Emerging Trends in Cloud-Based E-Learning: A Systematic Review of Predictors, Security and Themes

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Abstract

Cloud-based e-learning (CBEL) represents a promising technological frontier. Existing literature has presented a diverse array of findings regarding the determinants that influence the adoption of CBEL. The primary objective of this study is to conduct an exhaustive examination of the available literature, aiming to determine the key predictors of CBEL utilization by employing the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology. A comprehensive review of 35 articles was undertaken, shedding light on the status of CBEL as an evolving field. Notably, there has been a discernible downturn in related research output during the COVID-19 pandemic, underscoring the temporal dynamics of this subject. It is noteworthy that a significant portion of this research has emanated from the Asian continent. Furthermore, the dominance of the technology acceptance model (TAM) in research frameworks is affirmed by our findings. Through a rigorous thematic analysis, our study identified five overarching themes, each encompassing a diverse range of sub-themes. These themes encompass 1) technological factors, 2) individual factors, 3) organizational factors, 4) environmental factors, and 5) security factors. This categorization provides a structured framework for understanding the multifaceted nature of CBEL adoption determinants. Our study serves as a compass, guiding future research endeavours in this domain. It underscores the imperative for further investigations utilizing diverse theoretical frameworks, contextual settings, research methodologies, and variables. This call for diversity and expansion in research efforts reflects the dynamic nature of CBEL and the evolving landscape of e-learning technologies.

Keywords: Cloud-based e-learning, PRISMA, Secure cloud, TAM, Thematic analysis

1. Introduction

The landscape of business operations has undergone a profound transformation with the emergence of cloud computing (CC). Over the past decade, the realm of Information Technology (IT) has experienced a seismic shift catalyzed by CC (Wu & Plakhtii, 2021). CC, as a dynamic technological platform, furnishes the cyberinfrastructure required to expand and manage information storage capacities, all the while accommodating a diverse spectrum of demands. This revolutionary paradigm allows seamless access to software and hardware resources, liberating businesses from the burden of substantial upfront investments. It further facilitates the deployment of applications and services with minimal intervention from service providers [2].

While the potential of CC is vast, its adoption often hinges not on technical limitations but on perceptual and attitudinal factors [3]. Numerous studies have delved into the behavioral aspects that influence CC adoption, predominantly in the realm of businesses, with a focus on the organizational implications of transitioning to the cloud [4]–[6]. Curiously, scant attention has been directed toward educational institutions' utilization of CC. This technology offers the means for remote execution of tasks such as software access, database management, assignments, and projects. Beyond this, it serves as a versatile repository for multimedia and data [7]. The shortage of research on the prevalence of CC adoption in universities and the variables shaping organizational choices regarding this technology remains conspicuous [8], [9].

To unravel the enigma of CC adoption, scholars have often turned to established models like the Technology Acceptance Model (TAM) [10] and the Unified Theory of Acceptance and Use of Technology model (UTAUT) [11]. These models, while influential, have been critiqued for their biased focus on individual factors, neglecting the wider social, security, and technological dimensions [12]. Consequently, the literature still grapples with divergent findings regarding the determinants of cloud-based e-learning (CBEL) utilization. For instance, some researchers attribute these determinants to individual or technological factors [13]–[15], while others engage in debates over whether they belong to technological, organizational, or environmental categories; a prime example being the classification of "relative advantage" as either an organizational or technological factor [16], [17].

Existing studies within the literature have primarily explored the benefits of CBEL, often failing to employ robust methodologies such as the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). In light of these gaps, our study endeavours to address the overarching question surrounding CBEL predictors and its present status. To this end, we undertake a comprehensive literature review utilizing the PRISMA methodology. Our primary objectives encompass illuminating the current state of the literature and furnishing academia with insights to steer future research endeavours. Given the nature of this study as a literature review, the subsequent sections will dive into the methodology, background of the reviewed articles, thematic analysis, discussion, future research avenues, and conclusion.

2. Methodology

This study is using PRISMA to conduct a systematic literature review (SLR) of the predictors of CBEL. This section includes a discussion about the PRISMA method, data sources, eligibility and systematic review process.

2.1 PRISMA

The utilization of the PRISMA framework is of utmost importance in the identification of patterns and tendencies in literature, as well as in providing a comprehensive summary of prior research studies pertaining to a specific subject matter [18]–[20]. The systematic approach to conducting literature reviews serves as a guiding tool for researchers [21]. This approach encompasses procedures such as identification, selection, appraisal, and synthesis. Researchers can enhance the precision of their search and identify the most pertinent articles by utilizing PRISMA [22]. The PRISMA tool is useful for researchers in two primary ways. Firstly, it aids in the identification of relevant research questions and the establishment of inclusion and exclusion criteria for systematic reviews. Secondly, it facilitates the efficient examination of a significant scientific literature database [23].

2.2 Data Sources

The scholarly articles were procured from two prominent journal databases, namely Scopus and Web of Science (WoS). Scopus is a comprehensive collection of literature databases that includes more than 22,800 peer-reviewed journals from 5,000 publishers, covering a wide range of fields such as environmental sciences and social science. Conversely, the WoS encompasses a vast collection of over 33,000 scholarly journals that span across 256 diverse interdisciplinary subject areas. The WoS was initially established by the Institute for Scientific Information (ISI) and is presently under the management of Clarivate Analytics. It provides an extensive collection of historical records and citation information that covers a century.

2.3 Eligibility and Exclusion Criteria

The review utilized diverse criteria to ascertain the suitability and disqualification of articles. The aforementioned criteria encompassed the genre of written works, linguistic attributes, and temporal parameters. Exclusion criteria were applied to literature that included meta-analysis articles, book series, books, chapters in books, and conference proceedings. Furthermore, emphasis was given to English publications, with non-English publications being excluded to mitigate challenges in the translation and comprehension of the manuscripts. [24] suggested that due to the impracticality of perusing all published articles, it is advisable to establish a time limit for the study period. Thus, the current investigation limited its focus to scholarly articles released from 2013 to 2022, which offered extensive coverage of the developmental trajectory of the research subject.

2.4 Systematic Review Process

The systematic review procedure encompasses four discrete phases, namely identification, screening, eligibility, and quality appraisal, as illustrated in **Fig. 1**. Initially, the review identified the appropriate keywords to be employed for the purpose of identifying pertinent articles within the Scopus and WoS databases. These keywords were created by using thesaurus definitions, terminology linked to cloud computing, cloud-based e-learning, e-learning, technology usage in e-learning, and synonyms. The search results obtained from Scopus and WoS databases were combined, resulting in a total of 375 articles, with 170 articles from Scopus and 215 articles from WoS.

During the screening phase, the 375 articles were subjected to scrutiny through the utilization of the automated sorting feature provided by the databases. The methodology encompassed the exclusion of 277 articles that failed to satisfy the predetermined inclusion and exclusion criteria, alongside the elimination of 20 articles on account of duplication.

Following this, during the eligibility phase, the authors conducted a manual examination of the titles and abstracts of the articles that remained. A total of 31 articles were excluded from the study on the basis of their lack of focus on cloud computing and e-learning.

During the quality appraisal stage, the articles were evaluated to ascertain their appropriateness for incorporation into the review. In total, 47 articles underwent appraisal and were determined to be eligible. In order to ensure the moderate-to-high quality of the articles, a panel of two experts was consulted for evaluation. Twelve articles were excluded from the final selection on account of inadequate quality subsequent to the assessment. This has resulted in reviewing 35 articles.

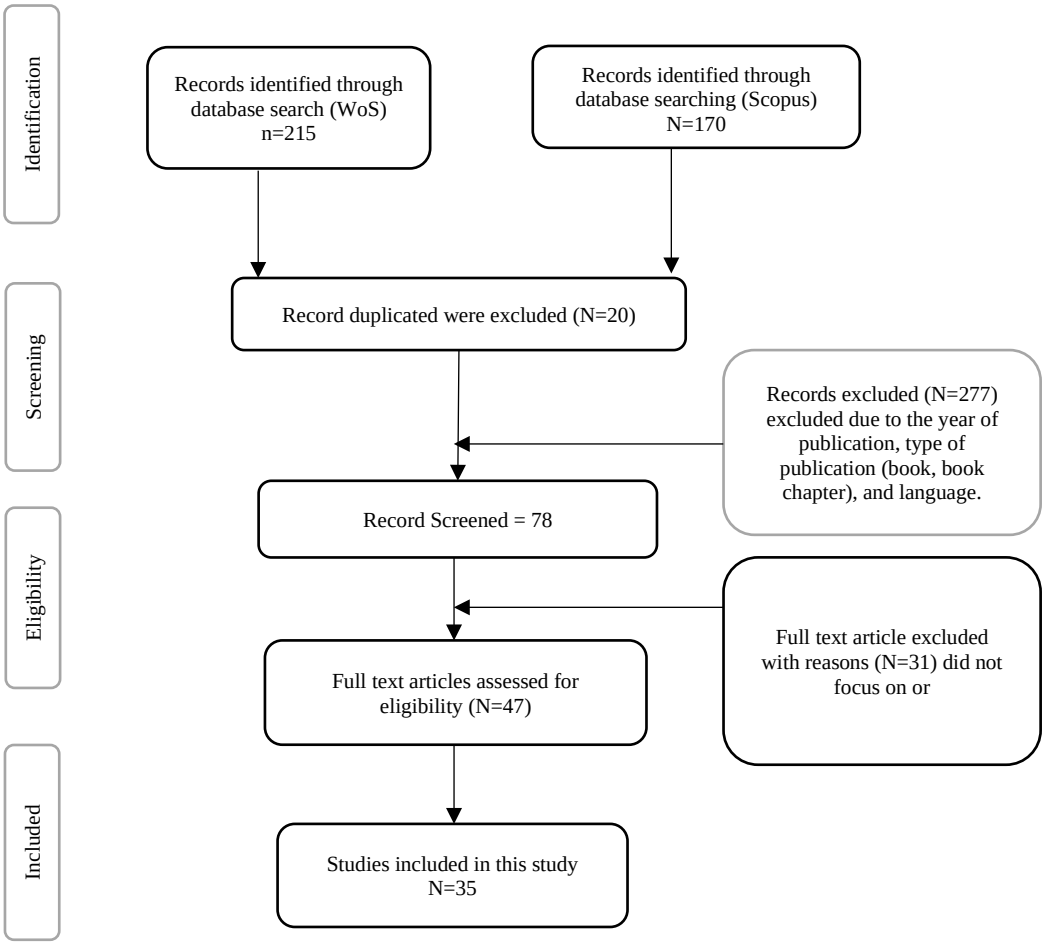

Fig. 1. Process of Literature Review

3. Results

3.1 Background of the articles

Fig. 2 shows that the articles were distributed based on year with the highest number being conducted in 2015 and 2019. A sharp drop in the number of articles is shown in 2020 and this could be due to the outbreak of COVID-19.

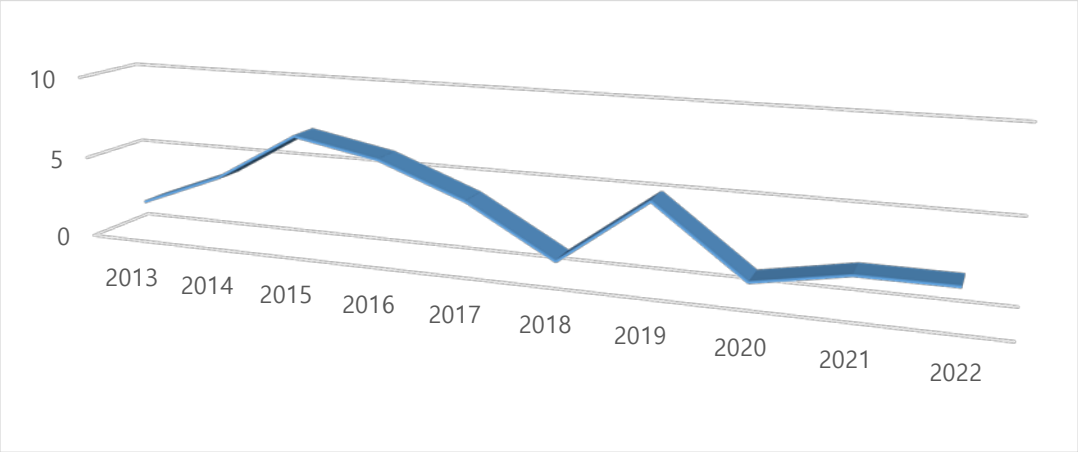

Fig. 2. Distribution of Articles Based on Year

In **Fig. 3**, it can be seen that the majority of articles were conducted in Asian countries followed by Europe while the lowest articles were in Africa and America. Based on countries, the highest number was conducted in Saudi Arabia followed by South Korea, Malaysia, Lebanon, and Taiwan. Some of the studies were conducted in two countries and they were counted separately.

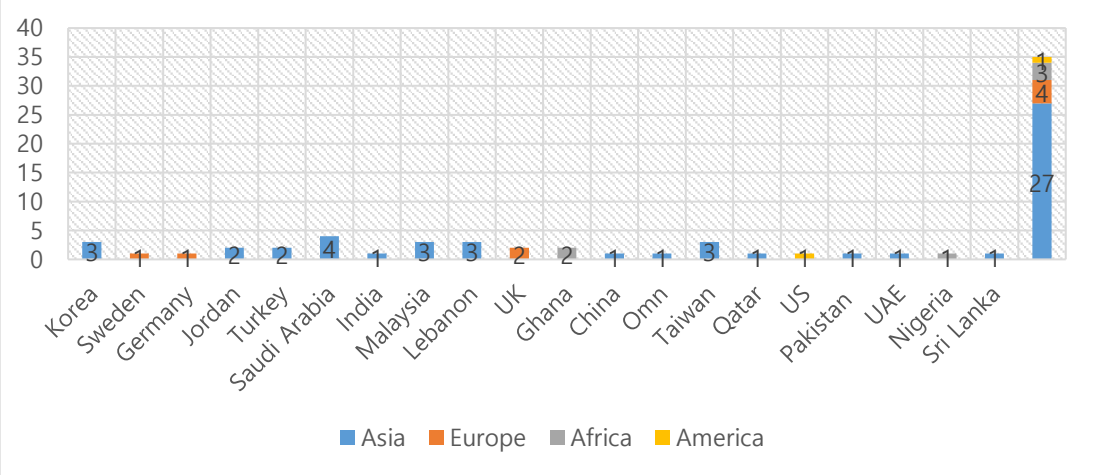

Fig. 3. Distribution of Articles based on Continents and Countries

The sample size of the reviewed studies is shown in **Fig. 4**. It shows that the maximum (Max) sample size is 1099 while the lowest sample (min) size is 30. The mean sample size accounted for 324.

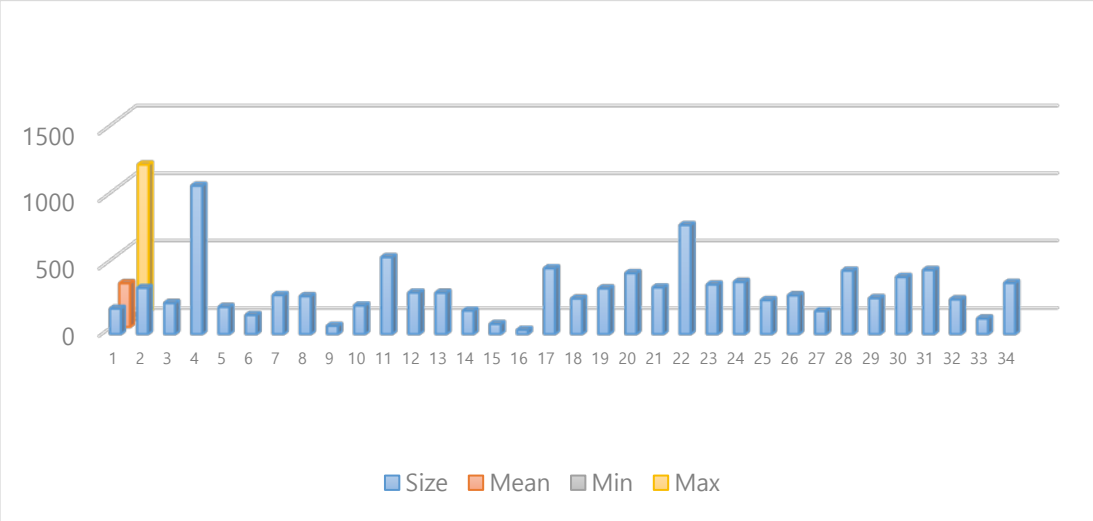

Fig. 4. Sample size

The statistical tools that has been used in reviewed articles reflect the sample size. As shown in **Fig. 5**, the SPSS accounted for 63% of the reviewed articles followed by Smart PLS with 20% and AMOS with 17%.

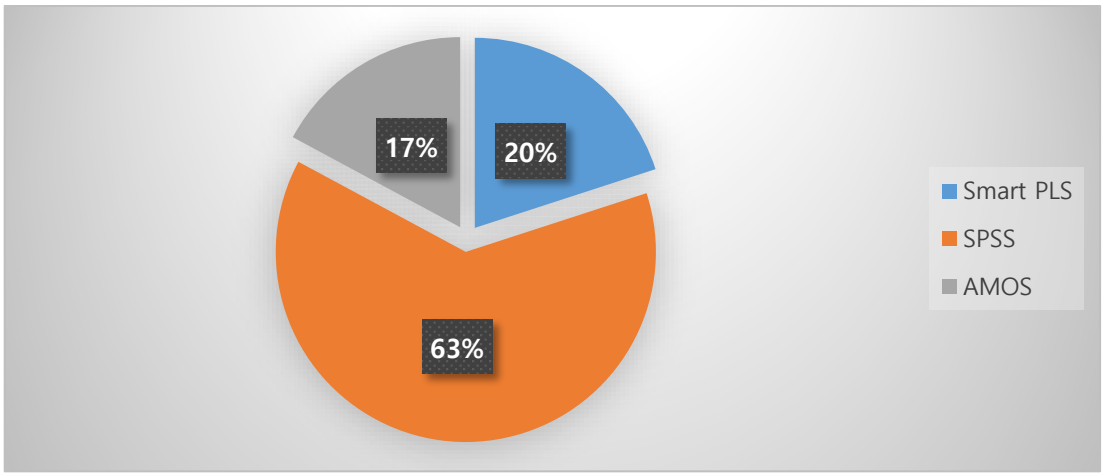

Fig. 5. Data Analysis Tools

4. Thematic Analysis

The thematic analysis was conducted by taking the frequency of the factors as they mentioned in the articles. Five themes have emerged which are the technological factors (TF), individual factors (IF), organizational factors (OF), environmental factors (EF), and others (o). The analysis also resulted in 37 sub-themes. However, six sub-themes were removed due to their redundancy in terms of meaning. For example, subjective norms and social influence refer to the same meaning and they were combined. This has resulted in 31 sub-themes as shown in **Table 1**.

Table 1. Thematic Analysis

Author	TF									IF									OF					EF			Other				
year	AC	SE	PV	TR	FA	RA	COP	COX	REL	SI	PI	PEOU	PU	SA	AT	SEF	PE	EE	CO	OR	TD	TMS	FC	CP	TP	GR	QA	OE	PP	QW	CL
[25]										X	X								X												
[26]	X	X	X																												
[27]				X								X	X	X																	
[28]	X	X											X	X	X												X	X			
[13]		X	X												x																
[29]												X				X												X			
[30]										X		X	X			X				X	X								X		
[31]							X	X												X	X	X		X	X						
[16]		X				X	X	X			X								X	X		X			X	X					
[32]		X							X			X							X												
[33]										X		X	X																	X	
[34]										X		X	X			X							X							X	
[17]		X				X	X													X		X		X	X	X					
[35]						X	X	X														X	X		X						
[14]		X			X							X	X																		X
[36]	X	X	X	X		X	X	X	X											X		X									
[37]							X	X		X		X	X		X	X													X		
[38]		X	X	X						X		X	X																		
[39]												X	X		X	X															
[40]										X							X	X					X								
[41]										X							X	X					X								
[42]										X		X	X		X	X				X									X		
[43]				X						X							X	X					X								
[44]				X						X						X	X	X													
[45]												X	X			X											X				
[46]										X	X												X				X				
[47]										X							X	X					X								
[48]												X	X			X													X		
[49]										X							X	X					X							X	
[50]		X		X								X	X																		
[51]						X			X	X		X		X																	
[52]									X	X		X																X			
[53]												X	X			X											X				
[54]	X					X						X																			
Total	4	10	4	6	1	6	6	5	4	16	3	18	14	3	5	10	6	6	3	6	2	5	8	2	4	2	4	3	4	3	1

TF: technological factors, IF: Individual factors, OF: organizational factors, EF: Environmental factors, SI: social influence, PI: Personal innovativeness, CO: Cost, AC: Accessibility, SE: Security, PV: Privacy, PEOU: Perceived ease of use, PU: perceived usefulness, SA: Satisfaction, FA: Familiarity, AT: Attitude, QA: service quality, SEF: Self-efficacy, OE: Openness to experience, RA: Relative advantage, COP; Compatibility, COX: Complexity, OR: Organizational readiness, TD: Training and development, TMS: Top management support, CP: Competitive pressure, TP: trading pressure, QW: quality of working life, FC, facilitating condition, CL: Culture.

4.1 Technological factors

As shown in **Table 1**, technological factors are related to the technological characteristics of using CBEL. The first sub-theme that emerged is the accessibility (AC) of the technology to be used anywhere at any time. Security is known to be an important factor in the technological context. It is an emerging concern along with privacy and trust. Despite the advancement in using technology, security, privacy, and trust are all still an ongoing issue. The fifth sub-theme is familiarity (FA). This variable refers to the knowledge of using the technology. The relative advantage is one of the variables that has been used as exchangeable between technological and organizational factors. It refers to the advantage of using the technology. For compatibility, it refers to the degree to which the new system is compatible with the existing systems. Complexity refers to the difficulty of learning how to use a new system. The last sub-theme is reliability which is the degree to which the system is reliable and functional.

4.2 Individual Factors

The individual factors were found to have nine sub-themes. Social influence is the effect of others which could be friends, family members, or experts on the decision of an individual to conduct a behaviour. Personal innovativeness was also considered an individual factor. The perceived ease of use and perceived usefulness (PU) are the variables of TAM, and they are highly frequent in the literature. The PEOU refers to the ease of using a system while the PU refers to the degree that the system is beneficial for the users in terms of performance.

Satisfaction of individuals with the system is considered an important variable but it has been examined in limited studies. The attitude is a variable that is derived from the theory of reasoned action and used by the theory of planned behaviour as well as the technology acceptance model. It refers to the positive or negative feeling toward using a system. Self-efficacy in terms of knowledge and confidence in using a system is a variable that is considered under the individual factors. The performance expectancy (PE) and effort expectancy (EE). Based on [11], performance expectancy is similar to perceived usefulness (PU) and effort expectancy is similar to ease of use (PEOU). Therefore, the four sub-themes can be combined into two themes.

4.3 Organizational Factors

Organizational factors are related to the organizational perspective of using the technology and they include cost (CO), organizational readiness (OR), training and development (TD), top management support (TMS), and facilitating conditions (FC). The cost is a critical factor in the usage of any technology. This affects the organizational readiness in terms of hardware, software, and other requirements for the usage of the technology. Training and development programs are part of the organizational factors. This variable is interrelated to the cost as having training and development programs is costly and organizational readiness in terms of human capital. The top management support can facilitate the implementation of new technology and provide the policy and the financial support to foster the usage of the technology. Facilitating conditions is important and directly related to the usage of the technology.

4.4 Environmental Factors

Environmental factors are related to external factors that can speed or slow the usage of the technology. The sub-themes are related to competitive pressure (CP) and trading pressure or

stakeholder pressure (TP) and government regulation (GR). The competitive pressure occurs when competitors start using the technology and benefit from the technology to improve their competitiveness while the trading pressure of the stakeholder pressure is the pressure of students, academic staff and non-academic staff in the context of e-learning and it can include other stakeholders such as community, customers and suppliers in term of business organization. Governmental regulation is critical because it can also lead to fostering or slowing the usage of the technology. Having laws and regulations can help in improving technology usage and vice versa.

4.5 Others

Some variables do not fit under the four themes. These sub-themes were listed under other. Quality is related to the quality of the system, information, and system. These variables were used in the information success system (IS system). The second sub-theme is openness to experience (OE) while the third is perceived playfulness (PP). Quality of work life is another important yet new variable in the context of cloud-based e-learning. This can be related to the academic staff who can access materials while sitting at home and similar it is related to students who can perform several tasks from anywhere at any time.

5. Discussion

The objective of this study is to understand the factors that affect the usage of CBEL. The study identified five themes and 30 sub-themes. Four of the sub-themes were further combined resulting in 28 sub-themes. **Fig. 6** demonstrates the main themes and their link to CBEL.

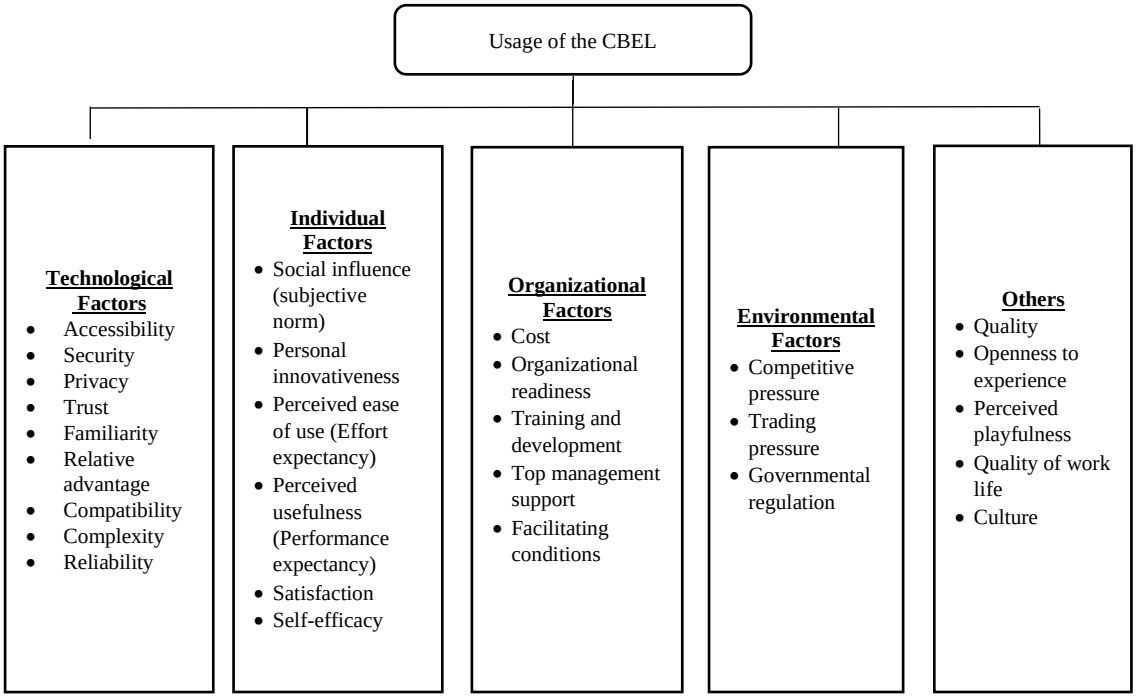

Fig. 6. Summary of Thematic Analysis

5.1 Technological Factors and CBEL

Several studies have deployed the TOE framework. The studies found that technological factors are important for the adoption of new technology. For example, a study conducted by Lian et al. (2014) found technological construct is the most important construct for the adoption of CC in Taiwan. Other studies such as [55] which investigated the public sector adoption, found that technological factors are essential for the adoption of CC by the public sector. [31] found that technological factors significantly affect the adoption of CC in India. Technological factors and sub-themes can be critical predictors of the usage of CBEL.

5.2 Individual Factors and CBEL

The individual factors are important for the CBEL. These factors are related to variables of TAM and UTAUT which include PU, PEOU, and SI as well as self-efficacy, satisfaction and attitude. Previous studies found that individual factors are important for the usage of CBEL or other technologies. For instance, [14] found that human-related factors are critical for using the CC. The sub-themes were examined in several studies and it is found that they have significant effects on the CBEL [37], [39], [42], [45], [50], [53] [56]–[58].

5.3 Organizational Factors and CBEL

Researchers who deployed the TOE framework have included organizational factors as one of their constructs. Organizational factors include sub-themes such as cost, organizational readiness, training and development, top management support, and facilitating conditions. [31] found that organizational factors have a significant effect on the adoption of CC. [16] found that organizational factors are an important construct for the adoption of CC in Taiwan. Similarly, [17] found that organizational factor is essential for the adoption of CC in developing countries. For the sub-theme, they have been examined in previous studies and found to be important predictors of the usage of CBEL [25], [30], [31], [36], [49].

5.4 Environmental Factors and CBEL

The environmental factors are part of the TOE. The factors include competitive pressure, stakeholder pressure, and governmental regulation. [31] and [16] found that environmental factors affected the adoption of new technology. Similar findings were derived by [17]. The sub-themes were found important predictors of the CBEL and other technologies [17], [35].

5.5 Other and CBEL

Under the theme others, five sub-themes were listed. These include quality, openness to experience, perceived playfulness, quality of work life, and culture. This sub-theme was examined less frequently, and they were found to be essential for the usage of the technology. for instance, quality and openness to experience were found important predictors of using technology in the study [28]. Perceived playfulness is also found to be important [30]. Quality of work life was included in prior literature and found to be an important factor for the usage of technology [33], [34]. The culture was proposed as an important factor in the study of [14].

6. Future Work

Based on the review of the literature, the prior studies on e-learning and CBEL are widely dominated by the TAM model. Other theories have been used marginally. Therefore, to improve the explanatory power of CBEL, future work can combine more than one theories

such as the TOE and UTAUT or the TOE and TAM. In addition, Information System success (IS success) can be also used in future work to reflect the quality and satisfaction of using a technology. Another important theory is the social exchange theory (SET) which can explain the benefits of using a technology as well as the trust in the technology provider can be also used in future work. Having these theories examined and used can help in validating the theories in different contexts.

The studies related to CBEL are still emerging. Most of the prior studies either focused on cloud computing or e-learning. However, studies that combine both are still limited. Therefore, more studies are needed and in particular in developing countries in Africa and the Middle East. Conducting more studies can help in validating the constructs that affect the usage of CBEL in the context of non-developed countries.

In terms of factors that have been used in previous studies, it was found that PEOU and PU are widely used. Additional factors can help in better understanding the CBEL. These can include technological characteristics as well as organizational characteristics along with the social characteristics of using new technology. Personal innovativeness, familiarity, and cross-culture factors such as the differences between two culture is also important for the usage of CBEL and can be included to enhance the explanatory power of CBEL. In addition, more moderating and mediating variables can be included to enhance the explanatory power of CBEL. These include the innovativeness, IT knowledge, and awareness of technology as well as the self-efficacy of users.

Most of the previous studies were quantitative in nature and deployed SPSS to analyze the data. More studies can be conducted using a different approach such as qualitative or focus groups or conducting a quantitative analysis using different analytical tools such as the Smart PLS because it facilitates the testing of mediator and moderator. To summarize the future work, **Fig. 7** shows a summary of the TCCM framework which represents T: theory, C: context, C: characteristics, and M: Methodology.

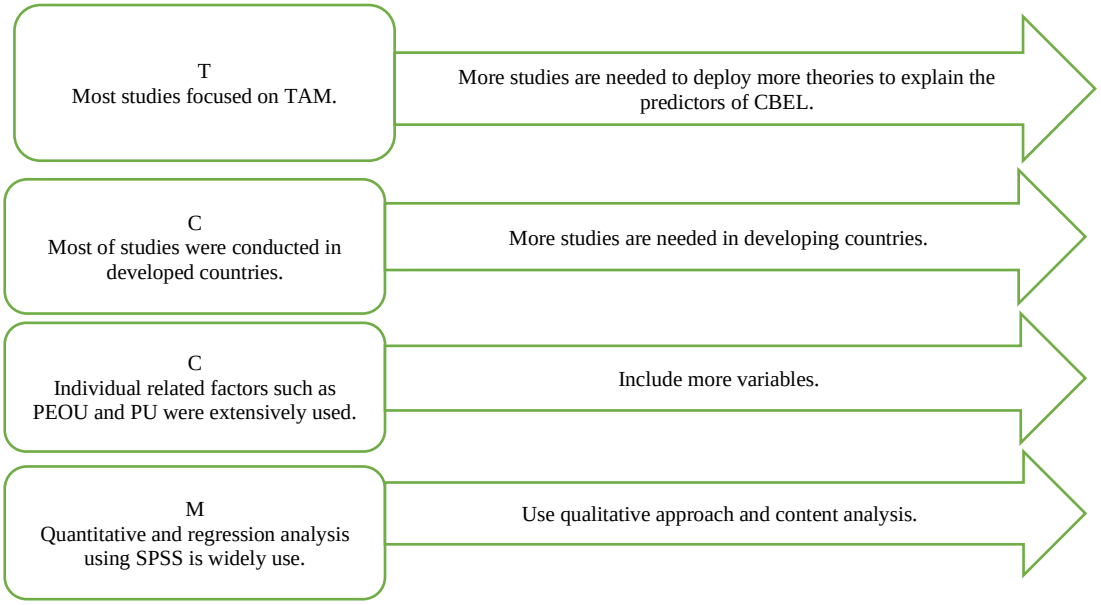

Fig. 7. TCCM Framework

7. Conclusion

The present research undertakes a methodical examination of the literature to identify the determinants that impact CBEL. Following the PRISMA methodology, a comprehensive set of 35 scholarly articles were identified and extracted from the Scopus and WoS electronic databases. The results show a trend toward rising CBEL research from 2013, with a noticeable decline during the COVID-19 pandemic. Most of the research studies were carried out in the continent of Asia. The TAM continues to be the prevailing theory utilized for adoption in CBEL. Nonetheless, several alternative theories have been proposed to explain the increasing complexity of technology adoption in CBEL, including the TOE framework, UTAUT, IS success theory, and the SET. The present research makes a scholarly contribution by introducing a model that pertains to the acceptance and implementation of CBEL, thereby expanding the current knowledge base. The results of the thematic analysis revealed the identification of five main themes and 28 sub-themes. These findings can be subjected to empirical testing to investigate the factors that influence the adoption of CBEL. Although this study provides significant contributions, it is merely one of the numerous literature reviews conducted on CBEL. Future researchers are invited to build on these results by using a variety of in-depth research techniques to have a better knowledge of CBEL adoption. It is advisable to conduct further research utilizing diverse and extensive methodologies to explain the adoption of CBEL. The aforementioned research endeavours are poised to make a valuable contribution towards the progression of knowledge in this particular domain. Furthermore, they are expected to aid forthcoming scholars in their efforts to build upon the discoveries about CBEL. Also, the findings of this study show that security, privacy, and trust are other open challenges facing the technology adoption of CBEL, which require further investigation.

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