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Innovations and Adoption: Examining the Constructs of Technology Acceptance Theories

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***Abstract*—The swift advancement of technology requires a more profound comprehension of the factors affecting its acceptance in different areas. This systematic literature review analyses prevalent notions and proposes additional constructs for incorporation into technology adoption theories to improve comprehension of user acceptance. The main issue is the need for an updated and organized study to identify the prevalent constructions utilized within technology adoption theory and propose new, less common constructs for consideration in the paper. A meticulous search strategy is employed, utilizing precise keywords and criteria in esteemed databases such as Scopus and Web of Science. The study methodology adheres to the PRISMA framework. The research focused on studies published between 2022 and 2024, culminating in analyzing 45 primary data entries. The findings were categorized into three themes: (1) user acceptance and behavioral intents, (2) technology integration and innovation, and (3) sustainability and social impact. The analysis indicated that only three are common among the 44 constructs examined. The constructs are Trust, Security Risk, and Attitude. This study's identified constructs provide a foundation for advancing technology adoption theories, emphasizing the necessity for continued research into their implications and exploring constructs beyond Computer Science.**

***Keywords*—Adoption of technology; acceptance of technology; constructs; determinants.**

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I. INTRODUCTION

In today's fast-paced digital landscape, where the effective integration of new technologies can significantly influence organizational performance and individual productivity, it is essential to understand technology adoption. Theoretical frameworks that have become fundamental tools for studying the factors that promote or impede technology adoption include the Technology Acceptance Model (TAM), Theory of Planned Behavior (TPB), Diffusion of Innovations (DOI), and Unified Theory of Acceptance and Use of Technology (UTAUT). These models are helpful to stakeholders seeking to enable more seamless transitions into new technology applications in addition to being academic frameworks [1], [2], [3], [4], [5], [6]. The applicability of these theories is becoming increasingly apparent as technology advances, calling for constant research and improvement.

Research on technology adoption is rich and varied right now. The Technology Acceptance Model (TAM) by [7], emphasizes perceived usefulness and ease of use as key constructs influencing technology adoption. Later modifications, such as TAM2 by [8], have expanded its application by adding contextual constructs and social influence. By incorporating psychological constructs like attitudes, subjective norms, and perceived behavioral control, TPB by [9] enhances this framework and offers a more complex picture of user intentions. While the DOI theory, as in [10] highlights the features of innovations and social context, the UTAUT by [11] synthesizes important components from these models and focuses on performance expectancy, effort expectancy, social influence, and facilitating conditions. These frameworks have produced significant empirical findings across several fields, such as information systems, healthcare, and education.

These theories have made significant contributions, although there are still disagreements and gaps. One significant problem is the limited integration of various frameworks; they frequently operate separately, producing fragmented conclusions about user behavior [12], [13], [14]. Some researchers support a unified strategy, arguing that combining several constructs could result in a more thorough understanding of technology adoption. Furthermore, even though the current models have undergone thorough testing,

little study has been done on how well they work in quickly changing technology environments like blockchain and artificial intelligence [15], [16], [17]. This makes it challenging to validate the applicability of traditional constructions in new environments, highlighting the urgent need for updated theoretical perspectives.

This article aims to accomplish two distinct objectives. Firstly, it will thoroughly review and compare the key constructs found in different technology adoption theories, explaining their similarities and differences. Secondly, it will suggest new constructs and modifications that can be used in the current frameworks. The article intends to promote scholarly understanding and practical application in technology adoption by filling theoretical gaps and offering integrative approaches. The main objectives of this paper are to inform users about feasible approaches to technology deployment in an ever-complex environment and to lay the foundations for future study.

II. Materials and Method

Technology adoption theories have evolved to address the dynamics of technology integration across many industries and the intricacies of user behavior. This review analyses significant constructs present in prominent models, including TRA, TAM, TPB, and UTAUT, as corroborated by diverse studies. Emerging research trends indicate a growing focus on contextual variables and demographic influences regarding technology adoption. In the realm of garment rental services, characteristics such as prior behavior and environmental awareness were identified [18], the requirements of elderly individuals utilizing voice-user interfaces were highlighted [19]. These studies indicate a shift in emphasis from fundamental usability to understanding user motivations. The UTAUT acceptance theory model reveals notable trends in analyzing diverse technological innovations across multiple contexts. Recent research has focused on expanding the UTAUT model by incorporating factors pertinent to specific technologies, such as mobile learning [20], blockchain [21], and e-health applications [22]. The growth of these models signifies an increasing acknowledgement of the necessity of adapting theoretical frameworks to the complexities of diverse user experiences and technology applications. Researchers have enhanced their comprehension of the determinants influencing adoption behaviors by incorporating additional variables such as trust, motivation, and e-health literacy. This indicates a shift towards a more user-centered methodology in technology acceptance research.

The amalgamation of elements from established models such as UTAUT, TPB, and DOI has augmented the efficacy of research projects. Previous research examined cloud-based quality management systems, whereas another researcher also analyzed digital technologies in construction, employing a combination of qualitative and quantitative methodologies [23], [24]. However, research by [25] discovered that adaptations of UTAUT frequently overlook significant constructs related to privacy and trust, suggesting that existing models may need modifications to more effectively understand the complexities of user behavior, especially in contexts where privacy is paramount. Previous researchers illuminate user behaviors regarding the replacement of smart devices, uncovering substantial findings that contest conventional technology adoption theories, particularly in switching intents and perceived utility. The study underscores the importance of privacy issues while revealing a significant deficiency in comprehending the intricate interactions among many factors that affect user decisions [26]

A multitude of research projects concentrated on specific places or people. For instance, the cultural influences on the adoption of mobile payments in Vietnam were examined [27]. While this research yields valuable data, they are typically inapplicable to broader groups or varied cultural situations. Moreover, there is a lack of research about the determinants that affect the adoption of specific technologies in educational settings, such as knowledge-based chatbots, as examined by [28]. In [29], a cross-cultural examination of virtual reality adoption, emphasizes that significant insights need to be gained regarding the influence of regional cultural norms on technological acceptance. In [30], the execution of Bring Your Own Device (BYOD) initiatives in Saudi Arabia was analyzed, highlighting specific regional challenges that may not apply in other settings.

While current models enhance user acceptability of existing technologies, there is a significant deficiency in research on emerging technology. To address this gap, the use of blockchain technology in Ethiopia was investigated [31], emphasizing the necessity for tailored frameworks that include local infrastructures and conditions. The application of augmented reality in retail, advocating for a comprehensive analysis of the aspects that drive user engagement with technology [32]. A significant deficiency exists in the study concerning socio-cultural aspects that may influence technological adoption, particularly in non-Western contexts. Moreover, a study by [33] provides insights into adopting AI but does not adequately investigate the motivational elements influencing its utilization. This indicates a need for a more comprehensive study examining the interplay between user motives and technology acceptability.

These limitations underscore the necessity for comprehensive models that integrate many aspects about user emotions and cultural context, encompass a broader geographic scope, and employ longitudinal approaches to document the evolving acceptance of technology over time. Furthermore, it underscores the necessity for comprehensive research to examine the suitable incorporation of these technologies into existing educational frameworks and to address the challenges posed by emerging technological advancements. Examining technology adoption ideas reveals a dynamic domain marked by established frameworks and new factors. Although fundamental components such as perceived usefulness and simplicity of use are still paramount, there is a growing acknowledgment of the necessity to incorporate supplementary elements, including trust, risk perception, and cultural impacts. The existing literature illustrates the need for theoretical frameworks to adapt to the complexities of modern technology use, promoting a multidimensional approach that includes various contextual and demographic factors.

The methodology used in this study is based on the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) framework [34]. The PRISMA framework used in this study involved four main processes:

identification, screening, and eligibility. These are included in Figure 1.

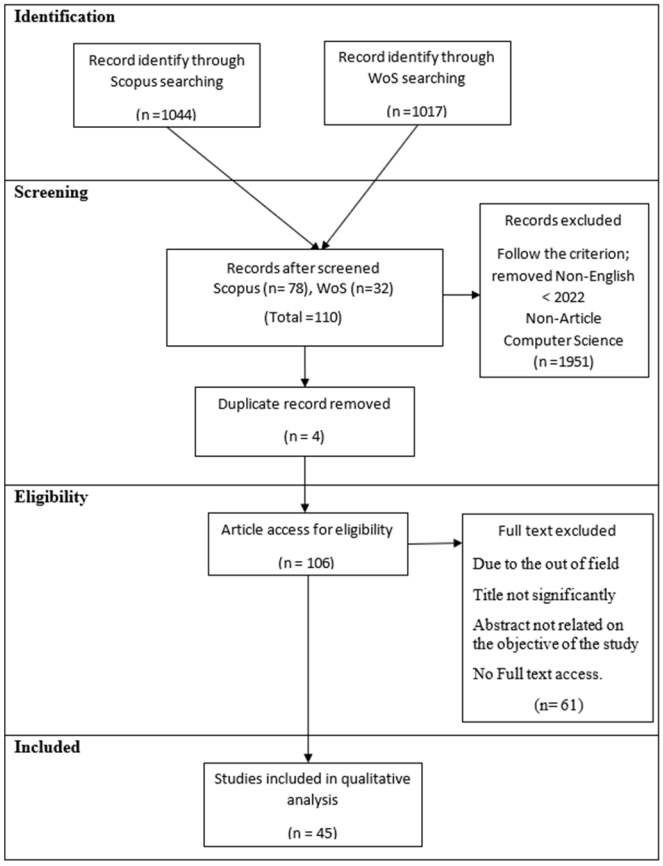

Fig. 1 PRISMA Framework

A. Identification

This study employed essential phases of the systematic review process to compile a significant body of pertinent literature. The method commenced with identifying keywords and succeeded by exploring associated terms through dictionaries, thesauri, encyclopedias, and previous research. All pertinent terms were identified, and search strings were formulated for the Scopus and Web of Science (WoS) databases, as referenced in Table 1. The preliminary stage of the systematic review produced 2061 relevant papers from the three databases.

TABLE I
SEARCH STRING

Scopus	TITLE-ABS-KEY (("Technology Adoption" OR "User Acceptance" OR "Adoption Models" OR "Integration of Frameworks") AND ("TRA" OR "TPB" OR "TAM" OR "TAM2" OR "DOI" OR "UTAUT") AND ("Constructs" OR "determinant")) AND PUBYEAR > 2021 AND PUBYEAR < 2025 AND (LIMIT-TO (SRCTYPE , "j")) AND (LIMIT-TO (OA , "all")) AND (LIMIT-TO (PUBSTAGE , "final")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (SUBJAREA , "COMP")) AND (LIMIT-TO (LANGUAGE , "English"))
WoS	("Technology Adoption" OR "User Acceptance" OR "Adoption Models" OR "Integration of Frameworks") AND ("TRA" OR "TPB" OR "TAM" OR "TAM2" OR "DOI" OR "UTAUT") AND ("Constructs" OR "determinant") (Topic) and 2024 or 2023 or 2022 (Publication Years) and Article (Document Types) and English (Languages) and Computer Science (Research Areas)
Date of Access: Sep 2024	

B. Screening

During the screening phase, possibly pertinent research items are assessed to confirm alignment with the established research question(s). This phase often entails the selection of study items grounded in the constructs of technology adoption theories. Duplicate documents are eliminated at this phase. Initially, 1951 publications were omitted, resulting in 110 papers for subsequent analysis according to defined inclusion and exclusion criteria (refer to Table 2). The primary criterion was an article in a journal, as it serves as the principal source of practical advice, encompassing reviews, meta-syntheses, meta-analyses, books, book series, chapters, and conference proceedings not addressed in the latest study. The review was confined to English-language publications from 2022 to 2024. Another selected factor is its relevance to the discipline of computer science. In total, four publications were declined owing to redundancy.

TABLE II
SELECTION CRITERION

Criterion	Inclusion	Exclusion
Language	English	Non-English
Timeline	2022 – 2024	< 2022
Literature type	Journal (Article)	Conference, Book, Review
Publication Stage	Final	In Press
Subject	Computer Science	Besides Computer Science

C. Eligibility

During the eligibility phase, the third step, 106 articles were prepared for review. At this step, all publications' titles and essential content were meticulously reviewed to confirm compliance with the inclusion criteria and alignment with the present study objectives. As a result, 61 items were excluded for failing to meet the criteria. Due to the lack of relevance in the title, the abstract's disconnect from the study's objectives, and the absence of full-text access to empirical evidence. Consequently, a total of 45 articles remain for the forthcoming evaluation.

D. Data Abstraction and Analysis

This study employed an integrative analysis as an assessment strategy to investigate and synthesize various research designs utilizing quantitative approaches. The objective of the study was to ascertain pertinent subjects and subtopics. The data collection phase constituted the initial step in the theme's development. Figure 1 illustrates the authors' thorough analysis of a collection of 45 publications for claims or content pertinent to the subjects of the present study. The authors subsequently assessed the prevailing substantial research about constructs within technology

adoption theory. The methodology employed in all investigations and the research findings are under examination. The author subsequently partnered with co-authors to formulate themes grounded in the conclusions within the framework of this study. A log was maintained during the data analysis to document any analyses, perspectives, inquiries, or other reflections pertinent to data interpretation. Ultimately, the authors evaluated the results to identify discrepancies in the theme design process. It is important to note that any differences among the notions are deliberated among the authors.

III. Results and Discussion

This investigation identified 45 papers utilized to address the research questions. Table III presents the findings of this study, which concentrated on constructs not included in the basic framework of the technology adoption theory referenced in the research. The findings were identified to focus on three primary themes: 'User Acceptance and Behavioral Intentions,' 'Technology Integration and Innovation,' and 'Sustainability and Social Impact.'

A. User Acceptance and Behavioral Intention

User acceptance and behavioral intention pertain to an individual's willingness to embrace and use new technologies, and this theme is the most prominent of the three, as the majority of the article aligns with it. Older people are more inclined to utilize voice-user interfaces (VUI) in smart home systems when they perceive them as beneficial, user-friendly, and reliable [19]. The study indicates that factors such as mobile self-efficacy and technological anxiety, prevalent among older adults, affect these elements, suggesting that products should be tailored for this demographic. A study by [35] investigate palm vein authentication technology and determine that user trust and risk perceptions are critical for its adoption. The research underscores developers' need to cultivate trust and mitigate privacy issues to enhance user adoption. A previous study by [36] advances this discourse by examining user interaction with educational technology such as Google Classroom, correlating usability and perceived utility with student acceptance of these tools in a Middle Eastern environment.

Recent research, such as that conducted on smart city technologies, indicates that the perceived ease of use of these technologies and the quality of ICT infrastructure are critical factors influencing citizens in Jordan's decision to adopt them [37]. Likewise, [38] discovered that enjoyment and the expense of autonomous passenger vehicles significantly influence consumer acceptance of these advances in Europe. The research indicates that many socio-economic aspects significantly influence individuals' decisions to adopt new technology. Furthermore, [39] examined digital interventions for depression and discovered that patients' trust in healthcare professionals significantly affects readiness to embrace technology-based treatments. Additional studies, such as those conducted by [40] and [32], investigate the application of these models within the healthcare and retail sectors. A study by [40] employ a mixed-methods approach that integrates the Expectation Disconfirmation Theory with the Technology Acceptance Model to elucidate the factors influencing patient satisfaction with telemedicine. They highlight the correlation between performance expectations and the actual service delivered. Conversely, [32] examine the impact of augmented reality in retail, demonstrating that performance expectations and enjoyment are crucial in fostering favorable customer behavior.

In conclusion, the subject of user acceptance and behavioral intentions elucidates critical factors across various technological domains, demonstrating how contextual elements influence technology adoption. Key factors like perceived usefulness and simplicity of use are critical, with studies frequently citing frameworks like the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). For elderly folks, technologies facilitating straightforward interactions, such as voice interfaces, might be highly advantageous, whereas biometric systems frequently confront challenges concerning privacy and perceived hazards. In educational settings, user-friendly technologies such as Google Classroom foster acceptance, highlighting the significance of cultural context and institutional support. Comprehending these dynamics is essential for effective technology integration, informing future research on user experiences and methods to improve technology adoption and satisfaction across all sectors.

B. Integration of Technology and Innovation

Technology integration and innovations pertain to incorporating technologies across many sectors, including education and healthcare. The adoption of Outcome-Based Education (OBE) systems among educators in Indonesia utilizing the UTAUT-3 model was examined [41]. The findings indicated that Behavioral Intention (B.I.) is crucial for affecting User Behavior (U.B.), with notable correlations identified between personal habits and the intention to employ technology. This study elucidates the collective impact of hedonic motivation and personal innovativeness on adopting educational technology inside the UTAUT-3 paradigm. This underscores educational institutions' need to adopt such frameworks for efficient technology integration.

A study by [42] examined the factors influencing the implementation of drone delivery systems in Medellín amid the COVID-19 pandemic. Performance risk, compatibility, and environmental benefits significantly influence individuals' decisions to use this technology. This signifies that public perception of the unique characteristics is essential for their acceptability. This study parallels the work of [43], who investigated blockchain adoption in the construction industry, highlighting the importance of institutional forces and perceived advantages among various stakeholders. Both studies offer significant insights into the influence of diverse contextual factors on technology acceptability across varied environments.

A study by [31] examined the application of blockchain technology inside Ethiopia's National Quality Infrastructure, utilizing an integrated TAM-TOE framework. Their findings indicated that technological compatibility and perceived utility are critical for adoption. This aligns with [23], emphasizing that resource availability and collaboration are essential for adopting digital technology in the construction industry. These studies underscore the necessity for strategies customized to local conditions and technology contexts,

illustrating how different dimensions can influence adoption success across diverse domains.

Examining technology integration and innovation provides significant insights across several industries, highlighting the determinants influencing the acceptance of new technologies. In educational contexts, frameworks such as UTAUT-3 illustrate how user behavior, enjoyment, and established habits can improve the teaching and learning experience. Using drones for delivery and blockchain technology across diverse sectors underscores the importance of perceived advantages, compatibility, and organizational support in influencing adoption choices. The utilization of virtual reality in experiential learning illustrates the capacity of immersive technology to tackle obstacles in remote education while highlighting the cultural elements that affect user acceptability. These findings underscore the necessity for tailored strategies that account for user experiences and environmental factors to facilitate successful technology adoption across many domains.

C. Sustainability and Social Impact

Sustainability and social impact denote the far-reaching societal effects of technological adoption, mainly focusing on sustainability. The study from [18] demonstrated that attitudes, subjective norms, and perceived consumer effectiveness are crucial in influencing the intention to utilize garment rental services in the United States. This study, grounded in the Theory of Planned Behavior (TPB), revealed that these factors collectively explained a substantial variance in consumer intentions, highlighting the significance of environmental knowledge and personal relevance in the decision-making process. A concurrent study by [44] examined the implementation of electric shuttle bus services, determining that attitude is the principal predictor of acceptance, while performance expectancy and social influence offer supplementary reinforcement. These results underscore the imperative of improving consumer awareness about environmental advantages to foster increased acceptance of sustainable transportation options [44].

A study by [45] investigated the acceptance of the work-from-home (WFH) concept among technical personnel in the power sector. This study employed the UTAUT theory and incorporated new factors, including emotional well-being and cultural considerations, which were identified as essential in the work-from-home context. This research suggests that addressing the comprehensive needs of employees might foster more sustainable work environments, particularly relevant in the post-pandemic situation. Similarly, [46] examined students' perceptions of Metaverse technology in higher education, identifying performance expectancy and facilitating conditions as key determinants of adoption. This study underscores the capacity of immersive technologies to improve social interaction and educational experiences, especially in underdeveloped countries.

The determinants affecting the adoption of sustainable cloud-based quality management systems among scholars in Jordan were examined [24]. The research, employing the UTAUT2 model and the TPB, identified perceived behavioral control and performance expectancy as key factors influencing usage intentions. This research enriches the comprehension of technology adoption in educational settings and emphasizes the necessity for institutions to cultivate environments that facilitate the integration of sustainable technologies. A parallel study by [47] examined using electric cars (EVs) in South India, revealing that perceived hazards significantly influenced behavioral intentions. The findings suggest that alleviating risk perceptions is crucial for promoting the use of electric vehicles, which are vital for attaining sustainable transportation. A study by [28] researched knowledge-based chatbots to enhance species literacy, emphasizing the integration of education and technology. The analysis indicates that the alignment between tasks and technological solutions is crucial in influencing users' intent to embrace these educational tools, offering essential insights into user engagement techniques. Additionally, another study by [48] it investigated the impact of digital innovations in the logistics industry, illustrating that technology adoption and integration yield favorable sustainability results. This study highlights the substantial influence of digital technologies on enhancing operational sustainability across many sectors.

The analysis of sustainability and social effects reveals an increasing interest in collaborative consumption, innovative technology, and sustainable practices across several sectors. Research findings indicate that consumer attitudes, societal influences, and perceived efficacy substantially impact the inclination to embrace sustainable solutions, such as apparel rental services and electric automobiles.

D. Constructs Identified

A designated threshold is utilized to classify constructs, allowing for the distinction between those that are common and those that are uncommon. This paper establishes a frequency threshold to evaluate the commonality of constructs within the framework of technology acceptance theory. A construct will be classified as common if it appears in at least 20% of the reviewed literature, translating to a minimum of 9 occurrences among the 45 articles examined, specifically those published between 2022 and 2024. Constructs that are referenced in fewer than 9 articles were regarded as uncommon. The following formula is used to calculate the frequency of the construct used.

$$Frequency\ of\ Construct = \frac{\text{Number of Articles mention using Construct}}{\text{Number of Article}} \times 100 \quad (1)$$

TABLE III
EXAMPLES OF CONSTRUCTS IDENTIFIED

Construct	Frequency	Un/Common
Perceived Consumer Effectiveness	2.22	Uncommon
Environmental Knowledge/Concern	4.44	Uncommon
Past Environmental Behavior	2.22	Uncommon
Self-Efficacy	11.11	Uncommon
Anxiety	6.67	Uncommon
Attitude	8.89	Common
Personal Innovativeness/ Innovativeness and Motivation	15.56	Uncommon
Satisfaction	2.22	Uncommon
Trust	31.11	Common

Construct	Frequency	Un/Common
Privacy Concern/Risk	11.11	Uncommon
Security/Perceived Risk	44.44	Common
Awareness	2.22	Uncommon
Financial Literacy/Cost	4.44	Uncommon
Uncertainty Avoidance	4.44	Uncommon
Perceived Enjoyment /Satisfaction	13.33	Uncommon
Design/ System Characteristic	4.44	Uncommon
Information Quality	2.22	Uncommon
Technical/Service Quality	8.89	Uncommon
ICT Infrastructure and Inadequate Internet Connectivity	2.22	Uncommon

IV. Conclusion

The analysis of several papers for this paper underscores the importance of the term "construct" as a vital element across multiple academic disciplines. It often signifies an abstract notion that indicates measurable aspects of human behavior or perceptions. Constructs serve as a theoretical framework to analyze complicated occurrences by breaking them into more manageable components. In the context of technology adoption, constructs may be designated by various labels such as "variables," "dimensions," or "factors," depending on the research focus and the theoretical framework employed.

The fundamental foundations of these technology adoption theories are inherently adaptable, permitting modifications that accommodate various circumstances and populations. This adaptability is essential, as it enables researchers to enhance these frameworks to increase pertinence, especially when investigating emerging technologies or contemplating cultural influences that may affect user behavior. The criticism of the Technology Acceptance Model (TAM) underscores its limited emphasis on technological dimensions, neglecting personal attributes and adverse views [49]. Consequently, although the foundational components provide a robust framework, the demand for adjustments arises from the necessity for practical applicability in both scholarly research and real-world scenarios and the obligation to deepen our comprehension of user behavior across various situations. Any changes must be grounded in empirical evidence to guarantee the validity and reliability, therefore enhancing the comprehension of technological acceptance dynamics.

This work examines the prevalent constructs utilized in technology adoption theory and proposes constructions that are either less common or rare for future research endeavors. To classify the constructs as common or uncommon, we computed the frequency of usage using the formula. We will also identify whether the construct is associated with another technology adoption theory and consider it common if it is already included in an established technology adoption theory. This is because some of the articles we studied have incorporated additional components from another recognized technology adoption theory into their framework. The study examines the requirements of older individuals utilizing voice-user interfaces, incorporating elements from the Senior Technology Adoption Model (STAM) into their framework [19]. The STAM is a comprehensive evaluation of older persons' readiness to adopt technological innovations and has been utilized to examine South Korean adults' intentions to employ daily life assistive technology [50]. Consequently, it represents an additional technology adoption theory.

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