

Systematic Review of Adaptive User Interfaces in E-Commerce for MSMEs: Gaps and User-Centric Indicators

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Abstract

Objective – Observations of research results related to adaptive user interfaces in e-commerce have been widely conducted; however, there is a need for evaluation and assessment of indicators based on user requirements. This study aims to conduct a systematic literature review and bibliometric analysis on adaptive user interfaces for MSMEs, based on existing empirical research.

Methodology – The methodology applied is a Systematic Literature Review, using the term “adaptive user interface for MSMEs” in “Article Titles, Abstracts, and Keywords” within the Scenedirect database, resulting in 5,622 publications from 1998 to 2025. The evaluation was carried out on November 21, 2025. The collected articles were analyzed using bibliometric analysis with VOSviewer software, based on fields of study including computer science, decision science, engineering, social sciences, business, management, accounting, and materials science.

Findings – Research on adaptive user interfaces for MSMEs has been extensively conducted in line with the digitalization of the e-commerce sector. The observations sought gaps and indicators in each article. Gaps were identified; however, further research is still needed to provide more specific, comprehensive, and well-founded recommendations. Indicators focus on how to provide ease and comfort for users, as well as offering recommendations to them.

Research Limitations – This study used the Scenedirect database for articles related to adaptive user interfaces for MSMEs. Future research could enhance generalizability by integrating other databases such as the Web of Science.

Keywords : *E-Commerce, Adaptive User Interface, MSMEs, Framework*

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1. INTRODUCTION

Research [1] states that the crucial problems faced by Micro, Small, and Medium Enterprises (MSMEs) include low adoption of digital markets despite increased access to technology, inadequate infrastructure and connectivity, high levels of technology anxiety, lack of trust in digital platforms, inconsistent government support that does not address psychological needs, competitive pressures not always matched by adoption capabilities, and insignificant roles of top management support. Meanwhile, Study [2] concludes that the challenges faced by MSMEs in Indonesia’s food sector lie in adopting e-commerce technology and enhancing innovation capabilities to improve business performance. The gap between large companies and MSMEs in utilizing technology, along with internal and external barriers, hinders MSME growth in the digital era. Therefore, the government has taken the first step by developing support programs and specialized training for MSMEs to help them improve their ability to leverage technology and innovate.

Secondly, the government collaborates with financial institutions to provide easier access to financing for MSMEs wishing to develop or expand their operations through e-commerce and

innovation. It is expected that MSMEs in Indonesia's food sector can enhance their performance through effective use of e-commerce and the development of innovation capabilities. Currently, beyond website-based e-commerce transactions, Study [3] explains the impact of using live streaming for sales, which attracts purchase intentions in Indonesia's social commerce. This study applies the S-O-R theory and IT Affordance, though several key issues can still be identified.

Digital marketing is one of the factors that can influence modernization and help increase online sales transactions in the general development of a company [4]. Study [5] states that digitalization brings significant transformation but requires ecosystem collaboration for long-term success. To achieve long-term success in digitalization, [6]-[7] argue that attention must be paid to the development of the digital economy, which is influenced by systemic interconnections among six main dimensions: digital infrastructure, business platforms, consumer platforms, data ecosystems, economic context, and regulation. With ongoing digital transformation, Study [8] asserts that the development of e-commerce heavily depends on the quality, availability, and equitable distribution of digital communication infrastructure, which is a key determinant strengthening digital economic growth.

Research [9][10][11] emphasize that digital transformation in business is not only about consumer interaction and technology adoption, but also about aligning strategies, resources, human capital, and ecosystem contexts. Through the SitAdapt system, user experience can be significantly enhanced in the digital customer journey. To support the digitalization process, Study [12] argues that strategic approaches in the digital era explain various ways human resources drive SME digitalization and guide businesses toward the best routes to achieve high performance through digitalization.

Research [13] investigates the gaps and inequalities in communication infrastructure development in Poland, which directly affect national e-commerce growth. Research aimed at increasing economic benefits for companies should consider the current digital economy context, which has shifted toward social media-based advertising. Study [14] demonstrates that social media advertising effectively improves company economic performance, particularly by increasing public attention, consumer interaction, and corporate reputation. Furthermore, risk assessment observations have been conducted for SMEs on e-commerce platforms such as Amazon, utilizing structured and unstructured data in a hybrid manner, and providing interpretations understandable to non-technical users [15].

From the studies conducted, it emerges that appropriate steps in the digital era involve using e-commerce to enhance economic benefits, company risk assessment, and equitable development of communication infrastructure for e-commerce growth. Ultimately, research has been carried out on an integrative framework explaining the theoretical evolution of e-commerce studies and online shopping behavior, particularly neglecting intercultural communication dimensions, as discussed in [16][17]. Efforts toward e-commerce also involve promotion through social media, with Studies [18][19][20][21][22] stating that live streaming has a significant impact on purchase intentions in social commerce.

To realize the answer to why research is conducted on user interfaces for e-commerce, the second research question is addressed: what is the appropriate user interface for e-commerce, as linked to several related papers. Study [23] states that user interface (UI) design and user experience (UX) have a highly significant impact on user appeal and the success of e-commerce platforms. Good interface design is crucial to increasing acceptance and use of the Automated Medical Reporting (AMR) system among healthcare providers. Good usability can reduce resistance to new technology [24]. Meanwhile, Study [25] highlights that the right combination of promotional strategies, attractive interface design, and satisfying user experience are key factors that can increase customers' repurchase intentions in e-commerce. Therefore, e-commerce companies need to pay integrated attention to these three aspects to build customer loyalty and maintain competitiveness in the digital market.

Research related to the need for adaptive user interfaces for MSMEs includes Study [26], which

developed a digital platform based on intuitive UI/UX that significantly improves Intellectual Property (IP) management, particularly trademarks, for Micro, Small, and Medium Enterprises (MSMEs) in Indonesia. This study applied Design Thinking and the User Experience Questionnaire (UEQ) with data from 150 MSME respondents, resulting in a valid and effective platform design. Study [27] states that increased e-commerce adoption and innovation capability are based on the TOE (Technological, Organizational, Environmental) framework and Entrepreneurial Orientation (EO), with recommendations for managerial and policy interventions. It is expected that MSMEs in Indonesia's food sector can improve their performance through effective use of e-commerce and innovation capability development.

Research [28] found that adaptive user interfaces enhance user experience, making it easier for patients to find necessary information and make purchasing decisions. To achieve this, research was conducted on a prototype of a User-Adaptive System (UAS) for online pharmacies utilizing Artificial Intelligence (AI). To create adaptive UI designs for MSMEs, Study [29] combined Reinforcement Learning (RL) and Deep Q Network (DQN)—successfully overcoming the limitations of static user interfaces by providing dynamic real-time personalization based on user behavior analysis. This advances interface personalization across digital domains such as mobile applications and e-commerce. Study [30] developed the AdaptUI framework, proving the effectiveness of context-based and recommendation-based approaches in creating adaptive user interfaces that improve UX and system efficiency in Smart Product–Service Systems.

Research [31] presents the FASECO framework, offering practical and strategic solutions to address digital challenges supporting e-commerce and digital transformation in SMEs. In addition, Studies [32][33][34] argue that the success of transformation in MSMEs depends heavily on their ability to develop and leverage dynamic capabilities. MSMEs that can quickly identify digital opportunities are more successful in adapting to changes in consumer behavior and technological developments.

To support dynamic transformation processes in MSMEs, Study [35] explains that optimizing adaptive user interfaces for MSME e-commerce in real-time can improve UX. Study [36] develops more personalized and effective adaptive interfaces, thereby enhancing user experience and motivation. Study [37] reveals that adaptive user interface systems, such as SitAdapt, have great potential to improve user experience by tailoring interfaces to user needs and situations. Previous research on adaptive user interfaces for MSMEs, such as Study [38], presents the implementation and structure of electronic applications for adaptive user profiles in the e-commerce context, evaluating their effectiveness and potential improvements.

With the design of adaptive user interfaces for dynamic MSMEs as the main goal to stimulate purchase intentions, consumer trust in the platform becomes essential. Study [39] explains that product design, price, and demographic factors can influence or strengthen purchase intentions toward local fashion amid global fashion dominance. Beyond price, purchase intentions are also influenced by short-form videos. Study [40] argues that new conceptual models and practical strategies can explain and address the phenomenon of online impulsive buying on short-form video commerce platforms, providing practical strategies for marketers to effectively manage entertainment content, promotions, and time pressure to trigger (or control) consumer impulsivity. Thus, building consumer trust in e-commerce platforms can be achieved by stimulating promotions, pricing, and short-form videos that drive consumer purchasing power.

From the grouped and studied literature reviews, to realize adaptive user interfaces for MSMEs in Indonesia, systematic literature review and the addition of indicators in development can be conducted to increase product sales. The purpose of this study is to carry out a systematic literature review and bibliometric analysis related to adaptive user interfaces for MSMEs based on existing empirical research. To answer the objectives of this study, the authors formulated three research

questions :

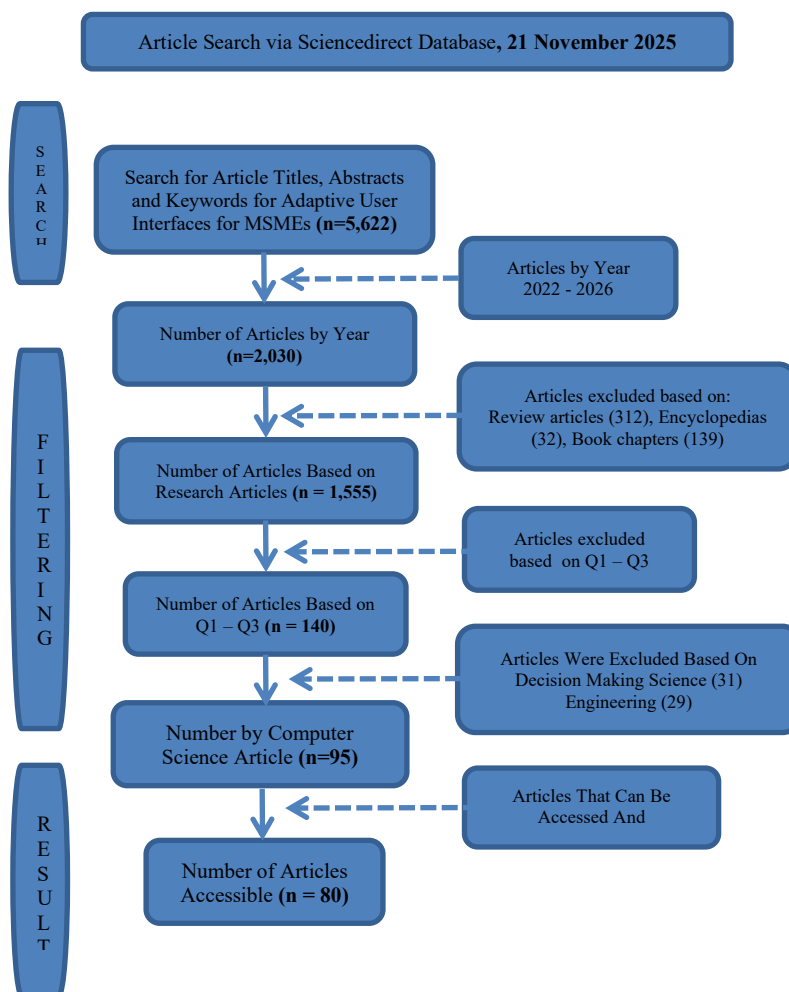
RQ1: How is current research allocated regarding adaptive user interfaces for MSMEs?,

RQ2: Why conduct research on user interfaces for e-commerce?,

RQ3: What is the appropriate adaptive user interface for MSMEs?.

2. METHOD

The systematic literature review in this study was conducted using a quantitative bibliometric approach to evaluate the literature by identifying trends, patterns, and research entities across multiple academic disciplines. For the framework, the PRISMA framework was applied to ensure that the literature review is comprehensive and replicable, providing a clear and transparent overview of the topic under investigation [41][42]. The inclusion criteria established were: (1) articles published up to November 21, 2025, (2) publications in English, and (3) focused on the topic of adaptive user interfaces for MSMEs.



Source: 2025 Research

Figure 1 Framework with the Prisma Framework

Bibliometric analysis was performed using VOSViewer, which visualizes bibliographic data to analyze citation networks, author collaborations, and co-occurring keywords, thereby revealing the intellectual structure and dynamics of the research field. The combination of bibliometric analysis and systematic review helps researchers synthesize empirical findings and map the landscape of research activities, including identifying key contributors and emerging trends [43]. The integration of these two approaches provides a comprehensive overview.

From the search conducted on November 21, 2025, through the Scencedirect database using article titles, abstracts, and keywords: “user interface and adaptive” across multiple academic disciplines, publications from 1998 to 2025 were retrieved, yielding a total of 5,622 articles related to adaptive user interfaces. This was further narrowed down to 2,020 articles published between 2022 and 2025 (see Figure 1). The findings were then filtered and classified according to research needs.

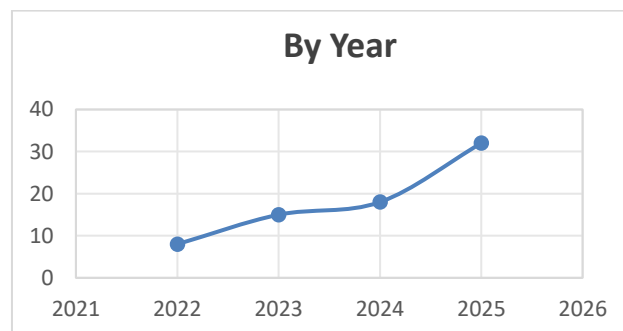
Filtering was carried out by eliminating documents based on type, including: review articles (312), research articles (1,555), encyclopedias (32), and book chapters (139). Next, filtering of research articles based on Scencedirect indexing from Q1–Q3 resulted in 140 articles. Further filtering by field of study yielded 95 articles. The final stage of filtering, based on accessibility, resulted in 80 articles. These 80 articles were used for further analysis in this study to answer the research questions outlined in the background (see Figure 1).

3. RESULTS

Based on the search results using the keyword adaptive user interface for MSMEs in the Scencedirect database, a total of 80 articles were obtained and used to answer the research questions. From the three research questions, the discussions in this chapter will include:

RQ1: How is current research allocated regarding adaptive user interfaces for MSMEs?

Based on the search results obtained from the Scencedirect database, there are 80 scientific articles related to adaptive user interfaces for MSMEs. This number indicates that research on adaptive user interfaces for MSMEs is quite extensive, as shown in Figure 2. Exploration of research on adaptive user interfaces for MSMEs began in 1998 with [44], entitled “IT Support Of Single Project, Multi-Project And Industry-Wide Integration.” Subsequently, this research attracted scholars to further develop the topic, with growth starting in 2023, when 15 articles were published. After 2023, the number of publications continued to increase, reaching 18 articles in 2024, and in 2025 experiencing a sharper rise—almost double—amounting to 32 articles (see Figure 2).



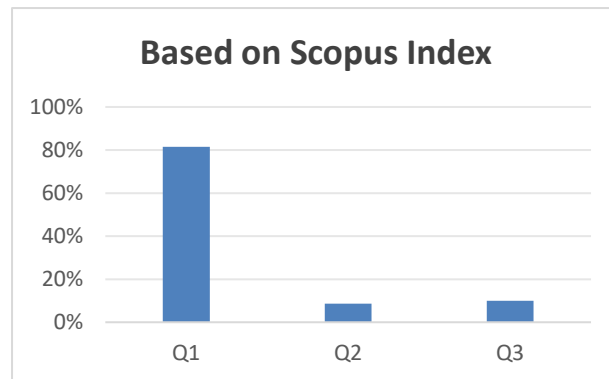
Source: Scencedirect database

Figure 2 Number of Publications by Year

Research related to adaptive user interfaces for MSMEs, based on the Scencedirect database, has been widely published in reputable journals. However, this does not diminish the opportunity for researchers to further develop adaptive user interfaces for MSMEs in order to generate new findings that optimize research outcomes. Along with the advancement of digitalization and the growing needs and comfort of users, the research domain has increasingly focused on ease of use, user comfort, and personalization within information systems. This focus can lead to studies on adaptive user interfaces for MSMEs across various fields, tailored to user needs.

The initial distribution of publications related to adaptive user interfaces for MSMEs, based on Scopus indexing from Q1 to Q3 in the Scencedirect database, shows that there have already been numerous publications for the keyword adaptive user interface for MSMEs indexed in Scopus.

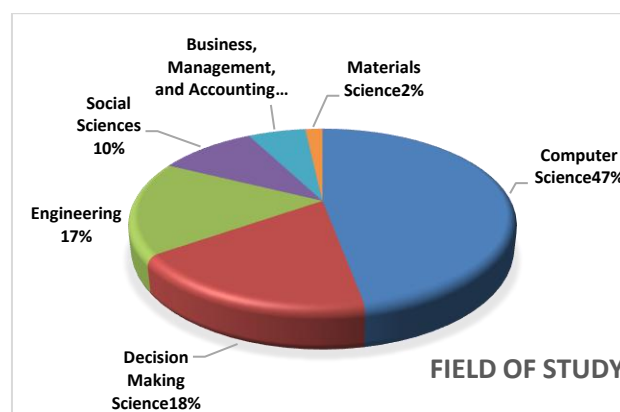
Publications indexed in Scopus at Q1 account for 81%, followed by Q2 at 9%, and Q3 at 10%. These data indicate that researchers are highly enthusiastic about ensuring that publications related to adaptive user interfaces for MSMEs are placed at the highest level in Scopus indexing. Consequently, researchers are able to provide high-quality data that can serve as references and enable subsequent studies to be conducted with greater quality (see Figure 3).



Source: Scencedirect database

Figure 3 Number of Publications Based on Scopus Index

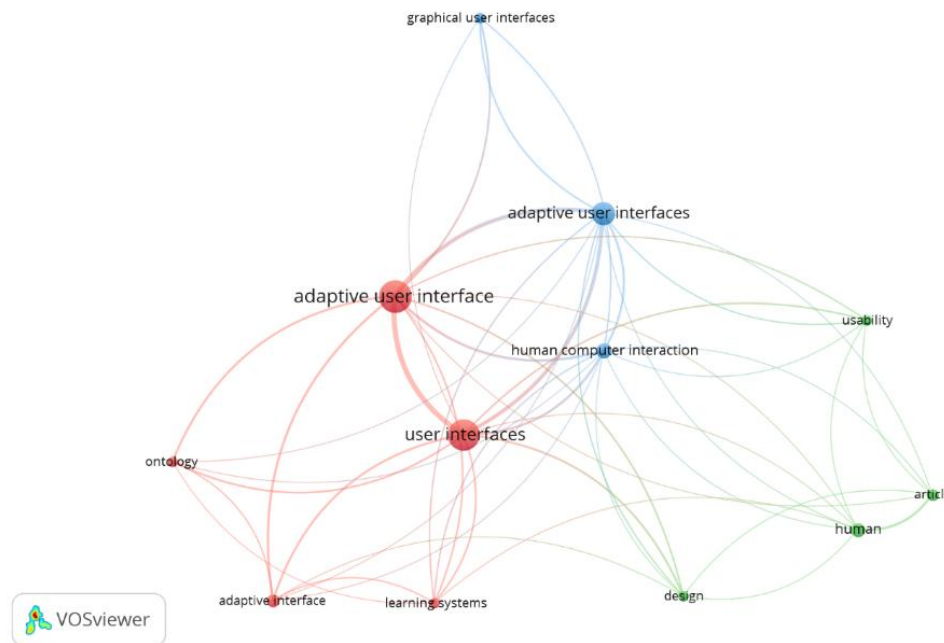
The second distribution of publications related to adaptive user interfaces for MSMEs, based on fields of study, shows that the dominant discipline is Computer Science (80), followed by Decision Sciences (31), Engineering (29), Social Sciences (17), Business, Management, and Accounting (10), and Materials Science (3). The allocation results indicate that researchers prefer conducting studies in the field of Computer Science, in line with the growing need for digitalization across all aspects and sectors, particularly in adaptive user interfaces for MSMEs (see Figure 4).



Source: Scencedirect database

Figure 4 Number of Publications by Field of Study

Based on the distribution of publications related to adaptive user interfaces for MSMEs, it is evident that the most prominent field of study is Computer Science, which is currently attracting significant interest from researchers. The data show that Computer Science accounts for 47%, followed by Decision Sciences at 18%, Engineering at 17%, Social Sciences at 10%, Business, Management, and Accounting at 6%, and Materials Science at 2%. The distribution results conclude that, in line with the era of digitalization, much of the research is concentrated in Computer Science to support the optimization of digital utilization across various sectors, thereby becoming a trend and a primary focus among researchers.



Source: Output VOSviewer Software

Figure 5 Number of Publications by Field of Study

The third distribution of publications related to adaptive user interfaces for MSMEs, based on the keyword adaptive user interface from the Scopus database and illustrated using VOSviewer, provides valuable insights. Metadata analysis with VOSviewer helps researchers and practitioners better understand the assumptions and findings related to adaptive user interfaces for MSMEs. Thus, bibliometric analysis using VOSviewer can reveal which variables have been extensively studied by previous researchers and which variables remain underexplored, serving as a foundation for future studies (see Figure 5).

Table 1 Keywords

Indeks	Keywords	Total Link Strength
1.	Adaptive User Interface	319
2.	User Interfaces	204
3.	Human Computer Interaction	118
4.	Adaptive Interface	47
5.	User – Computer Interface	27
6.	Usability	22

From a practitioner’s perspective, literature analysis using VOSviewer will assist in the sustainable implementation of adaptive user interfaces in the future and encourage researchers to pursue further development in line with digitalization. From Table 1, several key topics emerge, including: adaptive user interface (64), user interfaces (37), human-computer interaction (8), adaptive interface (7), usability (5), and user–computer interface (3)

The results of the literature analysis using VOSviewer show that there are linkage strengths for each keyword across the articles, with the following values: adaptive user interface (319), user interfaces (204), human-computer interaction (118), adaptive interface (47), user–computer interface (27), and usability (22). These data indicate that the linkage strength for adaptive user interfaces is very high, reinforced by the keyword user interface, which supports the process of research

development.

The fourth distribution of publications related to adaptive user interfaces for MSMEs is based on the number of citations for each article. The number of citations in the article entitled “RL For UX personalization” is 55 citations, the article entitled “Optimizing digital customer journey” is 55 citations, the article entitled “Real-Time Adaptation Of Context-Aware UIs” is 46 citations, the article entitled “User Context Ontology For Mobile Interfaces” is 37 citations, the article entitled “Adaptive User Profiling” is 12 citations, the article entitled “Adaptive Framework” is 8 citations, the article entitled “Recommendations UI For Web-Based E-Commerce” is 3 citations, the article entitled “Consideration Of People’s Design Preferences” is 2 citations, the article entitled “Situation-Aware UI Adaptations” is 1 citation, the article entitled “UI/UX-Centered IP Management For MSMEs” is 0 citations(see table 2).

Table 2 Articles Based on Citations

Rank	Paper (manuscript ref)	Citations (latest)	Theme / Short note
1	RL For UX Personalization	55 times	Reinforcement learning for real-time adaptation
2	Optimizing Digital Customer Journey	55 times	Emotions / personas / situations for adaptation
3	Real-time Adaptation of Context-Aware UIs	46 times	Real-time adaptive techniques and situational awareness
4	User Context Ontology for Mobile Interfaces	37 times	Context ontologies and mobile adaptation
5	Adaptive User Profiling	12 times	Adaptive profiling & neural-network models
6	AdaptUI Framework	8 times	Framework for adaptive UIs in Smart PSS
7	Recommendations UI For Web-Based E-Commerce	3 times	Real-time UI recommendation
8	Consideration Of People’s Design Preferences	2 times	Preferences, visual design in adaptive UI
9	Situation-Aware UI Adaptations	1 times	Situation-aware adaptations for e-commerce
10	UI/UX-Centered IP Management For MSMEs	0 times	MSME-focused UI/UX design

RQ2: Why conduct research on user interfaces for e-commerce?

From several studies, to realize a user interface (UI), it is necessary to create a personalized customer experience and effective task assistance in interactive e-business applications, where current systems fail to adapt in real-time to users’ interactive behavior, emotional states, and individual task completion, thereby hindering business success and user satisfaction, as shown in [45]. The development of an explanatory user interface (XUI) [46] enhances UI design to be more optimal in application, with each design accompanied by UI design guidelines. These guidelines provide explanations that can effectively create better and more responsive user interfaces, improving user experience in AI-based applications [47].

The importance of interaction between users and applications requires in-depth observation to ensure that users feel understood and comfortable in usage. According to [48][49], UI design presents the development of more effective and user-centered interfaces, aimed at user comfort in operating applications. To achieve a more effective and user-centered UI, principles outlined in [34] are applied.

To provide understanding and comfort for users in a UI design, user learning is required. Moreover, UI design in e-commerce is an essential tool for adapting to the unique needs and

preferences of users. Research [50][51] shows that s-commerce design still focuses on user behavior aspects and has not yet developed in a balanced manner toward technical design, trust, and system requirements. Therefore, the proposed classification framework can serve as a foundation to guide future research and development of s-commerce platforms that are more comprehensive, intelligent, and user-oriented.

From the above studies, it can be concluded that user interfaces for e-commerce are highly needed to ensure user comfort and ease of use, while considering user behavior aspects that have not yet evolved in balance with technical design, trust, and system requirements. By studying existing theories, a more comprehensive, intelligent, and user-oriented UI framework for e-commerce can be developed. To support the results of this UI framework, user guidelines are needed to provide effective explanations, create better and more responsive interfaces, and enhance user experience..

RQ3: How are adaptive user interfaces for MSMEs designed and implemented?

Understanding users is essential in presenting an adaptive user interface (UI), particularly in e-commerce applications, so that the application can be well accepted. Research [18] explains that real-time optimization of e-commerce user interfaces can improve UX, automatic conversion, and personalization. However, this study still requires large-scale development because the scope remains small, especially with limited user data, making the evaluation of design feedback less optimal. Nevertheless, to optimize adaptive user interfaces, this study employed eight (8) indicators: personalized layout and navigation, context responsiveness, content customization, proactive support and personalization, cross-platform adaptability, real-time adaptation, multimodal interaction, and ethical considerations.

Research [52] conducted research on the development of adaptive interfaces using five (5) adaptive UI indicators. This study produced a more personal, inclusive, and visually adaptive user interface by considering user design preferences based on demographic factors, thus providing an empirical foundation. However, this study did not yet include indicators linking individual user characteristics (age, gender, regional background) with visual design preferences, which have rarely been explored in adaptive UI development. Future research could therefore focus on developing UI/UX designs that adjust visual interfaces to user profiles, enhancing user experience, satisfaction, and engagement in personalized digital platforms [53][54].

Research [22] developed an adaptive user profiling model that integrates online and offline behavioral data with neural network support, using five (5) indicators overlapping with the first study. This research produced more accurate, personal, and real-time predictions of user characteristics, while also considering data security aspects (GDPR compliance). However, it still lacks an adaptive profiling system that integrates user behavior data from both online and offline environments simultaneously.

In Research [55], the AdaptUI Framework was developed—a new, modular, and comprehensive approach to building context-based adaptive interfaces in Smart Product–Service Systems. This framework integrates user, context, and environment, leveraging Model-Driven Engineering, and emphasizes reusability, scalability, and user experience. It uses five (5) indicators overlapping with the first study, thereby supporting previous research but applied to Smart Product–Service Systems.

Research [20] produced an adaptive UI, such as SitAdapt, which has great potential to enhance user experience by tailoring interfaces to user needs and situations. This study only used three (3) adaptive UI indicators, demonstrating that adaptive technology can be implemented and accepted by users, while exploring its potential to improve user interaction with e-commerce applications. However, Studies [56][57] highlight limitations in understanding, acceptance, and real-world application of situation-aware adaptive UIs in e-commerce, particularly among non-technical users and in real-world scenarios.

Research [33] conducted a quantitative analysis of the influence of specific UI/UX elements (homepage, navigation, and color) on user appeal in several major e-commerce platforms in Indonesia, using usability testing and Mean Opinion Score (MOS). There is still a lack of comparative and quantitative research specifically assessing the impact of UI/UX elements (homepage design, navigation interface, color theory) on user appeal in Indonesian e-commerce, using empirical approaches based on real user experiences. This study focused on interface design using three (3) adaptive UI indicators.

The application of Human-Centered Design (HCD) [58][59] in food processing technology development has proven effective in producing tools that meet the needs and capabilities of MSME actors. This approach not only improves efficiency and usability but also strengthens technology adoption, local independence, and innovation sustainability in the agri-food sector. From the studies reviewed, it can be concluded that to optimize MSME users with e-commerce services, an adaptive user interface framework for MSMEs is needed—one that ensures comfort, ease of use, and user trust.

4. DISCUSSION

From the observations of articles related to adaptive user interfaces for MSMEs, several indicators and gaps were identified in each study. Some findings are similar, some are interrelated, and others show differences. These findings will later be used to identify research gaps and to add appropriate indicators for studies on adaptive user interfaces for MSMEs (see Table 3).

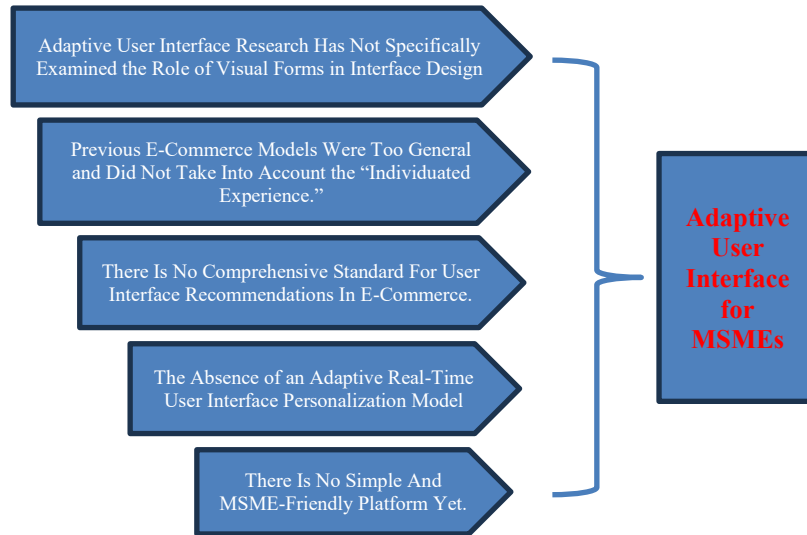
Table 2 Gaps and Indicators in Adaptive User Interface for MSMEs

No. Rujukan	Indicator	Research Gap
1. [2]	<ol style="list-style-type: none"> 1. How MSMEs utilize e-commerce features, such as transactions, promotions, and customer communication. 2. Innovation Capability: Innovation ability as a mediating variable. 3. Business Performance: The impact of e-commerce use and innovation on MSME performance. 	<ol style="list-style-type: none"> 1. Few studies have integrated e-commerce and innovation in MSMEs. 2. Limited research specifically focused on MSMEs. 3. The causal relationship between e-commerce → innovation → performance remains unclear in the MSME context
2. [12]	<p>Digitalization of SMEs</p> <ol style="list-style-type: none"> 1. Organizational strategy 2. IT readiness 3. Human resource competence 4. Organizational cultural barriers 	<ol style="list-style-type: none"> 1. Human capital has not been studied as a mediator between strategy and digitalization. 2. Lack of empirical studies on SME digitalization. 3. Few strong empirical models exist to guide SMEs in digital transformation.
3. [9]	<ol style="list-style-type: none"> 1. UI designed based on user needs (UCD, Design Thinking). 2. Navigation and flow designed to be simple for MSMEs. 3. Features tailored to user needs (brand checking, logo, plagiarism detection). 4. Status visualization using color codes to ease interpretation. 5. UI evaluation using UEQ to show user responses to UI adaptivity 	<ol style="list-style-type: none"> 1. Literature on SME digital transformation remains fragmented and non-integrative. 2. Limited studies on incumbent SMEs, with most focusing on large firms or start-ups. 3. Digital competitiveness models have not been empirically validated.
4. [36]	<ol style="list-style-type: none"> 1. Responsive across multiple devices 2. Navigation tailored to MSME users 3. Adaptive visual feedback (green, yellow, red) 4. Flexible layout 5. Language aligned with user needs 6. User evaluation determines improvements 7. Dynamic display based on input 	<ol style="list-style-type: none"> 1. No simple and MSME-friendly platform for trademark registration. 2. Low MSME understanding of the registration process and lack of educational tools. 3. Few UI/UX studies related to MSME intellectual property management.

<p>5. [33],[60]</p> <ol style="list-style-type: none"> 1. Homepage Design 2. Navigation Interface 3. Color Theory 	<ol style="list-style-type: none"> 1. Previous studies have not assessed the relationship between UI/UX and user attraction. 2. UI/UX elements are rarely evaluated separately (homepage, navigation, color theory). 3. Limited empirical data on younger users (ages 17–30).
<p>6. [11]</p> <ol style="list-style-type: none"> 1. User emotions 2. Eye gaze 3. Physiological responses 4. Interaction behavior & application metadata 5. User persona 6. Situational context 7. Rule triggers from SitAdapt 	<ol style="list-style-type: none"> 1. Few studies link UI/UX with conversion and retention. 2. Limited UI/UX research using complete iterative improvement approaches. 3. Lack of UX studies relevant to modern digital user behavior.
<p>7. [18]</p> <ol style="list-style-type: none"> 1. Personalized layout and navigation. 2. Context responsiveness 3. Content customization. 4. Proactive support and personalized 5. Cross-platform adaptability 6. Real-time adaptation 7. Multimodal interaction 8. Ethical considerations 	<ol style="list-style-type: none"> 1. Lack of UI recommendations specifically for web-based e-commerce. 2. Few studies integrating user evaluation with UI recommendations. 3. No comprehensive UI recommendation standards for e-commerce.
<p>8. [20],[61]</p> <ol style="list-style-type: none"> 1. Automatic ad personalization based on user behavior 2. Dark mode automatically activated at night 3. Responsive web design adapting to user devices 4. Settings menus for manual adjustments 	<ol style="list-style-type: none"> 1. No adaptive UI that is transparent and easy to understand. 2. No in-depth studies based on age differences. 3. Advanced AI for adaptive UI has not been evaluated. 4. Limited studies on ethics of emotion-based adaptation.
<p>9. [52]</p> <ol style="list-style-type: none"> 1. Visual design 2. Gamification elements 3. Navigation and functionality 4. Data and information presentation 5. Multimodality 6. Adaptive interventions 	<ol style="list-style-type: none"> 1. Adaptive UI studies have not specifically examined the role of visual shapes (basic and complex) in interface design. 2. No comprehensive studies testing the relationship between shape preferences and demographic factors such as age, gender, and region.
<p>10. [55], [62]</p> <ol style="list-style-type: none"> 1. Context-awareness 2. Personalization 3. Adaptability and adaptivity 4. Interaction flexibility 5. Reusability and scalability 6. UX-driven adaptation 7. Monitoring and feedback 	<ol style="list-style-type: none"> 1. No integration of context-aware recommendations to produce adaptive UIs. 2. Lack of integration of implicit + explicit feedback as the basis for UI adaptation. 3. Limited validation using real user data in adaptive UI systems.
<p>11. [28][63]</p> <ol style="list-style-type: none"> 1. Cultural communication factors 2. Digital communication behavior 3. E-commerce consumer behavior 	<ol style="list-style-type: none"> 1. No integration of e-commerce theory with cross-cultural communication theory. 2. The role of culture and communication styles in online shopping behavior has not been explained. 3. Previous e-commerce models are too general and fail to consider “individuated experience.”
<p>12. [39],[64]</p> <ol style="list-style-type: none"> 1. User behavior 2. Temporal aspects 3. Interaction patterns 4. Preferences & intent 5. RL rewards 6. Contextual factors 	<ol style="list-style-type: none"> 1. No adaptive real-time personalized UI models. 2. Rare use of Reinforcement Learning (RL) in interface personalization. 3. No integration of behavioral data + reward mechanisms for adaptation.

From several articles observed on adaptive user interfaces for MSMEs, based on the identified gaps and indicators, an analysis was conducted to highlight key issues and indicators related to adaptive user interfaces for MSMEs. The gaps found will serve as considerations for future research and development of adaptive user interfaces for MSMEs. Among the gaps identified are: the absence of a

simple and MSME-friendly platform, the lack of comprehensive UI recommendation standards for e-commerce, limited studies specifically examining the role of visual shapes (basic and complex) in interface design, overly general e-commerce models that fail to consider “individuated experience,” and the absence of real-time adaptive personalization models for user interfaces. Therefore, the author raises these issues as the focus of research on adaptive user interfaces for MSMEs (see Figure 6).

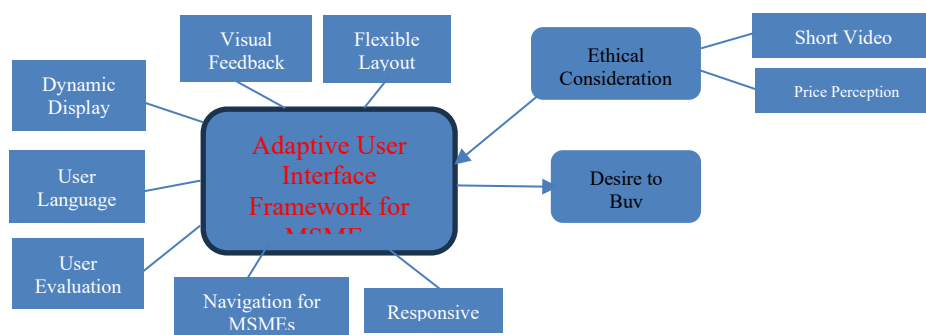


Source: 2025 Research

Figure 6 Research Ideas Based on Findings

From several indicators that were identified, a combination will be carried out to optimize the framework, and not all indicators will be used, but some will be added for further development. The indicators found in several studies will serve as references in designing an adaptive user interface framework for MSMEs, focusing on ethical considerations [18], since paying attention to these conditions is an initial step to gain user trust in an e-commerce platform. In addition, the indicators used as the basis for developing the adaptive user interface for MSMEs refer to [36], so that users can experience ease and comfort in using the system later on.

Once users gain trust through the convenience and ease provided, this will encourage them to engage in transactions. With the opportunities available, the system will offer products by promoting them through short videos and price offers. Through this effort, the adaptive user interface framework for MSMEs is expected to stimulate purchase intention among users, so that the contribution outcome is the emergence of user buying interest. The form of indicators to be used in designing the adaptive user interface framework for MSMEs can be seen in Figure 7.



Source: 2025 Research

Figure 7 Indicators for Compiling an Adaptive User Interface Framework for MSMEs

5. CONCLUSION

Based on 5,622 articles, quantitative analysis produced five main thematic clusters of adaptive UI for MSMEs, with publication trends increasing by +25% in 2024, confirming the acceleration of research on micro-sector digitalization. This study contributes through an open-source bibliometric map using VOSviewer, which can be utilized by e-commerce researchers for the standardization of themes, indicators, and scientific collaboration. The implications for SDG 9 (Innovation & Infrastructure) are evident: research mapping accelerates the design of adaptive UIs that are inclusive, lightweight, and affordable, thereby enabling MSMEs to be more prepared to adopt digital innovations.

Ultimately, observations from 80 academic publications collected from the ScienceDirect database yield several conclusions. First, research related to adaptive user interfaces for MSMEs has been widely conducted in both developed and developing countries, in line with digitalization across all fields since 1998. Second, research has grown significantly from 2023 until the present, when this paper was written, with many studies focusing on computer science to realize advancements in the digitalization era. Third, several gaps and indicators were identified across the articles. The gaps include: the absence of a simple and MSME-friendly platform, the lack of comprehensive UI recommendation standards for e-commerce, limited exploration of the specific role of visual forms (basic and complex shapes) in interface design, overly general e-commerce models that do not consider “dividuated experience,” and the absence of real-time adaptive UI personalization models.

Meanwhile, the indicators identified are used to support further research development through processes of integration or addition, which can produce an adaptive UI framework for MSMEs. Overall, the indicators related to adaptive UI for MSMEs are focused on user convenience and comfort, as well as providing recommendations to users. From these conclusions, researchers can gain insights to further develop future studies that contribute more effectively and provide novel findings in academic publications.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest between the authors or with the research objects in this article

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