Cloud Computing Adoption in Education: A Systematical Literature Review

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Abstract. The term "cloud computing" refers to the delivery of numerous services via the Internet. Because of providers that provide cloud services, users can store files and media on faraway servers and subsequently access the items online. Due to the lack of location requirements, this enables anyone to watch them remotely. This design is currently beginning to be implemented in the sphere of education, particularly in universities. In order to determine the factors influencing the adoption of cloud computing in education, previous academics have employed the technology adoption theory, which is discussed in this study. The purpose of this study, which is a systematic literature review, is to identify and assess knowledge gaps about the factors impacting the adoption of cloud computing in education. To fill in any gaps and add to the body of knowledge already in existence, this study will therefore enhance the information by offering a complete examination of the material that is already available.

Keywords: Cloud Computing, Education, Adoption.

Abstrak. Istilah "*cloud computing*" merujuk pada pengiriman berbagai layanan melalui Internet. Berkat penyedia layanan cloud, pengguna dapat menyimpan file dan media di server jarak jauh dan kemudian mengaksesnya secara online. Tanpa adanya persyaratan lokasi, hal ini memungkinkan siapa saja untuk mengaksesnya secara jarak jauh. Desain ini saat ini mulai diterapkan dalam bidang pendidikan, khususnya di perguruan tinggi. Untuk menentukan faktor-faktor yang memengaruhi adopsi cloud computing dalam pendidikan, peneliti sebelumnya telah menggunakan teori adopsi teknologi, yang dibahas dalam studi ini. Tujuan dari penelitian ini, yang merupakan tinjauan literatur sistematis, adalah untuk mengidentifikasi dan menilai kesenjangan pengetahuan tentang faktor-faktor yang memengaruhi adopsi cloud computing dalam pendidikan. Untuk mengisi kesenjangan tersebut dan menambah pengetahuan yang sudah ada, penelitian ini akan meningkatkan informasi dengan menawarkan analisis lengkap terhadap materi yang sudah tersedia.

Kata kunci: Computing, Pendidikan, Adopsi

1. INTRODUCTION

A way to supply numerous services through the internet is through cloud computing. For instance, the resources in concern include software, servers, databases, and data storage applications. Because of its many benefits, including cost savings, enhanced productivity, speed, efficiency, performance, and security, cloud computing is a popular choice. It is therefore not unexpected that many businesses or individuals use the cloud to store their data. According to IBM, three services make up the cloud computing system: platform-as-a-service (PaaS), infrastructure-as-a-service (IaaS), and software-as-a-service (SaaS). Platform as a Service (PaaS) is a technology stack that frees developers from having to create their own development tools or worry about the infrastructure's underpinnings, such
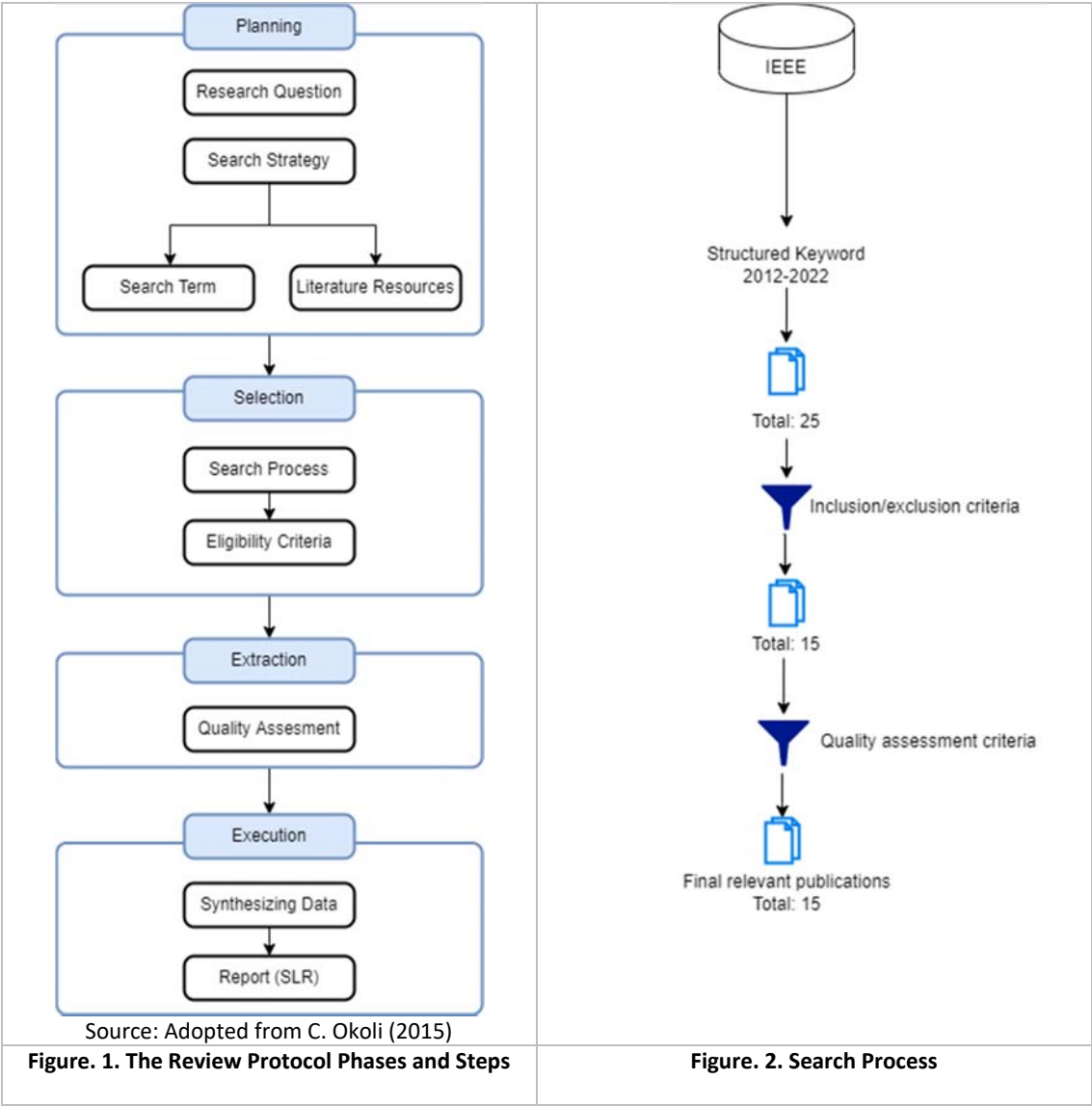
as operating systems, storage, and networking. Examples include readily available tools like Microsoft Azure App Service and Google App Engine. Infrastructure as a Service (IaaS) describes the fundamental computer parts that can be rented, such as storage, networking, and physical or virtual servers. Microsoft Azure and Google Cloud Platform are two examples. Software as a Service, (SaaS) is a form of cloud computing that the majority of people use on a regular basis. The end-user, who will use a web browser or mobile app to access the service, is uninterested in the hardware and operating system that underlie it. Google Workspace and Microsoft 365 are two examples.

Cloud computing is rapidly growing and is becoming essential in almost all sectors of life, including education, due to its numerous advantages. In the field of education, cloud computing benefits students, teachers, and administrators alike. Students can access their schoolwork from anywhere with an internet connection, teachers can instantly upload learning resources, and administrators can communicate efficiently while reducing data storage costs (Sakran, 2016). As technology continues to advance globally, innovations such as e-books have emerged, allowing users to easily download books in digital format from the internet. Additionally, online academic systems represent another application of cloud computing in education. Educational institutions or users simply need to register online to access these cloud computing services. Once the registration is completed and confirmed by the service provider, users can immediately utilize the various features offered by the information systems provided.

As mentioned earlier, cloud computing offers numerous benefits. However, several factors influence its implementation, particularly in the field of education. The successful adoption of cloud computing requires adequate facilities to support its use. Additionally, the preparedness of students, teachers, and other stakeholders plays a crucial role in determining its effectiveness (Al-Ammary et al., 2021). These factors present significant challenges for educational institutions aiming to adopt cloud computing as a technology to enhance the quality of education.

This comprehensive review of the literature aims to identify the adoption of cloud computing in the education sector. By highlighting gaps in previous research, the information presented in this Systematic Literature Review (SLR) serves as a valuable foundation for future studies. Furthermore, the SLR seeks to address inconsistencies in interpretations when identical data are analyzed by multiple meta-analysts. It also aims to enhance decision-making by identifying, analyzing, and summarizing the findings from relevant individual studies on cloud computing. To achieve these objectives, this

investigation will follow the SLR approach outlined by C. Okoli (2015), as illustrated in Figure 1.

Source: Adopted from C. Okoli (2015)

Figure. 1. The Review Protocol Phases and Steps

Figure. 2. Search Process

2. RESEARCH METHOD.

The research methodology for this study is illustrated in Figure 1. The process is divided into four primary stages, each comprising several steps. The first stage is **planning**, which includes two key components: defining the research questions and developing a search strategy. These components are designed to address the overarching theoretical questions present in existing research. The second stage is **selection**, which involves the search process, refining exercise data, and collecting additional data based on the established eligibility criteria. The third stage is **extraction**, where data are evaluated using quality

assessment criteria. Finally, the fourth stage is **execution**, which entails synthesizing the data for analysis to draw meaningful conclusion

A. Planning

Resesearch Question. The research question is What factors influence lecturers ans students in higher education reasy to adop cloud computing for the learninf process? The reaseaech question for this study was formulated by tge PICO framework. So, the component ashows in the table bewlow:

Table 1. PICO Analysis

Population	Lecturers and Students in Higher education
Intervention	Factors Influence
Comparison	N/A
Outcome	Ready to adopt cloud computing

Source: PICO framework

Search Strategy. The following provides a through examination of the search tactics utilizes in this study, including search term and literature resources, as shown in figure 2:

1) Search Term

Search terms are designed based on commonly used methods, based on the following criteria: a) Taking the most common themes or synonyms (alternative terminology related to keywords) b) using the "OR" operator for synonymous keywords and using the "AND" operator. to add the keyword combination used. So, for this research, general keywords, synonyms, and possible combinations of keywords are used. The following search terms are formed: ([``cloud" OR ``cloud computing"] AND [``education" OR ``teaching OR learning"]) AND ([``adoption"].

2) Literature Resources

This paper used one database, namely IEEE. The phrases "title," "abstract," and "index," which are used to characterize existing research publications, are also searched. Additional search terms are used to locate published journals or papers, conferences, magazines, early access articles, courses, and standards.

B. Selection

Search Process. The SLR methodology necessitates a thorough analysis of all the current literature that is being looked into. The processes in this technique are shown in Figure. 2. Each stage 1: IEEE is systematically searched as an electronic database source, and the findings are returned. Stage 2 of the search involves sorting the already-published research papers and then choosing 25 of them through the process of

elimination. Fifteen were selected because they were appropriate for the study topics in this work after researchers applied quality and assessment standards to it.

Eligibility Criteria Test. The work that has been done up to this point has been vetted and assessed for relevance. This procedure includes a few steps. The titles were initially evaluated for their applicability, and their contents were quickly skimmed to make sure they were relevant to the issue being investigated. They evaluated the specifications further, as shown in Table 2.

Table 2. Inclusion/Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
o Aimed – Cloud Computing practice. The period from 2012 onwards. o Domain – Cloud Computing and focuses Education sector. o Methods - quantitative, qualitative, mixed-mode that blends both, case studies or experimental. o Types - journals or papers, conferences, magazines, early access articles, courses, and standards. o Language - English language only.	o Apart from the education sector o Studies are excluded if they don't answer the research question (RQ). o Studies authored in languages other than English are not included. o Studies with videos are excluded from the list. o Studies that contain personal opinions or assumptions are disregarded. o Studies those authors provide without a basis in fact are eliminated.

C. Extraction

A scoring system was used to condense the original study. The articles were graded according to how well they could respond to predetermined questions. Based on how well the solutions fit the study questions, a score was assigned. The following table provides an overview of the recommendations. The scale has three options: "Yes = 1," "Partly = 0.5," or "No = 0". The result was a total relevance score. Other research must fall within the range of an "acceptable quality" score in order to be approved. The qualifying studies also must have a grade of at least two which means half of the total percentage score. So, sixty papers are included in this process because all papers from preprocessing are fulfilled were selected.

Table 3. Study Quality Checklist

| QA ID	Checklist Question	Answer
QA 1	Are the aims of the study clearly stated?	
QA 2	Is the proposed domain clearly stated?	Yes = 1
QA 3	Is the methodology used appropriately for the subject?	Partially = 0.5
QA 4	Is the research information useful for extensive academic research or for employers?	No = 0

D. Execution

Data Synthesis. This study uses the Descriptive – Narrative Grouping as a method of data synthesis. Basically, putting the ideas and findings of multiple sources in order to make an overall point. Excel spreadsheet is used for helping in this stage.

3. RESULTS

A. Regional/Country

Based on the fifteen articles, a total of three papers focused on their studies in Malaysia (Y. A. M. Qasem et al., 2018; S. A. Mokhtar et al., 2016; S. Riaz and J. Muhammad, 2015). Then two papers focused on their studies in China (Z. Cheng, 2021; X. Zhang and Y. Yan, 2021), and two more papers on their studies in Saudi Arabia (Tashkandi et al., 2015; N. S. Aldahwan et al.,2018). Lastly, there are eight papers from eight different countries including Libya (K. Abdelkader et al., 2021), Kenya (T. Kihara and D. Gichoya., 2014), India (C. Singla and S. Kaushal, 2015), United Kingdom (I. Ewuzie and A. Usoro, 2012), Pakistan (M. I. Tariq et al., 2017), Bangladesh (M. M. Rahman et al., 2018), Indonesia (Rudy and C. Cassandra, 2016), and Nigeria (A. M. Tom et al., 2019).
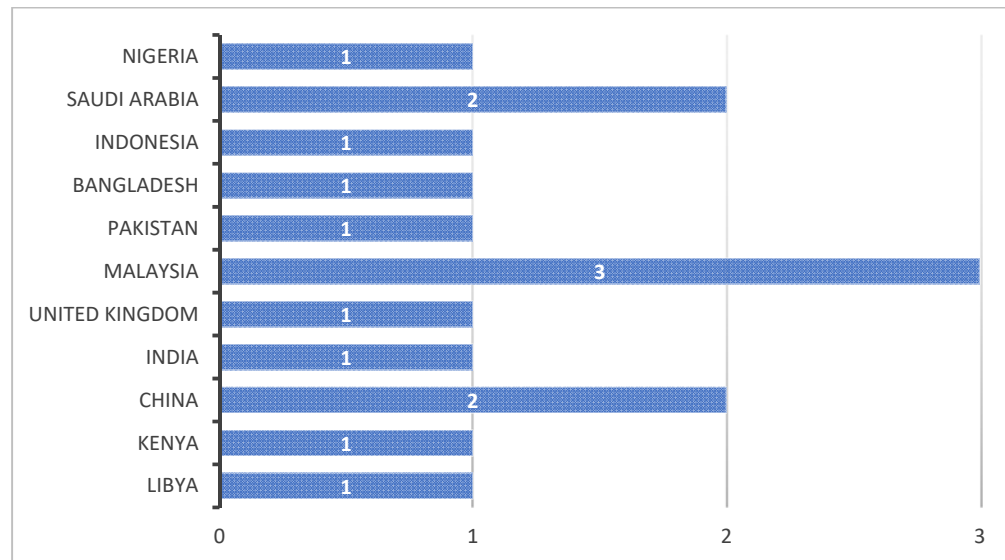
Source: from the data analysis

**Figure. 3. Region of focus in the identified studies (1)**

Source: from the data analysis

Figure. 3. Region of focus in the identified studies (2)

B. Publication Year

Concerning the year of publication, three articles were published in 2021 (K. Abdelkader et al.,2021; Z. Cheng, 2021; X. Zhang and Y. Yan, 2021), then three articles were published in 2018(Y. A. M. Qasem et al., 2018; M. M. Rahman et al., 2018; N. S. Aldahwan et al.,2018; C. Singla and S. Kaushal, 2015;), and three other articles were published in 2015(Tashkandi et al., 2015; S. Riaz and J. Muhammad, 2015). Meanwhile, there are two articles that were published in 2016(S. A. Mokhtar et al., 2016; Rudy and C. Cassandra, 2016). Lastly, five articles were published in five different years, for each year such as 2019 (A. M. Tom et al., 2019), 2017 (M. I. Tariq et al., 2017), 2014(T. Kihara and D. Gichoya.,2014), and 2012(I. Ewuzie and A. Usoro, 2012).
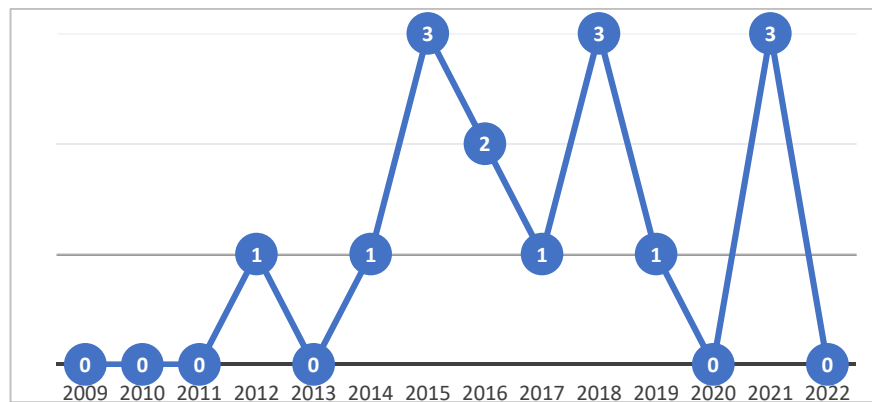
Source: from the data analysis

Figure. 4. Publication Year of The Articles

C. Overview The Articles

Source: from the data analysis

Figure. 5. Research Approach Utilized

Showed in Figure.5, it was recorded that 8 studies utilized qualitative analysis with various instruments including questionnaires. Also, 7 studies utilized quantitative analysis with various instruments including interviews, literature reviews, and observation. Overall, in detail shown in Table.4 below.

Table 4. Study Quality Checklist

No.	Author / Year	Country	Domain	Methods	Instrument	IV	DV
1	K. Abdelkader et al.,2021	Libya	Education	Quantitative	Questionnaire	Technology (Relative Advantages, Complexity, Compatibility, Risk); Institutuons(Top Management, External Support); Environtment(Competitive Presure, Technological readiness, staff effort)	Cloud Computing Adoption
2	T. Kihara and D. Gichoya.,2014	Kenya	Education	Qualitative	Interview		
3	B. Klimova and P. Maresova, 2016	Czech Republic	Education	Qualitative	interviews with open-ended questions		
4	Z. Cheng, 2021	China	Education	Qualitative	Literature Review		
5	C. Singla and S. Kaushal, 2015	India	Education	Qualitative	Literature Review		

6	I. Ewuzie and A. Usoro, 2012	United Kingdom	Education	Qualitative	Literature Review	n/a	n/a
7	X. Zhang and Y. Yan, 2021	China	Education	Qualitative	Literature Review	Interpersonal sipport, situational support, learning effect	Learning behaviour
8	Y. A. M. Qasem et al., 2018	Malaysia	Education	Qualitative	Literature Review	Task, Technological factors; Relative Advantage, Compatibility, Trust, and Security. The Organizational factors include: Thechnology Readirness, Cost saving, Top Management Commitmentand Cost Savings. The Environmental factor includes; Coercive Pressure, Normative Pressures, Mimetic Pressures	CC adoption
9	M. I. Tariq et al., 2017	Pakistan	Education	Quantitative	Questionnaire	34 predicators for cloud computing adoption	cloud computing adoption in public sector HEIs of Punjab, Pakistan
10	M. M. Rahman et al., 2018	Bangladesh	Education	Qualitative	Literature Review	UTAUT2(E-Trust, Skill Transferability, Social Influence, Facilitating Condition) and Techno-philia(complexity, perceived risk, and technophobia)	Actual use of CC
11	S. A. Mokhtar et al., 2016	Malaysia	Education	Quantitative	Questionnaire	Eight variables (relative advantage, complexity, compatibility, top management support, institution size, adoption plan, service provider support, and government support)	the adoption of cloud computing by higher education institutions.
12	Rudy and C. Cassandra, 2016	Indonesia	Education	Quantitative	Questionnaire	Attitude, Subjective Norm, Behavioral Control	Intention of Use
13	A. M. Tom et al., 2019	Malaysia	Education	Quantitative	Questionnaire	Technological factors; Relative Advantage, Compatibility, Trust, and Security. The Organizational factors include Top Management	Intention to Adopt IaaSBEL

No						
					Commitment and Cost Savings. The Environmental factor includes Competitive Pressure and Service Provider Support	
14	S. Riaz and J. Muhammad, 2015	Malaysia	Education	Quantitative	Questionnaire	the ease of learn and use, satisfaction, efficiency, memorability and error for assessing the usability of public cloud application (Google site)	Usability
15	N. S. Aldahwan et al.,2018	Saudi Arabia	Education	Qualitative	Experiment	n/a	n/a

Source: from the data analysis

4. ANALYSIS AND DISCUSSION

A. Overview Adoption Theories for Cloud Computing in Higher Education

In an education context, cloud computing can help lecturers and students with some benefits. When they decide to use cloud computing there is a process that occurs before they actually adopt it. There are many factors that can influence, so the previous researchers made a theoretical model predict the factors that really affect lecturers' and students' acceptance and eventually adopt cloud computing in learning. The existing study was analyzed in this study; several studies have considered the adoption of cloud computing can be seen in Table 5.

Table. 5. Overview of Theories Adoption

No	Theory/Model	Reference
1	TOE	K. Abdelkader et al., 2021; Tashkandi et al., 2015
2	TOE & DOI	M. I. Tariq et al., 2017; A. M. Tom et al., 2019
3	DOI & UTAUT2	M. M. Rahman et al., 2018
4	Theory of Planned Behaviors	Rudy and C. Cassandra, 2016
5	Usability Evaluation	S. Riaz and J. Muhammad, 2015
6	Agile	N. S. Aldahwan et al., 2018
7	SWOT Analysis	T. Kihara and D. Gichoya., 2014
8	FVM Model, TOE framework, DOI theory, and INT theory	Y. A. M. Qasem et al., 2018
9	NIST Definition	I. Ewuzie and A. Usoro, 2012

Source: from the data analysis

Therefore, based on the table, we can see that the Technology Organization Environment (TOE) is the most widely used established theory. Which can be combined with other theories such as Diffusion of Innovation (DOI). In TOE theory there are several factors that can affect the adoption of technology. According to K. Abdelkader et

al. (2021) some factors regarding TOE is Technology (Relative Advantages, Complexity, Compatibility, Risk); Institutes (Top Management, External Support); Environment (Competitive Pressure, Technological Readiness, Staff effort).

The established theories can be the foundation for modeling new adoption theories based on the new situation that impacted the result of adopting cloud computing. There are some technology acceptance factors that probably can use such as UTAUT (M. M. Rahman et al., 2018) or other acceptance model theories.

B. Influence Factors of Cloud Computing Adoption

In this review, the term "factor" refers to variables. These factors tend to assist adoption, and cloud computing services denote the existence of specialists and practices that can enhance the caliber of instruction and research. In addition, these factors influence students and lecturers in their intention to adopt cloud computing can be influenced by the practices to use and access the cloud. According to S. Riaz and J. Muhammad (2015), the ease of learning and use, satisfaction, efficiency, memorability, and error for assessing the usability of public cloud applications (Google site) are a factor that can be influenced by adoption. Then, based on Rudy and C. Cassandra (2016), Attitude, Subjective Norm, and Behavioral Control are significant positive to influence lecturers and students to adopt cloud computing in learning with public clouds-like Google docs and Dropbox. However, for using the technology institutional education should be facilitated with a supporting environment system. According to X. Zhang and Y. Yan (2021), the use of cloud computing can be the basis of distance education based on learning resources, but it must be done with the distance learning development of resources and technology. Because if it is not supported, then the interaction between teacher and student becomes rare because traditional habits become one of the things that make computers easy if not balanced with a good environment. Based on the analysis carried out on the database, it is necessary to conduct research using qualitative and quantitative approaches to lecturers and students by looking at the three forming factors, namely technology use, institutional readiness, and also supporting factors, both environmental and regulatory. Table.6, shows a list of factors based on previous studies. It is really important to do in-depth research separately on each component of cloud computing users, especially lecturers and students. But the other important thing that should be known is the impact on lecturers and students of cloud computing's success to adopt.

Table. 6. Influence Factors based on Existing Studies

No	Factors	References
1.	Attitude, subjective norm, behavioral control	Rudy and C. Cassandra, 2016
2	Technological factors; Relative Advantage, Compatibility, Trust, and Security. The Organizational factors include Top Management Commitment and Cost Savings	A. M. Tom et al., 2019
3	34 predicators for cloud computing adoption	M. I. Tariq et al., 2017
4	Eight variables (Relative Advantage, Complexity, Compatibility, Top Management Support, Institution Size, Adoption Plan, Service Provider Support, and Government Support)	S. A. Mokhtar et al., 2016
5	The ease of learning and use, satisfaction, efficiency, memorability, and error for assessing the usability of public cloud applications (Google site)	S. Riaz and J. Muhammad, 2015
6	Technological factors; Relative Advantage, Compatibility, Privacy Concern, Complexity, and vendor lock-in. The Organizational factors include Top Management Support. The Environmental factor includes Regulation Support, Government pressure, Peer Pressure	Tashkandi et al., 2015
7	Technology (Relative Advantages, Complexity, Compatibility, Risk); Institutions (Top Management, External Support); Environment (Competitive Pressure, Technological readiness, staff effort)	K. Abdelkader et al.,2021
8	UTAUT2 (E-Trust, Skill Transferability, Social Influence, Facilitating Condition) and Techno-philia (Complexity, Perceived Risk, and Technophobia)	M. M. Rahman et al., 2018
9	Interpersonal support, situational support, and learning effect	X. Zhang and Y. Yan, 2021

Source: from the data analysis

5. CONCLUSION

This study concludes by summarizing the most recent SLR research findings on cloud computing in the education industry from 2012 to 2021. Additionally, fifteen papers were analyzed using SLR approaches such as search strategy, research quality assessment, data extraction, and executions to get a sense of the present level of cloud computing adoption education. The data indicate that this paper's shortcoming is that just fifteen papers were reviewed. Future research may take this into account by reviewing additionally related and pertinent existing studies from additional database sources. Additionally, it was found that most prior research focused on cloud computing adoption, while only a small number examined the effects or post-adoption stage. This suggests that more investigation into topics like implementation obstacles, crucial success factors, and the effects of cloud computing on this sector may be conceivable at the post-adoption stage. As a result, these reviews will aid researchers in developing their study plans for the next study.

DAFTAR REFERENSI

Agarwal, A., & Ojha, R. (2023). Prioritising the determinants of Industry-4.0 for implementation in MSME in the post-pandemic period–a quality function deployment analysis. The TQM Journal, 35(8), 2181-2202. https://doi.org/10.1108/tqm-06-2022-0204

Brownlie, D. T. (1992). The role of technology forecasting and planning: Formulating business strategy. Industrial Management & Data Systems, 92(2), 3-16. https://doi.org/10.1108/02635579210009623

Daim, T., Bukhari, E., Bakry, D., Vanhuis, J., Yalcin, H., & Wang, X. (2021). Forecasting technology trends through the gap between science and technology: The case of software as an E-Commerce service. Форсайт, 15(2 (eng)), 12-24. https://doi.org/10.17323/2500-2597.2021.2.12.24

Elisa, E., Tukino, T., & Handoko, K. (2022). Penerapan forecasting methods untuk penjualan produk UMKM dengan algoritma k-nearest neighbor. Jurnal Tekinkom (Teknik Informasi dan Komputer), 5(2), 455-463. https://doi.org/10.37600/tekinkom.v5i2.629

Kotler, P., & Keller, K. L. (2016). Marketing management. Pearson Education.

Lesmarna, S. P., Alzami, F., Rizqa, I., Salam, A., Aqmala, D., Megantara, R. A., & Pramunendar, R. A. Development of time-series-based MLOps architecture for predicting sales quantity in micro, small, and medium enterprises (MSMEs). Transmisi: Jurnal Ilmiah Teknik Elektro, 26(2), 64-69. https://doi.org/10.14710/transmisi.26.2.64-69

Li, B., Yao, C., Zheng, F., Wang, L., Dai, J., & Xiang, Q. (2021). Intelligent decision support system for business forecasting using artificial intelligence. Arabian Journal for Science and Engineering, 1-11. https://doi.org/10.1007/s13369-021-05886-z

Li, X., Ang, C. L., & Gray, R. (1999). An intelligent business forecaster for strategic business planning. Journal of Forecasting, 18(3), 181-204. https://doi.org/10.1002/(SICI)1099-131X(199905)18:3<181::AID-FOR712>3.0.CO;2-3

Makridakis, S. S. (2020). The M4 Competition: Results, findings, and conclusions. International Journal of Forecasting, 36(1), 54-74.

Mia, M., Yousuf, M., & Ghosh, R. (2021). Business forecasting system using machine learning approach. 2021 2nd International Conference on Robotics, Electrical and Signal Processing Techniques (ICREST), 314-318. https://doi.org/10.1109/ICREST51555.2021.9331114

Mishra, S., Deshmukh, S. G., & Vrat, P. (2002). Matching of technological forecasting technique to a technology. Technological Forecasting and Social Change, 69(1), 1-27. https://doi.org/10.1016/S0040-1625(01)00123-8

Santoso, S., Kusnanto, E., & Saputra, M. R. (2022). Perbandingan metode pengumpulan data dalam penelitian kualitatif dan kuantitatif serta aplikasinya dalam penelitian akuntansi interpretatif. OPTIMAL Jurnal Ekonomi dan Manajemen, 2(3), 351-360. https://doi.org/10.55606/optimal.v2i3.4457

Saragih, H., & Karyati, C. M. (2023). The development of West Java MSMEs as a form of economic defense: An analysis with forecasting methods. West Science Business and Management, 1(05), 371-385. https://doi.org/10.58812/wsbm.v1i05.493

Smith, J. W. (2018). Forecasting in SMEs: Challenges and opportunities. Journal of Small Business Management, 56(4), 567-584.

Taufiqih, R., & Ambarwati, R. (2024). Enhancing sales prediction for MSMEs: A comparative analysis of neural network and linear regression algorithms. Jurnal Teknologi dan Manajemen Informatika. https://doi.org/10.26905/jtmi.v10i1.11875

Wolfe, H. D. (1956). Forecasting for business. Financial Analysts Journal, 12(1), 17-19. https://doi.org/10.2469/FAJ.V12.N1.17

Yuan, F. C., & Lee, C. H. (2020). Intelligent sales volume forecasting using Google search engine data. Soft Computing, 24(3), 2033-2047. https://doi.org/10.1007/s00500-019-04036-w

Żbikowski, K., & Antosiuk, P. (2021). A machine learning, bias-free approach for predicting business success using Crunchbase data. Information Processing & Management, 58(4), 102555. https://doi.org/10.1016/J.IPM.2021.102555