impact the festival's reputation and long-term success. Moreover, it is recommended that festival organizers carefully integrate and manage key success factors from the planning stage to the event's conclusion. Since festival attendees seek a unique experience, organizers should ensure these expectations are met through a well-structured and seamless festival experience.

5.3. Limitations and future research directions

As with any study, specific limitations exist within the context of this research. The findings apply to the Orange Blossom Festival and similar festivals with comparable themes and scales. Additionally, the study employed a convenience sampling method, where survey forms were distributed to all willing participants. A quota sampling method could yield results that capture more participant characteristics. Furthermore, future research could utilize qualitative methods, such as interviews, to gain deeper insights into the significance, shortcomings, and recommendations regarding key success factors. This approach would provide more detailed information for both theoretical contributions and practical applications. Future studies could also investigate additional factors influencing key festival success factors. Lastly, an important research avenue would be to explore the mediating variables that may impact the relationship between key festival success factors and participants' experience perceptions.

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Author contribution statements

The authors equally conducted the research design and implementation, analysis, and article writing without using AI applications.

Disclosure statement

The authors reported no potential competing interest.

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Andy Lee Baker

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Querying candidates via social media during the recruitment process of employees in hospitality businesses

Andy Lee Baker[1]

[1]*Corresponding author, The University of Alabama, Tuscaloosa, AL, USA, Email: andyleebaker@gmail.com, ORCID: https://orcid.org/0009-0003-6641-7810*

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Abstract

Integrating social media in the recruitment process has transformed hiring practices in the hospitality industry. Given the sector's high employee turnover rates and emphasis on customer service, hospitality businesses increasingly leverage platforms such as LinkedIn, Facebook, and Instagram to assess candidates beyond traditional applications. Social media allows recruiters to evaluate candidates' professional background, communication skills, and cultural fit while also providing access to passive job seekers. However, ethical and legal concerns regarding privacy, bias, and discrimination remain significant challenges. This study explores the advantages, limitations, and implications of social media screening in hospitality recruitment. Through qualitative analysis of HR professionals' perspectives, the findings highlight the need for a balanced approach that integrates social media insights with structured interviews and ethical hiring practices. The study underscores the importance of transparent recruitment policies and employer branding in attracting top talent while maintaining fairness and compliance with labor laws.

1. Introduction

The recruitment process in the hospitality industry is a multifaceted endeavor that requires businesses to identify, attract, and retain employees with the right skills and competencies. Given the high employee turnover rates and the dynamic nature of hospitality services, organizations continuously seek innovative strategies to enhance their hiring practices. In recent years, integrating social media into recruitment has emerged as a significant trend, enabling hospitality businesses to reach a broader audience, assess potential candidates more effectively, and make informed hiring decisions. Social media platforms such as LinkedIn, Facebook, Instagram, and Twitter have become valuable tools for employers to source, screen, and engage with job seekers (Demir & Günaydın, 2023).

The rapid digital transformation and the widespread use of social networking sites have reshaped traditional recruitment methods, shifting them toward more interactive and data-driven approaches (Beşirova, 2024; Skavronskaya et al., 2020). Unlike conventional recruitment channels, social media allows employers to access real-time information about candidates, including their professional backgrounds, interests, and even personality traits. This transparency enables businesses to evaluate a candidate's fit within their organizational culture before initiating formal interview processes. Moreover, social media provides a cost-effective means of reaching passive job seekers who may not be actively searching for new opportunities but could be enticed by compelling job offers.

The hospitality industry, characterized by its service-oriented nature, emphasizes employee attributes such as interpersonal skills, adaptability, and customer service orientation. Unlike technical industries, where qualifications and certifications often dominate the hiring criteria, hospitality businesses rely heavily on soft skills and personal interactions. Social media is an effective medium for assessing these attributes through a candidate's online presence, communication style, and engagement in industry-related discussions (Dominique-Ferreira et al., 2022; Oncioiu et al., 2022). Employers can gain valuable insights into candidates' work ethics, social interactions, and industry knowledge by reviewing their online activity, posts, and professional endorsements.

** The study received approval from the University of Alabama's Human Sciences Ethics Committee under protocol number 2024X-12A/74-3 and dated 2.3.2024. It adhered to the guidelines outlined in the Declaration of Helsinki for human subjects research. All responsibility belongs to the author.*

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Despite the advantages of using social media for recruitment, ethical and legal concerns remain central to this approach. Employers must navigate the fine line between conducting due diligence and infringing on a candidate's privacy (Gonzalez et al., 2020; Kwok & Muñiz, 2021). Many jurisdictions have implemented regulations to protect job seekers from potential discrimination based on social media content, making it crucial for recruiters to develop fair and transparent evaluation criteria. Additionally, biases arising from social media assessments pose risks of unfair hiring practices, as subjective interpretations of online behavior may influence decisions. Thus, hospitality businesses must establish ethical guidelines and best practices to ensure that social media screening complements, rather than replaces, traditional hiring processes.

Furthermore, social media recruitment is not without its challenges. The authenticity of online profiles, misinformation, and the potential for misrepresentation can complicate the hiring process (Demir & Günaydın, 2023; Dominique-Ferreira et al., 2022). Candidates may curate their online personas to project an idealized image that does not accurately reflect their professional competencies or personal characteristics. Hospitality businesses must, therefore, exercise caution and verify information through multiple sources, including structured interviews, reference checks, and skill assessments (Skavronskaya et al., 2020).

Another critical aspect of social media recruitment in hospitality businesses is employer branding. Just as businesses scrutinize candidates, job seekers also evaluate prospective employers based on their online presence (Kwok & Muñiz, 2021). A strong employer brand on social media can attract top talent, fostering engagement and interest among potential candidates. Companies that actively showcase their work culture, employee testimonials, and career development opportunities on social media platforms can enhance their appeal and establish themselves as desirable employers in the competitive hospitality sector (Oncioiu et al., 2022).

Given these considerations, this study aims to explore the role of social media in the recruitment processes of hospitality businesses. It examines how employers leverage social media for candidate screening, the benefits and limitations of this approach, and the ethical implications associated with querying candidates via online platforms. By analyzing current trends, best practices, and industry insights, this study will provide a comprehensive understanding of the impact of social media on recruitment in the hospitality sector.

2. Literature review

Effective recruitment begins with a thorough needs assessment and job analysis, which help hospitality businesses define the qualifications and competencies required for a given role. Social media platforms can assist in this process by providing access to industry trends, competitor hiring strategies, and job market insights. Employers can better align their job descriptions with current industry demands by analyzing job postings and candidate profiles. Social media also facilitates engagement with professionals and industry experts, offering valuable feedback on job roles and required skills (Balisi, 2014; Testa & Sipe, 2012). A well-defined recruitment strategy is essential for attracting top talent in the hospitality industry. Social media is pivotal in this strategy by allowing businesses to target specific demographics, utilize employer branding, and leverage online networks (Rahadi et al., 2022; Rahman et al., 2022). Platforms like LinkedIn enable businesses to create detailed job postings and interact with potential candidates through professional groups and discussions. Moreover, recruitment strategies that incorporate social media advertising can reach a broader audience and enhance employer visibility.

Social media platforms provide extensive networks for sourcing candidates, making it easier for employers to identify individuals who align with their organizational values (Kahl et al., 2022). Advanced search features on LinkedIn, Facebook, and industry-specific platforms enable recruiters to filter candidates based on experience, education, and skill sets (Demir & Günaydın, 2023). Additionally, employee referrals through social media enhance candidate credibility and reduce hiring time. Engaging with candidates through professional discussions and online events can also help recruiters build relationships with potential hires before initiating formal application processes (Sharaburyak et al., 2020). Social media offers recruiters an additional layer of evaluation by providing insights into candidates' communication styles, industry engagement, and professionalism (Demir & Günaydın, 2023). By analyzing candidates' LinkedIn recommendations, endorsements, and participation in professional groups, recruiters can assess their industry involvement and reputation. However, ensuring that social media evaluations are objective and do not introduce biases is crucial. A balanced approach that combines social media screening with traditional evaluation methods, such as interviews and skills assessments, ensures a comprehensive candidate assessment (Parks-Yancy & Cooley, 2023; Yaşar, 2022).

The final recruitment decision should be based on a holistic candidate evaluation, incorporating both social media insights and traditional hiring methods (Hosain et al., 2020). While social media can reveal additional aspects of a candidate's personality and professional network, it should not replace formal assessments (Demir,

2024). Employers must establish clear criteria to ensure fair decision-making and avoid discriminatory practices based on non-job-related social media content. Structured selection processes that integrate social media screening ethically can enhance hiring outcomes. Managing recruitment documents is a critical aspect of hiring, ensuring compliance with legal and organizational standards (Razmerita et al., 2014). Social media recruitment generates large volumes of digital data, including candidate interactions, online applications, and messaging histories. Effective document management systems help businesses track applicant progress, maintain confidentiality, and ensure compliance with data protection regulations (Dittes & Smolnik, 2019). Implementing secure and organized recruitment documentation practices ensures transparency and accountability in the hiring process. By integrating social media effectively into these key recruitment stages, hospitality businesses can enhance their hiring processes while maintaining ethical and legal standards. This literature review provides a foundation for understanding the role of social media in hospitality recruitment, highlighting its benefits, challenges, and best practices.

While social media screening provides employers with additional insights into candidates' personalities, professionalism, and potential cultural fit, it also raises concerns regarding privacy, discrimination, and data protection laws (Ladkin & Buhalis, 2016). One of the primary legal concerns is whether reviewing a candidate's social media activity violates privacy rights (Chatsuwan et al., 2023). In some jurisdictions, labor laws and data protection regulations restrict how employers can access and use personal information shared on social media. For example, the General Data Protection Regulation (GDPR) in the European Union mandates that employers must obtain explicit consent from candidates before collecting or processing their personal data, including social media content. Employers who fail to comply with such regulations may face legal consequences.

Another significant legal issue is the risk of discrimination. Social media profiles often contain personal information about a candidate's race, gender, age, religion, sexual orientation, political views, or disability status—protected characteristics under many anti-discrimination laws (Demir, 2011; Posthuma et al., 2011). If hiring decisions are influenced by such information, even unintentionally, employers may be liable for discriminatory practices. In the United States, for instance, the Equal Employment Opportunity Commission (EEOC) warns that social media screening could lead to biased hiring decisions and potential legal disputes. Many countries lack specific legislation governing the use of social media in recruitment (Demir & Günaydın, 2023). As a result, businesses operate in a legal gray area where practices vary widely. Some companies implement strict policies to ensure compliance with ethical hiring practices, while others engage in informal social media checks without standardized guidelines. Without clear legal frameworks, both employers and job seekers face uncertainties about what is permissible and what constitutes an infringement of rights.

3. Methodology

The study received approval from the University of Alabama's Human Sciences Ethics Committee under protocol number 2024X-12A/74-3 and dated 2.3.2024

3.1. Research design

This study employs a qualitative research design to explore using social media as a tool for querying candidates during the recruitment process in hospitality businesses. The qualitative approach was selected due to its ability to provide an in-depth understanding of the perceptions, attitudes, and experiences of human resource (HR) professionals. By focusing on qualitative interviews, the study aims to uncover insights that may not be easily captured through quantitative methods, allowing for a nuanced exploration of how social media influences recruitment decisions in the hospitality industry.

3.2. Sampling strategy

The study's participants were selected using purposeful sampling, a technique widely utilized in qualitative research to ensure that the chosen individuals possess the relevant experience and expertise to contribute valuable insights. This study's sample comprised 20 HR professionals working in various hospitality businesses, including hotels, restaurants, and travel agencies. The participants were chosen based on their direct involvement in recruitment processes and familiarity with using social media in candidate evaluation.

HR professionals from different management levels (e.g., HR managers, recruiters, and talent acquisition specialists) and various types of hospitality businesses (ranging from small independent establishments to large international chains) were included to ensure diversity in perspectives. This diverse sample allowed the study to capture a broad spectrum of practices and opinions regarding social media screening in recruitment.

3.3. Research questions

- How do HR professionals in the hospitality industry perceive the advantages and disadvantages of using social media for candidate screening during recruitment?
- What are the ethical and legal concerns associated with using social media to evaluate job candidates in hospitality businesses?
- To what extent does social media screening impact hiring decisions, and how do HR professionals mitigate potential biases in the recruitment process?
- What are the differences in social media recruitment practices across various hospitality businesses, and how do these practices align with local labor laws and privacy regulations?

3.4. Data collection

Semi-structured interviews were conducted with the selected HR professionals. This method was chosen because it allows for a structured yet flexible approach to data collection, allowing researchers to explore specific themes and participants to share their perspectives freely. The interview guide consisted of open-ended questions that focused on the following key areas:

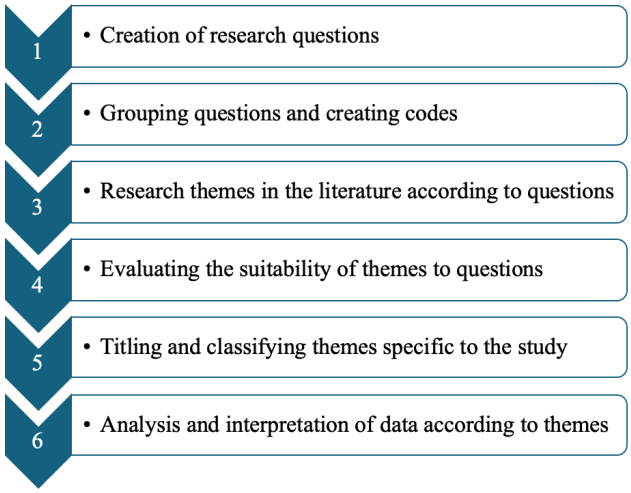
- The extent to which social media is used in the recruitment process.
- The types of social media platforms commonly utilized.
- The specific candidate attributes are assessed through social media.
- Ethical considerations and challenges associated with social media screening.
- The impact of social media evaluations on hiring decisions.

Each interview lasted approximately 45 to 60 minutes and was conducted either face-to-face or via online video conferencing platforms, depending on participant availability and preference. With the participants' consent, the interviews were recorded and later transcribed verbatim to ensure accuracy in data analysis.

3.5. Data analysis

Thematic analysis was employed to analyze the qualitative data collected through interviews. Thematic analysis is a widely used method in qualitative research that involves identifying, analyzing, and reporting patterns (themes) within the data. The process of thematic analysis followed the six-phase framework as in Figure 1.

Figure 1. The process of thematic analysis



Source: Öksüz et al. (2025)

3.6. Ethical considerations

Ethical principles were strictly adhered to throughout the research process. Before participating, all HR professionals were provided with detailed information about the study's purpose, procedures, and confidentiality measures. Written informed consent was obtained from all participants, ensuring their voluntary participation. All

interview transcripts were anonymized to protect participant privacy, and any identifying information was removed. Additionally, the study complied with ethical guidelines related to social media research, recognizing the potential ethical dilemmas associated with online candidate screening. Participants were encouraged to discuss any ethical concerns they faced in their professional practice, contributing to a critical reflection on the ethical dimensions of social media use in recruitment.

3.7. Trustworthiness and rigor

Several measures were implemented to ensure the findings' credibility, dependability, and transferability. Triangulation was used to compare responses from HR professionals in different hospitality sectors to identify commonalities and discrepancies. Member checking was also conducted, where selected participants were allowed to review and validate their interview transcripts and preliminary findings. Furthermore, an audit trail was maintained to document the research process, including decisions made during data collection and analysis.

3.8. Limitations

While this study provides valuable insights, it is essential to acknowledge its limitations. First, the sample size was limited to 20 HR professionals, which, although sufficient for qualitative research, may not fully capture all perspectives within the hospitality industry. Second, the reliance on self-reported data means that responses may be influenced by social desirability bias. Lastly, since social media policies and recruitment practices vary across organizations and regions, the findings may not be entirely generalizable to all hospitality businesses.

4. Results

4.1. Themes for analysis

Theme 1: Perceived benefits of social media screening in recruitment

Many HR professionals in the hospitality industry consider social media a valuable tool for candidate evaluation. According to participants such as P3, P7, P12, and P18, social media platforms provide additional insight into a candidate's personality, behavior, and overall professionalism. Unlike traditional resumes and interviews, social media allows employers to observe candidates more formally, offering a glimpse into their values, interests, and communication style. Participants P2, P9, and P15 highlighted that social media screening helps verify the accuracy of the information provided in resumes. Many recruiters have encountered discrepancies between what candidates claim and what their online presence suggests. For example, a candidate might list extensive experience in customer service, yet their online posts or profiles may indicate a lack of relevant experience. HR professionals view this as a preventive measure to ensure transparency and honesty in recruitment.

Additionally, P4, P11, and P17 emphasized that social media helps assess a candidate's cultural fit within the organization. Understanding a candidate's social behavior is crucial, especially in the hospitality industry, where employee interactions with guests significantly impact customer satisfaction. Employers seek individuals who align with the company's values, and a candidate's social media activity—whether through posts, comments, or shared content—may indicate whether they are a good match. Moreover, some HR professionals noted that social media screening allows businesses to identify potential red flags before hiring. Participants P6 and P13 cited instances where inappropriate online behavior, such as discriminatory comments, excessive negativity, or controversial political statements, raised concerns about a candidate's suitability for a hospitality position. Since employees in this industry frequently interact with diverse clientele, businesses must ensure that hires maintain a professional and inclusive attitude.

Theme 2: Ethical and legal concerns of social media screening

Despite its benefits, social media screening raises significant ethical and legal concerns. Participants such as P1, P6, P10, and P14 expressed apprehension about the invasion of privacy and the subjective nature of hiring decisions based on social media activity. In many cases, social media platforms contain personal content unrelated to professional competencies, making it difficult to draw clear distinctions between a candidate's personal and professional life. P5, P8, and P13 noted that unconscious bias could affect hiring decisions when social media is used as a screening tool. Employers may unknowingly discriminate against candidates based on their personal beliefs, lifestyle choices, or social affiliations. For example, a recruiter might develop a negative impression of a candidate due to their political views, hobbies, or personal associations, even if these aspects have no bearing on their ability to perform the job.

Another issue raised by HR experts such as P16, P19, and P20 is the unclear legal framework surrounding social media screening. While some countries and regions have laws restricting the use of social media in hiring decisions, others lack clear guidelines. This legal ambiguity puts businesses at risk of facing discrimination lawsuits or reputational damage. For instance, rejecting a candidate based on personal social media content may be interpreted as an unfair hiring practice, especially if the candidate challenges the decision legally.

4.2. Results based on themes

4.2.1. Results for businesses

From a business perspective, social media screening provides a supplementary method for evaluating candidates. Hospitality businesses rely heavily on customer-facing employees, making it essential to assess an applicant's communication skills, professionalism, and alignment with company values. By reviewing social media profiles, HR professionals gain insights that may not be evident in traditional hiring processes. However, the lack of standardized policies on social media screening poses a challenge. Many HR professionals noted inconsistencies in how businesses approach online evaluations. While some organizations have structured guidelines for reviewing candidates' social media, others conduct screenings informally without clear criteria. These inconsistencies can lead to biased decision-making and potential legal repercussions.

Furthermore, hospitality businesses must consider the ethical implications of social media screening. While some content may be relevant to professional assessment, such as posts related to industry experience or customer service interactions, other personal content—such as vacation photos or political opinions—may be irrelevant. Employers must strike a balance between gaining useful insights and respecting candidates' privacy.

4.2.2. Results for candidates

For job seekers, social media presence can be both an advantage and a disadvantage. Participants P7, P12, and P18 mentioned that candidates who maintain a professional online image may benefit from social media screenings. A well-curated LinkedIn profile, industry-related blog posts, or positive engagement in professional discussions can enhance a candidate's appeal to employers. Conversely, the fear of being judged based on personal content may lead candidates to restrict or alter their online presence. Some participants, such as P9 and P15, suggested that job seekers should be cautious about what they post, as seemingly harmless content might be misinterpreted by recruiters. This creates additional pressure on candidates to manage their online image, potentially limiting their freedom of expression.

Additionally, candidates may feel that social media screening invades their privacy. P5, P10, and P14 argued that employers should evaluate applicants based on their professional qualifications rather than personal lives. When candidates feel scrutinized based on personal matters unrelated to their job performance, it may create distrust between employers and potential hires.

4.2.3. Legal considerations

Legal concerns surrounding social media screening vary across jurisdictions. Some regions have laws that prohibit employers from requesting access to a candidate's private social media accounts, while others provide minimal regulation. HR professionals P16, P19, and P20 highlighted that the absence of clear legal frameworks creates uncertainty for businesses regarding best practices. Companies that engage in social media screening must ensure compliance with existing labor laws and anti-discrimination policies. Failing to do so can result in legal challenges if a candidate believes they were unfairly rejected based on personal content rather than professional qualifications. To mitigate legal risks, hospitality businesses should establish transparent policies outlining what aspects of social media are considered relevant for hiring decisions.

Moreover, businesses must obtain informed consent from candidates before reviewing their social media profiles. P13 and P17 emphasized the importance of transparency, suggesting that recruiters should communicate openly about the role of social media in the hiring process. Providing candidates with an opportunity to clarify or contextualize their online presence can help ensure fair assessments.

4.2.4. Results for the tourism and hospitality industry

The tourism and hospitality industry places significant emphasis on customer service, communication skills, and public relations. As a result, employers seek candidates who demonstrate professionalism and strong interpersonal abilities. Social media screening can serve as an additional method to evaluate these qualities. However, the fast-

paced nature of the industry means that many potential employees—especially younger candidates—may have an extensive online presence that does not always reflect their professional capabilities. Overreliance on social media screening could result in the exclusion of otherwise qualified candidates based on subjective judgments about their personal lives.

Additionally, the global nature of the hospitality industry introduces cultural considerations. Social norms regarding online behavior vary across regions, and what may be considered acceptable in one culture might be viewed differently in another. HR professionals must account for these cultural differences to avoid biases in social media evaluations.

5. Discussions and conclusions

The use of social media as a tool for screening job candidates in the hospitality industry has sparked significant debate among HR professionals. While social media provides recruiters with additional insights into candidates' personalities, professionalism, and cultural fit, it also presents ethical, legal, and privacy concerns. Based on interviews with 20 HR professionals, this study highlights both the perceived benefits and potential drawbacks of social media screening in recruitment.

A key finding from the study is that HR professionals widely acknowledge social media as a valuable supplementary tool for candidate evaluation (Demir & Günaydın, 2023). Many participants noted that platforms such as LinkedIn, Facebook, Instagram, and Twitter offer an informal yet insightful representation of candidates' communication skills, customer service aptitude, and professionalism. Social media can indicate how well a candidate interacts with others, especially in the hospitality industry, where strong interpersonal skills and positive public engagement are critical (Ma & Cai, 2023; Schweiggart et al., 2025). For example, recruiters often assess whether candidates demonstrate respectful and customer-friendly behavior in online interactions, which can serve as a proxy for how they might behave professionally.

However, despite the advantages of social media screening, ethical and legal concerns remain at the forefront of discussions (Beşirova, 2024). Several HR professionals expressed concerns about privacy invasion, noting that reviewing a candidate's personal life may lead to unfair judgments that are not directly related to their job qualifications. The study also highlights the risk of unconscious bias in recruitment decisions. For example, HR professionals may form negative impressions based on candidates' social or political beliefs, personal lifestyle choices, or cultural expressions, which could lead to discriminatory hiring practices. Furthermore, the legal landscape regarding social media screening remains ambiguous (Berhanu & Raj, 2024; Gibbs et al., 2015). While some jurisdictions have established guidelines restricting the extent to which employers can use social media information in hiring decisions, others lack clear regulations. The absence of standardized legal frameworks creates uncertainty for both businesses and job seekers, leading some organizations to adopt cautious approaches while others continue to use social media screening with little regulation.

The findings of this study suggest that hospitality businesses must establish transparent policies regarding social media use in recruitment. Clear guidelines on what constitutes relevant professional behavior versus personal privacy can help mitigate ethical concerns and ensure fairness in hiring. Additionally, providing training for HR professionals on best practices for social media screening can help reduce bias and improve the consistency of hiring decisions. Overall, while social media screening can be a valuable recruitment tool, it must be used responsibly. Employers must balance the need for additional candidate insights with ethical considerations, ensuring that hiring decisions are fair, non-discriminatory, and legally compliant. Future discussions should focus on developing industry-specific policies and best practices to guide the responsible use of social media in recruitment.

5.1. Theoretical implications

This study contributes to the growing body of research on digital recruitment and HR practices by providing empirical evidence on the role of social media in candidate screening within the hospitality industry. The findings support theories related to employer branding, online impression management, and digital labor market signaling. Specifically, the study aligns with signaling theory, which suggests that candidates use online platforms to communicate their professional competencies while employers use these signals to assess potential hires. The research adds to discussions on privacy management theory by illustrating how HR professionals navigate the ethical boundaries of personal and professional online identities. The study highlights the need for further theoretical development regarding the impact of social media on hiring biases and ethical recruitment practices. Future research could explore how different cultural contexts influence the acceptance and application of social media screening in hiring decisions.

5.2. Practical implications

The findings of this study provide actionable insights for HR professionals, hospitality businesses, and policymakers. First, hospitality businesses should develop clear policies on social media screening to ensure consistency and fairness in recruitment. Defining what aspects of social media activity are relevant to job performance can help mitigate the risks of bias and discrimination. Second, HR professionals should receive training on ethical and legal considerations related to social media screening. Standardized evaluation frameworks can help recruiters make objective hiring decisions while respecting candidates' privacy. Third, job seekers should be aware of the increasing role of social media in recruitment and proactively manage their online presence. Maintaining a professional and positive digital footprint can enhance employability, particularly in industries prioritizing customer service and public engagement. Finally, policymakers should consider establishing clearer regulations on social media use in recruitment. Providing guidelines on ethical hiring practices can help balance employer interests with candidate rights, ensuring fair and transparent recruitment processes in the digital age.

5.3. Limitations and suggestions for future studies

While this study provides valuable insights into the use of social media in recruitment, it has several limitations. First, the sample size was limited to 20 HR professionals within the hospitality industry, which may not fully capture the diversity of perspectives across different regions and business models. Future research should consider expanding the sample size and including participants from various sectors to provide a more comprehensive analysis. Second, the study relies on qualitative interviews, subject to self-reporting biases. Participants may have presented socially desirable responses rather than fully disclosing their true practices and opinions. Future studies could incorporate observational methods or experimental designs to validate findings and minimize bias. Third, this study focuses on HR professionals' perspectives, but future research should also examine job seekers' experiences with social media screening. Investigating how candidates perceive and respond to employers' online evaluations could provide a more balanced understanding of the implications of social media screening in recruitment. Finally, as digital recruitment continues to evolve, future studies should explore the role of artificial intelligence and automated tools in social media screening. Examining how AI-driven recruitment platforms analyze candidate profiles and their impact on hiring fairness and bias would be valuable to the existing literature.

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Author contribution statements

The author self-conducted the research design and implementation, analysis, and article writing without using AI applications.

Disclosure statement

The author reported no potential competing interest.

Ethical committee approval

The study received approval from the University of Alabama's Human Sciences Ethics Committee under protocol number 2024X-12A/74-3 and dated 2.3.2024. It adhered to the guidelines outlined in the Declaration of Helsinki for human subjects research. All responsibility belongs to the author.

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Research trends and the impact of ChatGPT on educational environments

Thoriqi Firdaus, Rizqoh Mufidah, Rika Nur Hamida, R'maya Inkya Febrianti, Alvira Eka Rahel Guivara

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Research trends and the impact of ChatGPT on educational environments

Thoriqi Firdaus[1], Rizqoh Mufidah[2], Rika Nur Hamida[3], R'Maya Inkya Febrianti[4] and Alvira Eka Rahel Guivara[5]

[1]*Corresponding author, Department of Natural Science Education, Universitas Negeri Yogyakarta, Indonesia, E-mail: thoriqifirdaus.2023@student.uny.ac.id, ORCID: https://orcid.org/0009-0005-2340-8468*
[2]*Department of Natural Science Education, Universitas Trunojoyo Madura, Indonesia, ORCID: https://orcid.org/0009-0006-5746-3120*
[3]*Department of Primary Education, Universitas Trunojoyo Madura, Indonesia, ORCID: https://orcid.org/0009-0003-8027-1336*
[4]*Department of Natural Science Education, Universitas Trunojoyo Madura, Indonesia, ORCID: https://orcid.org/0009-0007-7728-2674*
[5]*Department of Natural Science Education, Universitas Trunojoyo Madura, Indonesia, ORCID: https://orcid.org/0009-0008-6990-598X*

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Abstract

This study aims to explore research trends and patterns and analyze ChatGPT's impact on education. The methodology employs a mixed-method approach, incorporating bibliometric analysis and a systematic literature review. Research data were sourced from the Scopus database using the keywords "ChatGPT" AND "Education" OR "Learning." The findings indicate that the trend of document publications in the Scopus database related to ChatGPT has seen a notable increase since its introduction in 2022, continuing through 2024. The journal JMIR Medical Education has emerged as the foremost source of citations, making significant contributions. The United States leads the way in article contributions (22.6%), followed by China (9.6%). Countries such as the United Kingdom, Canada, and Italy display high levels of international collaboration, likely enhancing the diversification and quality of research.

1. Introduction

The advancement of technology in the era of Society 5.0 has transformed the educational paradigm, ushering in a shift toward digitalization in the learning process (Firdaus, 2023). The advancement of the digital era has positioned artificial intelligence (AI) technology as a central component in the education sector (Sadiku et al., 2022). One of the latest developments in AI is the introduction of natural language models such as ChatGPT in educational settings (Kamalov et al., 2023). The deployment of ChatGPT in educational environments yields significant impacts (Castillo et al., 2023). ChatGPT introduces a new paradigm for teachers and students through AI's capability to answer various questions and respond in a human-like manner (Dalalah & Dalalah, 2023). The emergence of ChatGPT has revolutionized education in an era characterized by rapid and boundless technological usage (Vargas-Murillo et al., 2023). ChatGPT is unavoidable in demonstrating education's role in addressing the era's advancements.

The effects of ChatGPT on learning compel educators and students to continuously explore its strengths and weaknesses (Gill et al., 2024; Firdaus et al., 2024). The technological era has broadly impacted the use of ChatGPT, making learning more diverse by fostering greater student engagement and understanding (Einarsson & Lund, 2023). ChatGPT's ability to respond to various questions, akin to human intelligence, has led to significant changes in learning (Javaid et al., 2023). Concerns about detecting fake texts generated by ChatGPT highlight teachers' need for proper management as facilitators (Dalalah & Dalalah, 2023). Supervising ChatGPT in addressing various scientific inquiries can reveal potential weaknesses in the teaching and learning process (Karatas et al., 2024). Academics must adapt teaching practices and assessments to embrace the new reality of readily available AI (Sullivan et al., 2023). ChatGPT has the potential to streamline access to information and assist teachers in curriculum

**This study has complied with the Research Publication Ethics stated in "Wager E & Kleinert S (2011) Responsible research publication: international standards for authors. A position statement was developed at the 2nd World Conference on Research Integrity, Singapore, July 22-24, 2010. Chapter 50 in Mayer T & Steneck N (eds) Promoting Research Integrity in a Global Environment. Imperial College Press / World Scientific Publishing, Singapore". For this reason, the author states that he conducted the research within the framework of ethical principles. It is not a human study, so ethical approval is not required. All responsibility belongs to the author.*

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planning, yet integrating this technology raises ethical dilemmas, including privacy, confidentiality, and bias (Srinivasan et al., 2024). Additional concerns regarding ChatGPT relate to the reduced interaction between students and teachers (Limna et al., 2023). Therefore, the deployment of ChatGPT by educators and students requires astuteness in its application, ensuring its ethical, reliable, and efficient use.

ChatGPT has become a popular choice for exploring study subjects in various academic publications. Research related to ChatGPT delves into the development of algorithms that mimic human responses (AI Lily et al., 2023), educators' perceptions (ElSayary, 2024), learners' views (Shoufan, 2023), deficiencies and constraints (Tyson, 2023), as well as the effects and prospects of ChatGPT for students (Gill et al., 2024). Anticipating digital literacy in education seeks to address disruptions caused by ChatGPT and its negative impacts on the educational landscape. However, the historical significance of using ChatGPT is increasing, as the chatbot can research, integrate, interpret, and compile content in a human-like manner, presenting substantial transformations and obstacles for the education domain (Tirado-Olivares et al., 2023).

The presence of ChatGPT has stimulated academic discussions and research on its impact on educational environments. Bibliometric analysis and systematic literature review approaches are crucial for comprehensively understanding the effect. Bibliometric analysis is a method to explore and analyze scientific data to reveal the evolution of a field and highlight emerging areas within it (Donthu et al., 2021). In contrast, a systematic literature review (SLR) aims to identify all studies addressing a research question and its methodology, developed to minimize selection, publication, and data extraction biases (Nightingale, 2009).

Bibliometric analysis enables researchers to identify research trends, collaboration networks, and the evolving knowledge map related to using ChatGPT in education. Conversely, SLR can provide a detailed overview of existing research findings, identify benefits and challenges encountered, and offer insights into the ethical and pedagogical implications of using this technology. The combination of these two methods not only provides a comprehensive picture of ChatGPT's impact on education but also helps identify existing research gaps and potential future developments. Thus, this study aims to explore previous research trends and patterns and analyze the effects of ChatGPT on education.

2. ChatGPT

ChatGPT stands for Generative Pre-Trained Transformer. It was first introduced to the public by OpenAI in November 2022 and originated in the United States. OpenAI has developed a language model called ChatGPT to generate human-like text (OpenAI, 2022). ChatGPT is a processing model composed of deep learning and reinforcement algorithms trained on over 150 billion human-created items (Downling & Lucey, 2023). ChatGPT has garnered widespread popularity across various demographics. Statistical analysis indicates that ChatGPT users have increased significantly since its launch, with nearly 2 billion monthly visits by April 2024 (Duarte, 2024). The latest version of the ChatGPT application is GPT-4o, launched on May 13, 2024, offering enhanced intelligence and significantly faster text, voice, and vision processing capabilities. GPT-4o surpasses existing models in comprehending and discussing images that users share (Open AI, 2024). The AI capabilities within ChatGPT enable it to learn continually, improve, and even self-develop without human programming assistance (George et al., 2023). As long as users continue to pose questions to ChatGPT, its ability to answer various questions, both simple and complex, will improve, eventually matching the precision of human-generated responses (Kabir et al., 2024). Most ChatGPT users are aged 25 to 34, with the top target audience categories including programming and developer software, computer electronics and technology, video game consoles and accessories, education, and graphics (Similarweb, 2024).

3. Method

This study has complied with the Research Publication Ethics stated in "Wager E & Kleinert S (2011) Responsible research publication: international standards for authors. A position statement was developed at the 2nd World Conference on Research Integrity, Singapore, July 22-24, 2010. Chapter 50 in Mayer T & Steneck N (eds) Promoting Research Integrity in a Global Environment. Imperial College Press / World Scientific Publishing, Singapore". For this reason, the author states that he conducted the research within the framework of ethical principles. It is not a human study, so ethical approval is not required.

3.1. Data source and search strategies

The research data for this study comprises documents from the Scopus database that discuss ChatGPT in educational settings. The selection of documents does not impose any publication start date constraints, as ChatGPT

only emerged in 2022. The choice of the Scopus database is based on the platform's extensive geographical and thematic coverage (Dindorf et al., 2023). The sample search utilizes article titles, abstracts, and keywords with the terms “ChatGPT" AND "Education” OR “Learning” or employs the query (TITLE-ABS-KEY (ChatGPT) AND TITLE-ABS-KEY (education) OR TITLE-ABS-KEY (learning)).

3.2. Research design and data analysis

This study employs a mixed-method approach, integrating quantitative and qualitative research methodologies. The quantitative aspect of the research utilizes bibliometric analysis, while the qualitative component employs a systematic literature review.

3.2.1. Bibliometric analysis

Bibliometric analysis is a statistical method characterized by its precision in exploring and analyzing large volumes of scientific data to reveal variations and highlight developments within a specific field (Donthu et al., 2021). This study utilizes bibliometric analysis to identify emerging research trends related to using ChatGPT in education and learning. Based on research publications indexed in Scopus as of July 7, 2024, there are 4,402 research documents published in Scopus. However, for this bibliometric analysis, the study is limited to document types classified as articles and sources limited to journals, resulting in 2,024 documents. This study employs R Studio software with the Biblioshiny package for bibliometric analysis. Thus, documents are exported in BibTeX format. Before the analysis, 20 articles were excluded due to non-compliance with bibliometrics metadata requirements, leaving 2,004 articles for analysis.

Table 1. Completeness of bibliographic metadata

MD	Description	MD	MS %	Status
AU	Author	0	00.00	Excellent
DT	Document Type	0	00.00	Excellent
SO	Journal	0	00.00	Excellent
LA	Language	0	00.00	Excellent
PY	Publication Year	0	00.00	Excellent
TI	Title	0	00.00	Excellent
TC	Total Citation	0	00.00	Excellent
C1	Affiliation	19	0,065972222	Good
DI	DOI	22	01.10	Good
AB	Abstract	75	0,176388889	Good
DE	Keywords	219	0,480555556	Acceptable
RP	Corresponding Author	240	0,525694444	Acceptable
ID	Keywords Plus	1067	53.22.00	Critical
CR	Cited References	2005	100.00.00	Completely missing
WC	Science Categories	2005	100.00.00	Completely missing

MD: Metadata; MS: Missing Count

3.2.2. Systematic literature review

The systematic literature review identifies eligible studies by following the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). PRISMA is an evidence-based set of policies that enhances the transparency and quality of systematic reviews (Figure 1). These guidelines assist researchers in providing clear, detailed explanations, ensuring that readers can fully understand the methods used and the results obtained (Page et al., 2021).

4. Results

4.1. Bibliometric mapping of extant studies

4.1.1. Descriptive analysis: evolution of publications and the most globally cited articles

The publication rate of articles discussing ChatGPT began in 2022 and has since seen a significant increase in user engagement and rapid development through 2023 and 2024. Numerous authors have contributed articles examining the influence and impact of ChatGPT on the educational domain. The frequency of research outcomes between 2022 and 2024 is depicted in Figure 2.

Table 2, which presents the annual scientific production, demonstrates the increase in articles published yearly. The rise in the number of articles discussing ChatGPT has been recorded over the past three years, namely 2022,

2023, and 2024. In 2022, the initial year of ChatGPT's emergence, two research publications were listed in the Scopus database. In 2023, there was a notable increase, with 813 articles published. This trend continued with a significant surge in 2024, reaching 1,189 published articles. In 2024, the widespread use of ChatGPT was evident, particularly among students, university attendees, educators, and academic staff. Research on ChatGPT in 2024 gained remarkable popularity. The number of publications is closely related to the average number of citations per year. The average citation per year is detailed in Table 2.

Figure 1. PRISMA Model

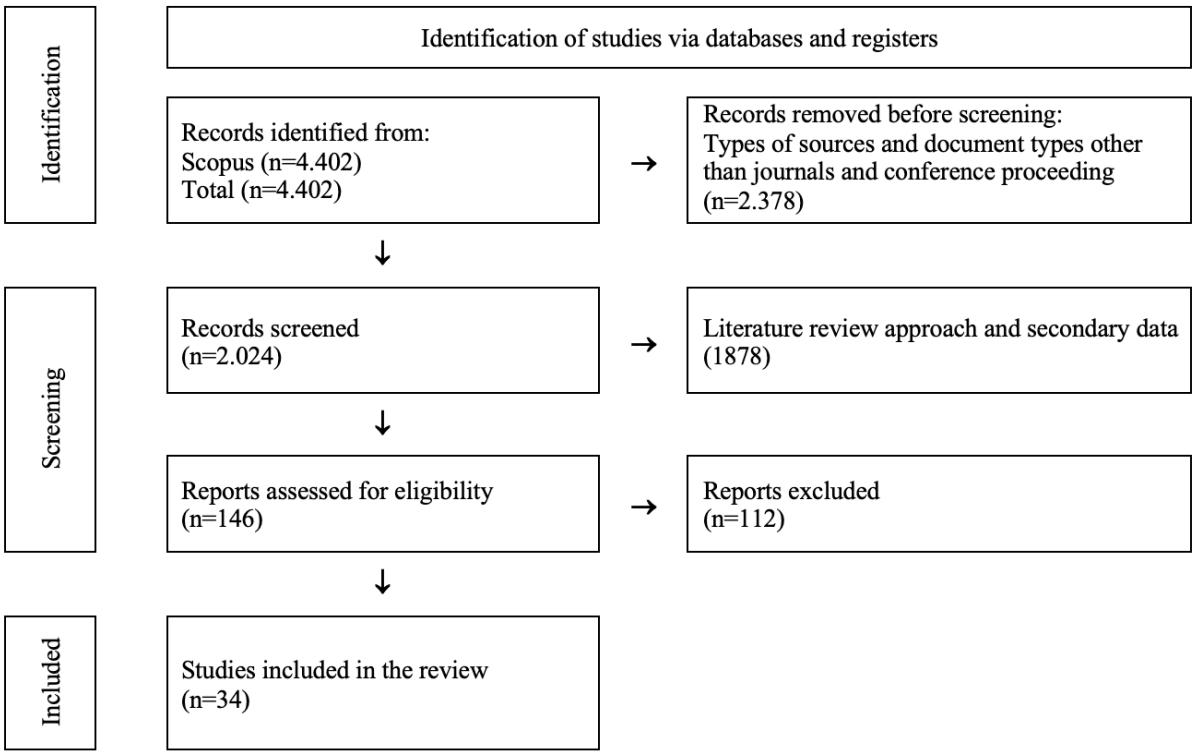


Figure 2. Annual scientific production

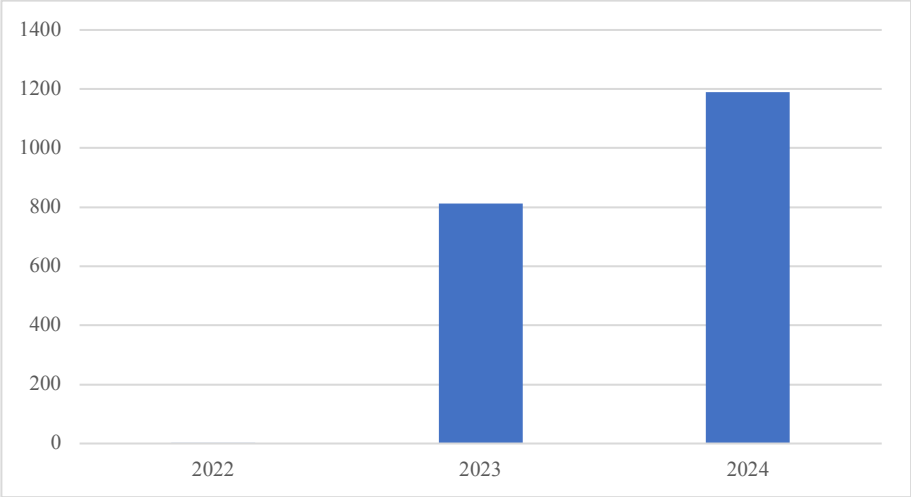


Table 2. Average citation per year

Year	MeanTCperArt	N	MeanTCperYear
2022	117,50	2	39,17
2023	20,12	813	10,06
2024	1,95	1189	1,95

Table 2, "Average Citation per Year," illustrates the average total citations over the three years considered. The average number of citations per article in 2022 is notably high, at 117.50. The small sample size influences this elevated figure, as only two articles were published that year. It suggests that each article was highly impactful. The average citations per year for 2022 is 39.17, indicating that despite the small sample size, the articles were very influential. In 2023, the average number of citations per article decreased significantly to 20.12. This decline corresponds with a substantial increase in the number of published articles on ChatGPT in the Scopus database, which rose to 813. The broader and more diverse coverage in 2023 likely contributed to the lower average citations per article. The average citations per year also decreased to 10.06, reflecting the increased number of articles diluting the citation impact of highly cited works. By 2024, the average citations per article further declined to 1.95, despite the number of articles increasing to 1,189, even though data collection occurred mid-year. This trend indicates a continued rise in publications, leading to broader coverage and reducing the average number of citations per article. The average number of citations per year in 2024 stands at 1.95, showing a sharp decline in citation impact compared to previous years.

4.1.2. Citation source analysis and local impact

Scientific articles indexed in Scopus that investigate and understand the impact of ChatGPT in educational settings total 2,006 documents published in various international journals. The overall number of papers collected has been published across different journals. One measure of a scientific article's success is the number of citations it receives. The higher the citation count, the greater the benefit and significance of the article. Consequently, the potential readership dramatically influences the impact and credibility of a journal. The most relevant sources for this research are presented in Figure 3, and the local impact sources are detailed in Table 3.

Based on Figure 3, the journal with the highest number of scientific articles on the analysis of ChatGPT is JMIR Medical Education, with 46 articles. Education and Information Technologies follows it with 34 articles, and Computers and Education: Artificial Intelligence with 29 articles. The Journal of Applied Learning and Teaching and the Journal of Chemical Education have an equal number of publications, with 23 articles each. IEEE Access occupies the fifth through eighth positions with 22 articles, Education Sciences with 19 articles, Scientific Reports and TechTrends with 18 articles, and Journal of Medical Internet Research with 15 articles. The most relevant sources are closely related to the local impact sources presented in Table 3.

Figure 3. Most relevant sources

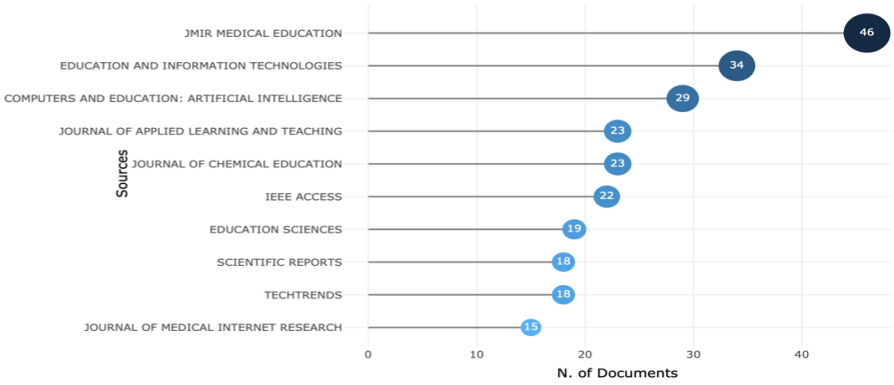


Table 3. Source local impact

Source	h_index	g_index	m_index	TC	NP
JMIR Medical Education	12	33	6	1112	46
Journal of Applied Learning and Teaching	12	23	6	1145	23
Journal of Chemical Education	10	18	5	334	23
Computers and Education: Artificial Intelligence	8	13	4	203	29
Education and Information Technologies	8	18	4	329	34
Education Sciences	6	11	3	139	19
International Journal of Management Education	6	9	3	340	9
Scientific Reports	6	9	3	88	18
European Archives of Oto-Rhino-Laryngology	5	11	2,5	124	13
International Journal of Educational Technology in Higher Education	5	10	2,5	287	10

According to Table 3, JMIR Medical Education is identified as the journal with the highest number of articles and possesses robust metrics. It indicates that many authors have cited articles from this journal as references. JMIR Medical Education discusses language processing models or programming codes by ChatGPT that are revolutionizing medical education. Education and Information Technologies exhibit equally robust metrics as Computers and Education: Artificial Intelligence, though their research foci differ. Education and Information Technologies concentrates on ChatGPT's potential as a learning catalyst, while Computers and Education: Artificial Intelligence explores advanced tool accessibility based on artificial intelligence (AI). The Journal of Applied Learning and Teaching and the Journal of Chemical Education have equal publications and robust metrics. The Journal of Applied Learning and Teaching significantly impacts discussions on the limitations and challenges of AI, as well as the potential of ChatGPT for enhancing student learning. In contrast, the Journal of Chemical Education primarily addresses the performance and potential of ChatGPT to effect substantial changes in chemistry education.

Education Sciences is relevant to integrating ChatGPT into teaching strategies, whereas Scientific Reports focuses on the implications of ChatGPT for scientific communication. The International Journal of Management Education primarily addresses strategies for integrating ChatGPT into education from a constructivist learning perspective. Although these three journals possess similarly strong metrics, their research focuses differ while remaining within the same overarching context. The European Archives of Oto-Rhino-Laryngology is dedicated to identifying responses generated by ChatGPT across various domains. The International Journal of Educational Technology in Higher Education concentrates on evaluating the proficiency and reliability of ChatGPT. Despite having relatively lower metrics, these journals maintain their credibility and value in the academic discourse.

4.1.3. Collaboration analysis: countries and authors

Figure 4, "Most Relevant Authors," illustrates data on authors with the most relevant articles published. Zhang Y is the leading author, having published 15 journals. It is followed by three authors—Wang C, Wang J, and Wang Y—each with 14 articles. Chen J's count decreases to 12 articles, and further down, Li Z, Seth I, Wang X, and Wang Z each have 11 articles. The lowest count is observed for Chen Y, who has published nine articles. The data in Figure 4 shows a non-uniform, zigzag pattern of author contributions, with the colors indicating decreasing publication numbers. As the publication numbers decrease, the colors shift from dark blue to light blue, reflecting the diminishing quantity of published work.

Table 4 provides data on the local impact of authors, including several metrics: h-index, g-index, m-index, total citations (TC), and number of publications (NP). The h-index reflects the number of significant publications an author has. The g-index offers a more detailed view of frequently cited articles, emphasizing quality over quantity. The m-index accounts for the duration of a researcher's productivity, providing insight into how quickly an author establishes their scientific impact.

Figure 4. Most relevant authors

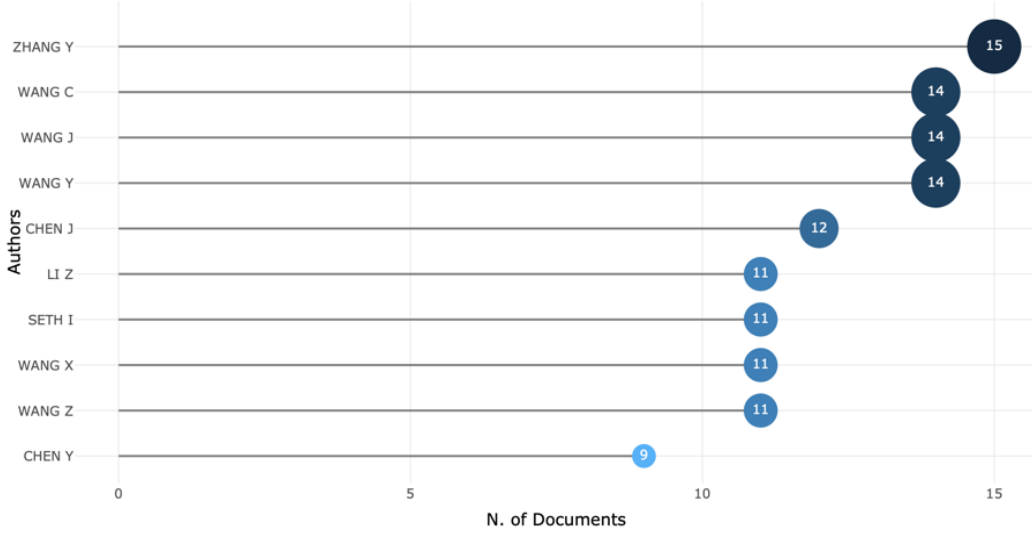


Table 4. Authors local impact

Author	h_index	g_index	m_index	TC	NP
Tan S	7	8	3,5	1253	8
Seth I	6	11	3	153	11
Rozen WM	5	9	2,5	139	9
Xie Y	5	6	2,5	134	6
Currie G	4	4	2	63	4
Gupta R	4	4	2	72	4
Hunter-Smith DJ	4	4	2	129	4
Karakose T	4	4	2	45	4
Li B	4	6	2	41	7
Pack A	4	5	2	52	5

Table 5. Corresponding authors countries

Country	Articles	Articles %	SCP	MCP	MCP %
USA	453	22,6	396	57	12,6
China	193	9,6	151	42	21,8
United Kingdom	85	4,2	59	26	30,6
Australia	66	3,3	47	19	28,8
Germany	58	2,9	42	16	27,6
India	51	2,5	36	15	29,4
Turkey	51	2,5	45	6	11,8
Korea	45	2,2	34	11	24,4
Canada	40	2	22	18	45
Italy	39	1,9	27	12	30,8

Table 4 shows that TAN S has the highest h-index, while SETH I has the highest g-index, indicating differences in citation distribution across their articles. The higher m-index values for TAN S and SETH I reflect their consistent productivity over a more extended period. The author's local impact data is closely related to the countries of the corresponding author, as presented in Table 5. The United States (USA) is the most significant contributor, with 453 articles accounting for 22.6%. Most of these articles are single-country publications (SCP) (396), with a relatively low percentage of multi-country publications (MCP) at 12.6%. Despite the high scientific output, domestic researchers conduct much of the research independently. China is the second-largest contributor, with 193 articles (9.6%) and a higher proportion of MCP at 21.8%, indicating greater involvement in international collaboration than the USA.

The United Kingdom, Canada, Italy, and India show a high tendency for international collaboration, with MCP percentages of 30.6%, 45%, 30.8%, and 29.4%, respectively. It suggests that these countries are active in international cooperation, which enhances the diversification and quality of research. High MCP percentages indicate a positive inclination towards international collaboration, with countries possessing strong global research networks or specialized facilities often attracting collaborative interest from other nations. Government or institutional policies promoting collaboration can further increase MCP percentages. Figure 5 presents a world map where countries are shaded in varying gradients of blue. Darker blue shades represent higher levels of scientific production, while lighter shades indicate lower levels than dark blue. Some countries are not colored, indicating a lack of data or deficient scientific output.

Figure 5 illustrates the distribution of scientific production across countries, with varying shades of blue representing the intensity of scholarly output. Countries such as the United States are shaded in a very dark blue, indicating a very high level of scientific production. It includes factors such as the number of publications, research, or other scientific contributions. Other countries like Canada, China, Germany, and several European and Asian nations are depicted in lighter shades of blue, reflecting moderate levels of scientific output. Many countries in Africa, parts of Asia, and Latin America are shown in even lighter shades or are not colored at all, indicating low levels of scientific production or a lack of available data. Table 6 presents the Top 10 countries with the highest number of citations for their scientific work, highlighting the global impact and recognition of research contributions from these nations.

Table 6 enumerates the ten nations most frequently cited in academic publications based on total citations (TC) and average citations per article (ACA). The United States leads with the highest total citations (4039), despite its

average citations per article (8.90) not being the highest. It indicates a substantial volume of publications. The United Kingdom ranks second in total citations but boasts the highest average citations per article (25.30), indicative of the high quality of research produced by UK scholars. Australia ranks third in total citations, with a similarly high average of citations per article (18.50), underscoring its significant contribution to academic literature. China registers a considerable number of total citations, though with a lower average of citations per article (5.90), suggesting a high volume of publications with varied citation impact. India presents a moderate contribution in total and average citations per article (12.90), reflecting relevant and impactful research.

Hong Kong exhibits relatively high total citations and a notable average of citations per article (15.30). The United Arab Emirates demonstrates a high average of citations per article (17.20), indicative of influential research, despite its total citations being lower than other countries in this list. Italy shows a similar total citation count to the United Arab Emirates, with relatively high average citations per article (13.50), denoting significant academic contributions. Canada makes a moderate impact in both total citations and average citations per article (12.30), highlighting the relevance of its research. South Korea rounds out the list with the lowest total citations but a moderate average of citations per article (10.00), indicating a substantial number of publications with a reasonably good citation impact.

Figure 5. Countries scientific productions

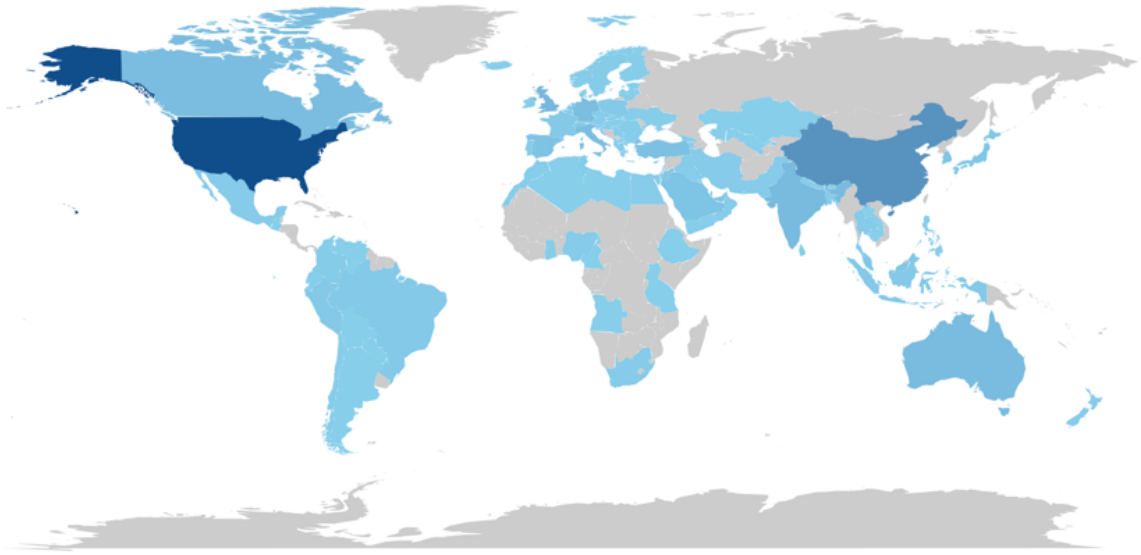


Table 6. Most cited countries

Country	TC	Average article citations
Usa	4039	8,90
United Kingdom	2151	25,30
Australia	1220	18,50
China	1141	5,90
India	658	12,90
Hong Kong	581	15,30
United Arab Emirates	533	17,20
Italy	525	13,50
Canada	492	12,30
Korea	451	10,00

4.1.4. Development of ChatGPT research issues

The total distribution of publications is closely related to the number of citations each year. Table 7 presents the top 10 most-cited documents, highlighting the most influential research outputs in the field.

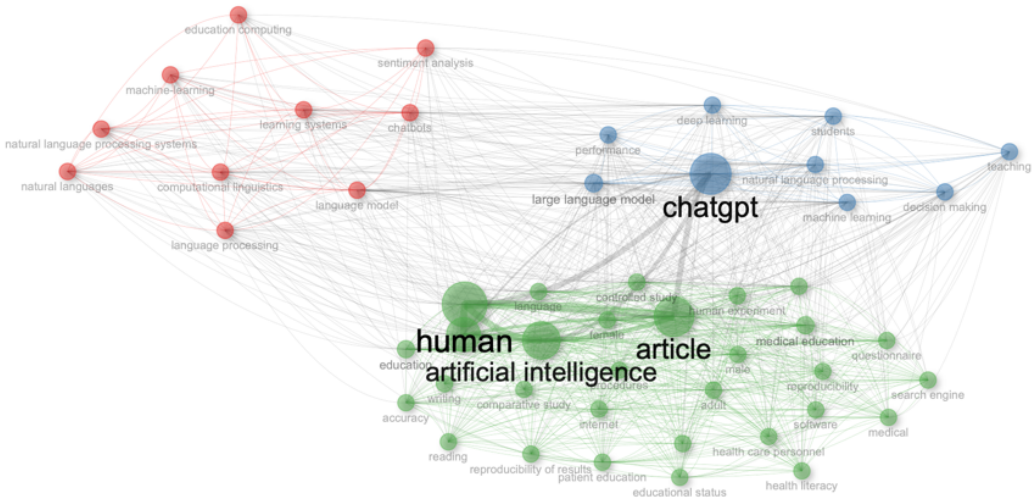
Table 7. Most cited document

Paper	DOI	TC	TCY	NTC
Dwivedi YK, 2023	10.1016/j.ijinfomgt.2023.102642	953	476,50	47,36
Gilson A, 2023	10.2196/45312	611	305,50	30,36
Tlili A, 2023	10.1186/s40561-023-00237-x	418	209,00	20,77
Rudolph J, 2023	10.37074/jalt.2023.6.1.9	400	200,00	19,88
Cotton DRE, 2024	10.1080/14703297.2023.2190148	334	334,00	171,40
Cascella M, 2023	10.1007/s10916-023-01925-4	313	156,50	15,55
Pavlik JY, 2023	10.1177/10776958221149577	289	144,50	14,36
Salvagno M, 2023	10.1186/s13054-023-04380-2	281	140,50	13,96
Cooper G, 2023	10.1007/s10956-023-10039-y	241	120,50	11,98
Lim WM, 2023	10.1016/j.ijme.2023.100790	237	118,50	11,78

Table 8. Trend topics

Term	Frequency	Year (Q1)	Year (Median)	Year (Q3)
Educational status	77	2023	2023	2024
Writing	57	2023	2023	2024
Human experiment	56	2023	2023	2023
Artificial intelligence	809	2023	2024	2024
Human	585	2023	2024	2024
ChatGPT	566	2023	2024	2024

Figure 6. Co-occurrences network



Citations used in scientific writing acknowledge the influence of previous scholarly work. The total number of citations an article receives is considered a precise indicator of its impact within a research domain. The recognition of the top 10 most-cited articles in Table 7 underscores the significance of these research outputs. These articles provide valid and credible information on ChatGPT's understanding, development, and impact. Articles with high citation counts are highly relevant to their research domain and offer critical solutions to existing problems, making them significant contributions that serve as a foundation for discoveries. The most-cited documents are closely related to the trending research topics in Table 8.

Table 8 reveals six prominent research topics and their associated trends. The issues garnering significant attention and influencing citation counts from 2023 to 2024 include Artificial Intelligence (AI), with a term frequency of 809. It is followed by the topics of humans, with a term frequency of 585, and ChatGPT, with a term frequency of 566. These three topics are particularly prominent and are a substantial focus of current research discussions. In addition, the trend topics educational status, writing, and human experiment have term frequencies of 77, 57, and 56, respectively. Despite having lower frequencies, these topics continue to attract the interest of researchers. All six trend topics are closely interconnected. Furthermore, the relationship between these terms extends beyond the six mentioned, encompassing related terms such as language model, medical education, learning, deep learning, controlled study, and others. Figure 6 illustrates the correlations between these various topics.

Table 9. Extraction of the studies in the review

Article	Sample size and characteristics	Type of research	Main finding
(Xu et al., 2024)	Nine experts: 3 ICT experts and six higher education professors.	Qualitative research	ChatGPT has the potential to address challenges faced by learners in Personal Learning Environments (PLEs) by enhancing cognitive, non-cognitive, and metacognitive skills
(Lyu et al., 2023)	Sixty-two low-dose chest computed tomography lung cancer screening scans and 76 brain magnetic resonance imaging metastases screening scans.	Experimental research	ChatGPT can successfully translate radiology reports into plain language with an average score of 4.27
(Papastratis et al., 2024)	3000 virtual user profiles and 1000 real profiles for experiments	Experimental research	AI-based diet recommendation methods can generate accurate and personalized weekly meal plans for different cuisines, population groups, and medical conditions with high accuracy and variability.
(Jo et al., 2024)	Ten evaluators	Evaluative research study	the three Generative Artificial Intelligence (GAI) tools, GPT-4, Google Bard, and CLOVA X, demonstrated similar or better communicative competence compared to the information book regarding questions
(Wang et al., 2023)	Fifty-two medical students participated in the 2020 examination, 49 medical students took part in the 2021 examination, and 65 students participated in the 2022 examination.	Comparative research	ChatGPT's performance in the Chinese National Medical Licensing Examination (NMLE) was lower than that of medical students, with its correct answer rate being influenced by the year of the exam questions released, indicating the potential for improvement through deep learning.
(Sun, 2024)	100 students' English	Experimental in nature research	the ChatGPT-based language model demonstrates the remarkable potential for diverse applications in English language education
(Avello-Martínez et al., 2024)	41 master's students: an experimental group with 20 students and a control group with 21 students.	Experimental research	ChatGPT did not significantly improve digital storytelling skills in the short term.
(Sabir et al., 2024)	219,294 ChatGPT tweets were categorized as 56,012 positive, 107,796 negative, and 554,870 neutral.	Experimental research	achieving an accuracy of 96.41% with the SVM classifier when using TF-IDF as a feature extraction technique.
(Choi, 2023)	312 MCQs derived from the K-CBMSE test items	Evaluative research	ChatGPT exhibited % overall accuracy of 76.0% in answering multiple-choice questions, with limitations in generating correct rationales and references.
(Rahman & Watanobe, 2023)	60 teachers	Primarily exploratory and experimental	ChatGPT offers significant advantages for researchers by supporting the writing process and assisting in code optimization.
(Jošt et al., 2024)	Thirty-two participants	Experimental study	there is a negative correlation between increased reliance on Large Language Models (LLMs) for critical thinking-intensive tasks like code generation
(Alanzi, 2023)	54 participants	Qualitative research	ChatGPT has several advantages for teleconsultants in the healthcare sector, but it is associated with ethical issues.
(Tyni et al., 2024)	88 participants	Mixed-methods study	ChatGPT 3.5 outperforms 4.0 with student input, and integrating expert roles in prompts is unreliable and necessary only with game designer input for ChatGPT 3.5.
(Hosseini et al., 2023)	420 respondents	Developing a research	there was greater interest in using ChatGPT
(Kosar et al., 2024)	182 participants	Experimental research	ChatGPT usage did not significantly influence the students' performance in practical assignments, grading results, or midterm exams
(Fütterer et al., 2023)	5,541,457 users tweets	Analyzing Twitter data	the global reception on Twitter about ChatGPT was rapid and widespread
(Piccolo et al., 2023)	184 programming	Evaluation study	ChatGPT successfully solved 139 out of 184 programming exercises, demonstrating its potential to aid in programming tasks in life sciences education and research.
(Taloni et al., 2023)	1023 questions	Comparative cross-sectional study	GPT-4.0 outperformed both humans and GPT-3.5 in answering multiple-choice questions from the American Academy of Ophthalmology self-assessment program

Article	Sample size and characteristics	Type of research	Main finding
(Tsai et al., 2024)	450 multiple-choice questions	Cross-sectional study	ChatGPT-4 demonstrated strengths in urology with an overall accuracy of 57.8%, surpassing ChatGPT-3.5 significantly
(Cohen et al., 2023)	150 authentic questions	compared the performance of ChatGPT to the real-life actual performance	ChatGPT's performance in Hebrew OBGYN residency examinations was significantly lower compared to the actual performance of residents and English language tests
(Ng & Chow., 2024)	4,251,662 tweets.	quantitative study	the identification of six prominent peaks in ChatGPT conversations across 4 million tweets
(Gobira et al., 2023)	7,006 participating	Assessment of the performance of ChatGPT-4.0	ChatGPT-4.0 exhibited an overall accuracy of 87.7% in non-nullified questions and 71.4% in nullified questions
(Dubiel et al., 2024)	Query scope (3 classes), Query purpose (6 classes), Response format (4 classes), Information feature (13 classes)	Experimental research	Lightweight LLMs can be fine-tuned for on-device deployment
(Li, 2023)	42 students were in the experimental group, and 39 were in the control group.	Quasi-experiment	ChatGPT-based flipped learning guiding approach significantly improved students' performance
(Kämmer et al., 2024)	N=640	Prospective, randomized controlled experiment	Examine the influence on the diagnostic process and outcomes of interacting with a large language model compared with a human coach
(Al Ghazali et al., 2024)	39 students, which was relatively small in size.	Experimental research	ChatGPT shows promise in knowledge recall and reasoning skills. It faces challenges related to student engagement and completion rates.
(Farazouli et al., 2024)	24 university teachers	Qualitative approach	patterns of downgrading in student-written texts indicate a more critical approach to grading these texts than chatbot-generated responses.
(Noy & Zhang., 2023)	600 participants	Experimental research	Replicating treatment effects on time using an objective measure of 'time active.'
(Collins et al., 2024)	a mixed cohort of participants ranging from undergraduate students to professors of mathematics.	Empirical research & experimental research	Correctness and helpfulness of model responses are highly correlated, but they can diverge in exciting ways
(Currie & Barry,2023)	Long-answer–style questions (8 subjects) and calculation-style questions (2 subjects) were included for examinations.	Experimental study	ChatGPT powered by GPT 3.5 performed poorly in calculation examinations and written tasks, scoring significantly lower than students across nuclear medicine subjects, indicating limitations in depth of insight, research breadth, and information currency.
(Groza et al., 2024)	GPT-3.5-turbo and gpt-4.0	The experimental setup of the study	GPT-4.0 surpasses the state-of-the-art performance in phenotype concept recognition tasks when constrained to a subset of the target ontology with prior knowledge of expected terms.
(Kufel et al., 2023)	120 questions	Prospective study focused on one specialty exam in radiology and diagnostic imaging	ChatGPT's performance in the pass rate of Poland's radiology and imaging diagnostics specialty exam is yet to be determined, requiring further research on improved model versions.
(Tong et al., 2023)	160 questions for evaluation	Experimental research type	ChatGPT demonstrated a correct response rate of 81.25% for Chinese and 86.25% for English questions, with good predictive performance indicated by Brier Scores of 0.19 for Chinese and 0.14 for English, showing promise for global healthcare despite language bias challenges.
(Tang et al., 2023)	six domain experts	Evaluating large language models (LLMs) for medical evidence summarization	Large language models (LLMs) like GPT-3.5 and ChatGPT struggle with identifying salient information, are error-prone in generating summaries over more extended textual contexts, and produce factually inconsistent and misleading summaries, which could lead to potential harm due to misinformation.

Based on Figure 6, the classification is elucidated through cluster analysis distinguished by varying colors. The results indicate 49 items meeting the threshold across three clusters. The first cluster, represented in red, contains ten items. The second cluster, depicted in blue, encompasses nine items. The third cluster, illustrated in green, includes 30 items. This correlation also visualizes the network of research topic trends. The cluster analysis reveals that the first cluster (red) primarily addresses topics related to language modeling or language processing within educational systems assisted by ChatGPT or artificial intelligence. The research subtopics include language models, chatbots, computational linguistics, learning systems, natural language processing systems, language processing, sentiment analysis, educational computing, natural languages, and machine learning. Research within this cluster focuses on the potential of language modeling, particularly in computing, medical education, and machine learning using artificial intelligence (AI).

The second cluster (blue) centers on ChatGPT, the principal topic of this research. The research subtopics in this cluster encompass ChatGPT, large language models, machine learning, students, natural language processing, deep learning, decision-making, performance, and teaching. These subtopics relate to ChatGPT during the study analysis process. The third cluster (green) focuses on artificial intelligence, commonly called AI. The subtopics in this cluster include AI, human, article, language, medical education, controlled study, patient education, learning, educational status, human experiment, comparative analysis, reproducibility of results, and several other topics. This cluster concentrates on AI-related issues, with ChatGPT being one of the AI products.

The investigation into and understanding of the impact of ChatGPT within the learning environment, based on the issues raised from the cluster analysis, suggests that natural language processing models or language processing in programming code creation can enhance biomedical information skills among medical students. Furthermore, ChatGPT, an advanced AI model within the learning environment, can significantly foster student engagement and comprehension. The impact of ChatGPT on the learning experience, particularly in writing, grammar, and vocabulary expansion, demonstrates positive outcomes for students. ChatGPT presents opportunities for educational institutions and acts as a catalyst for enhancing the quality and accessibility of education.

4.2. Systematic literature review

The utilization of ChatGPT in education has generated a variety of positive and negative impacts. Analysis from multiple articles reveals diverse outcomes depending on the context and application. Some studies indicate improvements in skills and learning experiences, limitations and challenges, potential in professional training and education, influence on teaching and assessment, and ethical considerations. ChatGPT can enhance cognitive, non-cognitive, and metacognitive skills by providing personalized feedback with tailored learning resources (Xu et al., 2024). Additionally, in the context of flipped learning, a ChatGPT-based approach has been shown to improve student performance, self-efficacy, learning attitudes, intrinsic motivation, and creative thinking (Li, 2023). Despite its substantial potential, ChatGPT also exhibits limitations in certain aspects. For instance, GPT-3.5-powered ChatGPT performs poorly in calculations and writing tasks, indicating limitations in the depth of insight and current information (Currie & Barry, 2023). Furthermore, using large language models (LLMs) for tasks requiring intensive critical thinking, such as code creation and debugging, negatively correlate with final grades in programming education (Jošt et al., 2024).

In professional education, ChatGPT demonstrates varying capabilities. It can accurately and personally provide weekly meal plans and simplify health information while retaining key messages (Papastratis et al., 2024). However, ChatGPT's performance on China's national medical licensing exams is lower than that of medical students, indicating a need for further enhancement in academic abilities (Wang et al., 2023). Additionally, the use of ChatGPT in teaching can influence how instructors assess student-written texts. Farazouli et al. (2024) found that instructors tend to be more critical of texts written by students than responses generated by chatbots, indicating a difference in assessment standards when AI technology is involved in the teaching process. ChatGPT can support telemedicine consultations in the healthcare sector, but ethical issues must be addressed (Alanzi, 2023). Concerns about language bias and the inability to accurately identify critical information also pose challenges (Tang et al., 2023). While ChatGPT offers numerous benefits in learning and education, including assisting in teaching and personalizing learning, significant challenges must be addressed. ChatGPT must be monitored and adapted to ensure its impact remains positive and beneficial to the educational process.

5. Discussions and conclusions

The findings from the bibliometric analysis reveal the evolution of research on ChatGPT from 2022 to 2024. Research on ChatGPT began to emerge in 2022 with two published articles and saw a significant increase in 2023

and 2024, reaching 813 and 1189 articles, respectively. This growth reflects the rising interest in the impact and applications of ChatGPT, particularly in education. However, the average citations per article decreased from 117.50 in 2022 to 1.95 in 2024, coinciding with the increased number of published articles. Although the number of articles increased, the average citations per article declined due to the tendency of a higher volume of publications to reduce the average citation impact.

Citation source analysis indicates that the journal JMIR Medical Education stands out with 46 documents and possesses vital metrics, including an h-index of 12 and 1112 citations. Articles from this journal are frequently cited in research discussing the use of ChatGPT in medical education. Other journals, such as Education and Information Technologies and Computers and Education: Artificial Intelligence, contribute significantly to the related literature. Citation sources are also linked to collaboration. Collaboration analysis shows that the United States has the highest contribution of articles (22.6%), followed by China (9.6%). Countries like the United Kingdom, Canada, and Italy exhibit high levels of international collaboration, potentially enhancing the diversity and quality of research.

The United States possesses the highest total citation count, which indicates its high productivity in academic publications. However, its average citations per article are lower than those of countries like the United Kingdom and Australia. It suggests that while the U.S. has many publications, the quality and impact per article not be as high as those of the countries mentioned above. Despite having a lower total citation count than the U.S., the United Kingdom demonstrates exceptionally high research quality with the highest average citations per article. It signifies that publications from the U.K. are highly influential and frequently cited in academic literature. Australia and the United Arab Emirates also exhibit high research quality with significant average citations per article. In contrast, China, with a high total citation count, has a lower average citation per article, indicating variability in the impact of its publications. Other countries, such as India, Hong Kong, Italy, and Canada, demonstrate substantial contributions to academic research with relatively high average citations per article, indicating the relevance and influence of their research outputs.

Artificial intelligence (AI) emerges as the most frequently discussed topic, with high frequency in related terms such as "ChatGPT," "human," and "educational status." Cluster analysis indicates that the main topics include language processing models, ChatGPT itself, and AI in general. ChatGPT has become a highly intriguing subject in scientific research, particularly regarding its impact on education. ChatGPT in education offers significant opportunities to improve the quality of learning and expand access to education, with substantial potential to develop students' language skills and comprehension.

International collaboration can enhance access to resources and technology, expand researchers' networks, and enrich perspectives in research. It can certainly increase the visibility and impact of research. However, cultural differences, language barriers, regulatory disparities, and varying research priorities can hinder collaboration. Additionally, coordinating researchers from different countries can present logistical challenges. Independent research can focus more on specific national issues and be quicker and more efficient since it does not require cross-country coordination. Collaborative research can yield more holistic and globally applicable knowledge through broader sharing of resources and expertise. Countries with a high percentage of multi-country publications (MCP) demonstrate greater involvement in global collaboration, which can enrich research outcomes. On the other hand, countries with a high proportion of single-country publications (SCP) focus more on national issues. Both approaches have advantages and challenges, and a deep understanding of these dynamics can aid in developing better research strategies.

ChatGPT has proven effective in enriching students' learning experiences by providing personalized feedback and tailored learning materials. However, ChatGPT powered by the GPT-3.5 model has limitations in handling tasks that require complex calculations and producing in-depth writing. ChatGPT is still limited in providing deep and accurate insights in some fields. As demonstrated by the results of China's national medical licensing exam, its academic capabilities are still below the expected standard. Despite its potential as an educational tool, ChatGPT still needs further improvement to be reliable in teaching materials that require deep and specialized knowledge.

The influence of ChatGPT on teaching and assessment also warrants attention. It can introduce bias in evaluation, affecting the objectivity and validity of academic assessments. Establishing transparent and fair guidelines for using this technology is essential to ensure consistent and transparent assessments. The ethical aspects of using ChatGPT are also a primary concern. The use of AI in medical consultation and education requires strict policies to protect user privacy and prevent data misuse. Additionally, language biases in this model could lead to misinterpretations or overlooking critical information, which can negatively impact decision-making processes.

Research on ChatGPT significantly increased from 2022 to 2024, with published articles surging from merely two in 2022 to 813 in 2023 and 1189 in 2024. This increase reflects substantial interest in ChatGPT's applications and impact, particularly in education. Despite the growing number of articles, the average number of citations per article declined from 117.50 in 2022 to 1.95 in 2024, indicating that the proliferation of publications can dilute the average citation impact.

JMIR Medical Education has emerged as a primary citation source with solid contributions, followed by other journals such as Education and Information Technologies and Computers and Education: Artificial Intelligence. The United States stands out as the most significant contributor with a high level of international collaboration, followed by countries such as China, the United Kingdom, Canada, and Italy. This global collaboration is crucial for enriching the perspectives and quality of research, although it also faces challenges such as cultural and regulatory differences. Overall, research on ChatGPT demonstrates significant potential for enhancing the quality of education and global accessibility. ChatGPT offers numerous advantages in learning and education, including assisting in teaching and personalizing learning. However, significant challenges must be addressed, including technical limitations and ethical concerns. Therefore, the use of ChatGPT in education must be carefully monitored and adapted to ensure its sustained positive impact and contribution to improving education quality.

5.1. Theoretical implications

The increased use of ChatGPT in education significantly contributes to developing educational technology theories, particularly in language-based learning, personalized learning, and cognitive development (Dalgıç et al., 2024) . These findings suggest that ChatGPT can be pivotal in expanding existing theoretical frameworks, such as constructivist learning theory, the Technological Pedagogical Content Knowledge (TPACK) framework, and artificial intelligence (AI) -based learning models. Consequently, future research could explore how ChatGPT enriches or challenges established learning models, focusing on personalized feedback, enhanced student engagement, and developing critical thinking skills. These findings also reflect a paradigm shift toward AI-driven education that is more student-centered. ChatGPT can contribute substantially to understanding how AI-based tools can support self-directed learning, metacognitive development, and knowledge construction by students. Future theoretical research should investigate the role of AI in helping or even redefining existing learning theories. However, it is essential to note that the limitations and potential biases inherent in AI models like ChatGPT must be a central concern, leading to discussions on the ethics and reliability of AI in educational contexts.

5.2. Practical implications

The use of ChatGPT in educational settings shows significant potential in enhancing students' cognitive, non-cognitive, and metacognitive skills. ChatGPT can be integrated into personalized learning pathways, offering students tailored feedback and relevant learning resources. For example, ChatGPT can enhance students' intrinsic motivation, improve their understanding, and stimulate creative and critical thinking within the flipped classroom model. As such, educators must be trained to effectively leverage ChatGPT in curriculum design and create interactive learning environments. In the context of professional education, ChatGPT demonstrates a range of capabilities. For instance, ChatGPT can simulate patient interactions or simplify complex medical information in medical education. However, its use still needs refinement to meet the more stringent standards of national examinations. Therefore, educational institutions must provide professional development for instructors on integrating AI into their teaching practices and educating students on critically engaging with AI tools.

Clear ethical guidelines must accompany the implementation of ChatGPT in education to ensure fair and secure usage. These guidelines should include standards for assessing AI-generated written work and methods for ensuring transparency in AI-driven feedback systems. Privacy concerns and potential biases in the responses provided by ChatGPT must also be addressed to ensure the technology is used optimally and does not harm students. Moreover, ChatGPT can be an extremely valuable tool in supporting the learning of students with diverse needs, particularly in inclusive education. For instance, with its ability to provide immediate feedback and support self-directed learning, ChatGPT can assist students with learning disabilities or those who require specialized support, especially in underserved areas with limited access to traditional educational resources.

5.3. Limitations and future research directions

This study offers valuable insights into the impact of ChatGPT usage in education, but it has several limitations that should be acknowledged. One such limitation is the restricted scope of the data analyzed, where the bibliometric analysis only includes articles indexed in the Scopus database, thus excluding other potentially relevant

sources. The result in the omission of important articles that have not been indexed or those published on alternative platforms, which could influence the overall depiction of research trends. Additionally, this study primarily focuses on quantitative analysis, such as publication counts and citation numbers. It does not provide a comprehensive qualitative examination of ChatGPT's influence on learning outcomes across various educational settings. Moreover, the research does not delve deeply into the potential risks and challenges associated with ChatGPT's use, such as the long-term effects of AI on students' critical thinking skills or more complex ethical issues related to applying this technology in education. Many studies focus on immediate impacts within the initial years of ChatGPT's implementation, leaving long-term social and technical concerns largely unexplored.

Future research should aim to conduct more in-depth and extensive studies involving a wider array of platforms and databases beyond Scopus to expand the data coverage and include articles that have not yet been indexed. The research would provide a more comprehensive view of the development of ChatGPT-related research in education and facilitate comparisons across different research sources. Furthermore, subsequent studies should aim to understand the long-term effects of ChatGPT on education. Longitudinal studies are essential to assess how the use of this AI tool impacts the development of critical thinking, problem-solving, and social skills among students. This approach would allow researchers to observe whether there are significant changes in learning quality and student development over time. Future research could also focus on a deeper exploration of ChatGPT usage's ethical and social challenges. For example, how can we ensure that AI is deployed in a manner that is equitable, unbiased, and accessible to all social groups? Research could investigate how educational policies can be crafted to address potential inequalities stemming from uneven technological dependence between more developed and less developed schools or regions.

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Author contribution statements

The authors equally conducted the research design and implementation, analysis, and article writing without using AI applications.

Disclosure statement

The authors reported no potential competing interest.

Ethical committee approval

This study has complied with the Research Publication Ethics stated in "Wager E & Kleinert S (2011) Responsible research publication: international standards for authors. A position statement was developed at the 2nd World Conference on Research Integrity, Singapore, July 22-24, 2010. Chapter 50 in Mayer T & Steneck N (eds) Promoting Research Integrity in a Global Environment. Imperial College Press / World Scientific Publishing, Singapore". For this reason, the author states that he conducted the research within the framework of ethical principles. It is not a human study, so ethical approval is not required. All responsibility belongs to the authors.