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A DISCUSSION OF VARIOUS "CLOUD- BASED E-LEARNING MODELS"

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ABSTRACT

Many organisations in academia, business, and government are now using the cloud computing platform, which has been widely used. The virtual environment may be quickly set up to run scientific programs for e-learning and to provide hands-on lab activities, making it a cost-effective alternative to real laboratories for teaching and training. We provide an overview of cloud use in this article with the goal of equipping students with practical skills in an educational setting. Along with presenting a taxonomy of cloud-based e-learning, we also assess the most important current contributions in this area. We also evaluate and compare the various e-learning implementations and conduct a comparative study of the models and frameworks published in the literature. We also address the current and future problems with using the cloud for online education and provide some suggestions on how to fix them.

KEYWORDS Artificial Intelligence, Virtual Reality, Cloud, Integration, Industry

INTRODUCTION

Proper education is crucial for economic and social development in today's society. The global population's digital literacy has increased due to the widespread use of internet services, particularly social networks. This has led to the rise of new technology learning paradigms, such as mobile learning. Many long-established occupations are becoming extinct due to increased technical complexity and automation of formerly human-only tasks. This trend is reflective of the globalisation of the digital economy, which calls for a complete overhaul of the educational system and the development of new competences.The shift from local PCs to online apps for curriculum delivery is a direct result of the Internet's meteoric increase in popularity among educational practices. Institutions of higher learning have implemented novel approaches to teaching in response to recent technology developments, such as distance learning, e-learning, and mobile learning. Learning management systems (LMS) have become a major movement in higher education, providing a central hub for online collaboration between faculty and students. Cloud computing offers dynamic scalability and efficient use of resources, making it a powerful tool for cutting costs while delivering cutting-edge instruction. Educational institutions are solely responsible for the learning process, content management, and knowledge delivery. New e-learning platforms can be developed in the cloud, compatible with a broad variety of hardware, and modern consumers do not need specialized cloud computing expertise to link their desktops or laptops to the server.

AI and Cloud Computing

AI powered by the cloud, you can store and analyses data in an advanced fashion, and machine learning technologies can learn and enhance operations all the time.

The concept of artificial intelligence (AI) originated in science fiction, as did many previous scientific breakthroughs. Artificial intelligence (AI) emerged as a popular concept when a number of mathematical and philosophical ideas reduced human mind to the mechanical transformation of many symbols.

Businesses may improve their data processing skills and productivity with the aid of cloud computing, which provides state-of-the-art computer resources via the internet. Artificial intelligence (AI) is the way to use such resources to increase abilities. AI internet-based service executes ML tasks in modern cloud environments without a hitch. Thanks to this setup, we can control our favorite music with the sound of our voices, have access to a smart thermostat, and use Google Home. Systems that use Using cloud-based artificial intelligence (AI) might provide more flexible and cost-effective strategic insights. For example, SAAS developers may expand their consumers' possibilities by using AI approaches.

Benefits of AI Cloud Computing in Education

Data processing and storage are both optimized with the use of cloud computing and AI, whereas ML technologies enhance operational performance via continuous learning.

Saved money overall: The education industry may benefit from AI Cloud Computing and IAAS platforms' state-of-the-art capabilities without the hefty costs of traditional data centres and IT infrastructure.

- **Smart automation and improved productivity:**

Reduced staff stress and more resources available for higher-priority tasks are two benefits of AI's ability to automate complex data processing and analysis tasks.

Challenges of AI Cloud Computing

Network connectivity:

Reliable network access is essential for cloud-based machine learning applications. Connectivity issues may significantly impact operations that depend on machine learning algorithms. Further processing in the cloud also requires the data to travel a distance, which adds more processing time. Timely answers and the short procedures needed for resolution are affected by the substantial time delay of sending data to the cloud.

Data privacy:

An important concern with AI cloud computing ensures the security of individual records. Machine learning sensors collect data from a wide range of users before sending it for analysis. Computing in the cloud for use on the go lacks proper security standards, which may lead to data breaches and other security issues.

LITERATURE REVIEW

Gerald (2024) Computer science curricula will need to adapt quickly to keep up with the ever-changing landscape of cloud computing and artificial intelligence (AI). The purpose of this study is to investigate how artificial intelligence (AI) and cloud computing (CC) might be incorporated into educational frameworks to better equip students for the challenges they will face in today's computing environment. The abstract discusses the effects of incorporating artificial intelligence and cloud computing into computer science courses, as well as current trends and educational methods. Contributing to the continuing dialogue on designing computer science education for the future, this paper addresses obstacles and highlights successful approaches.

Xu, Zhiyi. (2024). An effort to delve into the possibility of Artificial Intelligence (AI) improving learning experiences and student results is made in this study piece. Consequently, it has set out to do research into the best ways to create learning experiences and results using various artificial intelligence (AI) techniques, such as data learning, VR/AR, automation, and machine learning. Afterwards, data was collected via a case study in a mathematics classroom to verify whether AI did, in fact, result in better learning experiences and study results. Positive outcomes were measured in academic performance, motivation and engagement, learning progression, and other areas, confirming that AI had a beneficial impact.

Grover, Veena & Nandal, Manju. (2024). A number of advantages, including as consistency, scalability, decreased costs, and enhanced usability, have resulted from the development of technology that drives e-learning. On the other hand, problems also exist and must be solved. If we want to make e-learning even better, we need to think about these things. The advent of cloud computing has opened up vast new possibilities for teaching and learning online. For the purpose of improving the existing state of online education, this chapter presents a paradigm that makes use of Edu-Cloud computing and cloud machine learning. With the help of these cutting-edge cloud technologies, educators can easily exchange course materials with students, keep them up-to-date on exams, assignments, and other crucial information, and even anticipate a student's ultimate grade and engagement level. This chapter provides a high-level summary of the ways in which cloud machine learning and Edu-Cloud computing may improve online education.

Padmasiri (2023) As far as user happiness and engagement are concerned, offering experiences is king in today's digital world. With its revolutionary solutions, artificial intelligence (AI) has become a game-changer in the realm of user experience (UX) design. Using the Design Thinking (DT) methodology as a lens, this study examines the opportunities and threats presented by artificial intelligence (AI) for user experience (UX) design. A survey was sent out to user experience experts in Sri Lanka via a snowball sampling technique as part of the process. The online survey asked participants about their experience with AI-driven user experience design, the role of AI in the design team's decision-making process, and the difficulties they had encountered. The data was analysed utilizing R Studio and MS Excel. The results prove that AI technologies enable UX experts to create DT-compliant, user-centric solutions. User experience experts may find a "Recommendation Guide" with a list of resources they should use to incorporate AI into DT.

Li, Qiang. (2021). A smart education administration platform is being developed using cloud computing and artificial intelligence technologies, based on the principle of cloud computing and the service-oriented architecture (SOA) design pattern. The platform's data storage is housed in a Hadoop-controlled storage cluster, providing intelligent and efficient services for education management, education portal, and remote classroom. It can perform basic activities like user registration, educational administration, and content storage, and can be used on various devices. The database can handle massive amounts of simulated data, with sequential read taking 752s, sequential write taking 312s, random read 968s, and random write 211s, respectively, when millions of records are added to the database. The content storage service's stress tests show that the system can run steadily under high concurrency conditions, maintaining output quantities of 3500 pages/min in 60s. This management platform is crucial for advancing intelligent and information-based school management.

RESEARCH METHODOLOGY

The relevant literature proposed combining the conventional schooling system with cutting-edge technological tools such as online learning, cloud computing, grid computing, etc. From elementary school all the way up to college, there has to be a concerted effort to bridge the gap between the old school system and the new technology. But it seems that the most effective way to promote sophisticated ideas, theories, and practices among the country's people is to integrate cutting-edge technology like cloud computing with higher education.

RESEARCH DESIGN

Research design is the framework of research, according to Md. Inaam Akhtar. It is the "Glue" that secures a research project's many components. In a nutshell, a research design is a blueprint for the intended investigation. A well-thought-out plan guarantees that a substantial and effective process has been adhered to when seeking solutions to research questions. Study type, research goals, research (data collecting) technique, statistical analysis, etc. are all part of the research design, which aims to carefully identify the research gap and outline the route map.

POPULATION:

No. of Colleges affiliated to J.C Bose-Haryana Technical University, Faridabad: **200**

1. No. of Colleges affiliated to Haryana University, Rohtak: **15**

Total number of colleges in Haryana and Rohtak: 215

Sample Size Chosen:

Count of colleges selected from Rohtak and Haryana: 20

The following colleges are associated with J.C Bose-Haryana Technical University, Faridabad: Haryana University, Rohtak is connected with ten colleges.

A total of 600 individuals were selected from the Haryana and Rohtak areas.

Thirty people were randomly selected from each college: ten faculty members, five administrators, two information technology managers, and twenty students.

The final tally for the faculty: 200

A total of 400 students were selected.

Respondent's Size:

There was a total of 460 replies from the Haryana and Rohtak areas.

The research did not include 66 surveys because they were deemed incomplete. The sum of all replies from Haryana and Rohtak is 394.

From Haryana, 172 people filled out the survey.

Some 222 people from Rohtak filled out the survey.

STATISTICAL TECHNIQUES

In order to accomplish its goals, the current research made use of the following five main statistical techniques:

The following is a list of the available data for "Exploratory Factor Analysis (EFA); Confirmatory Factor Analysis (CFA); Structural Equation Modelling (SEM); Moderation Analysis using z-test; and Independent-Sample t-test":

ANALYSIS

COMPARATIVE ANALYSIS OF DIFFERENT "CLOUD- BASED e-LEARNING MODELS"

A comparison table is created to outline the key aims, benefits, and disadvantages of the different Cloud-based e-Learning architectures and platforms that were described before:

Important Research Findings

This chapter delves into the effective efforts in the area of CBeLS, drawing various conclusions that are summarised below:

- The Seattle model provides diverse resources via a community-driven approach.
- The Cloud-based e-Learning Architecture (5-Layers) established a standard for HEIs to implement and profit from CC.
- The Cloud-based Model for e-Learning in Higher Education (3-Layers) provides comprehensive capabilities for developing, implementing, accessing, transporting, and managing cloud services.
- The e-Learning Improved Architecture for Clouds prioritises SaaS development to provide cloud-based solutions for e-learning.

DESCRIPTIVE OBSERVATIONS

The data was obtained via a questionnaire disseminated online in the form of a Google Form. The survey's respondents comprised administrators, IT managers, instructors, and students from several undergraduate and postgraduate institutions and universities in Rohtak and Haryana. The respondents were the study's main stakeholders. The survey yielded 460 replies, 394 of which were selected for further investigation and analysis. The remaining 66 replies were either incomplete or inconsistent, therefore they could not be included in the analysis and were thus excluded from the research.

Along with identifying critical success or barrier actors influencing CBeLS adoption in higher education in India, the survey sought information about respondents' knowledge and usage of CBeLS (if they used any of the cloud-based platforms) with a focus on colleges and universities in Rohtak and Haryana. Table 1 displays the distribution of respondents according to their demographic location, i.e.

Table 1: Number of Responses based on Demographic Location

	No of Responses	Percentage
Rohtak	222	56.3%
Haryana	172	43.7%
Total	394	100%

Table 2 depicts the distribution of replies depending on the respondent's academic profile, since the respondents comprised a variety of stakeholders, including administrative workers, an IT manager, faculty members, and students from Rohtak and Haryana colleges and universities.

Table 2: Number of Responses based on the Academic Profile of Respondent

Academic Profile	No of Responses	Percentage
Administrative	14	3.7%
Faculty Member	81	20.6%
IT Manager	4	1 %
Student	295	74.7%
Total	394	100%

Table 2 shows that the majority of responders are faculty members and students, who would ultimately be the primary end-users of the "Cloud-based e-Learning System" in their individual institution. Figure 1 depicts the number of responders as 3.7% administrative workers, 20.6% academic members, 1% IT managers, and 74.7% students.

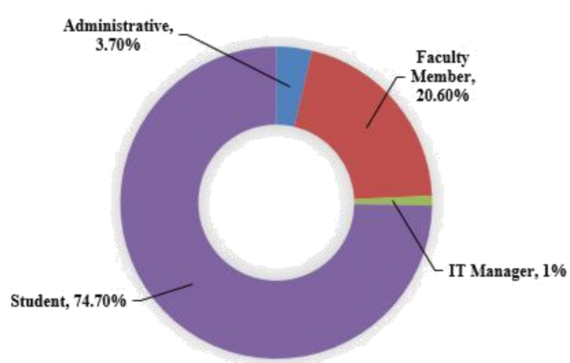

Figure 1. Percentage of Responses based on the Respondent's Academic Profile

According to the data obtained, 325 (82.5%) respondents are aware with various cloud computing services such as Google Drive, iCloud, Microsoft Cloud, and so on; yet, only 227 (57.6%) of them use cloud-based services. Figures 1 and 2 show the number of respondents who are acquainted with and use cloud computing services, respectively.

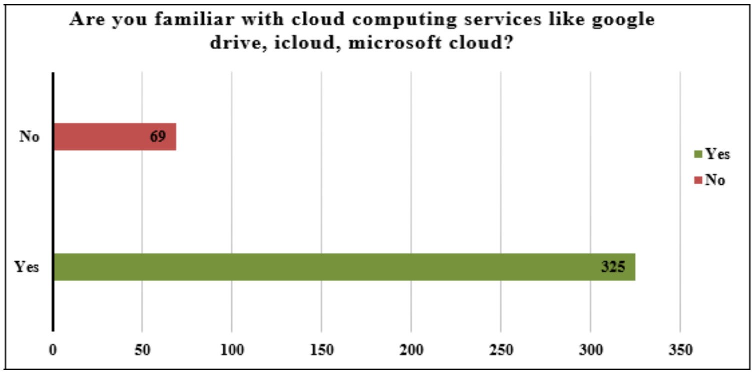

Figure 1 Number of Respondents who are familiar with Cloud Computing Services

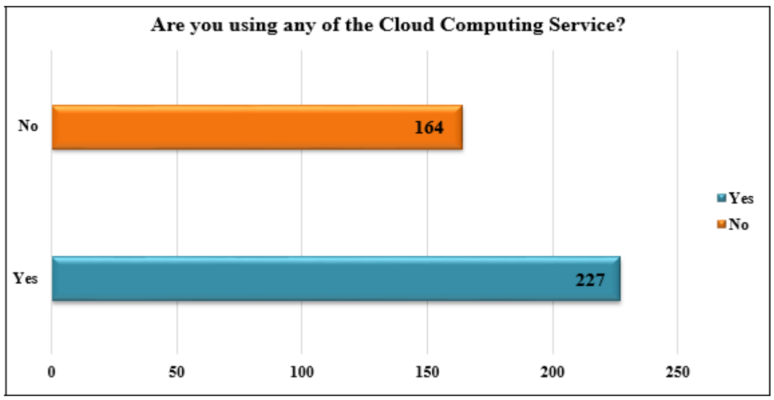

Figure 2. Number of Respondents who are using Cloud Computing Services

Only 162 (41.1%) respondents replied "Yes" when asked whether their institution or university offers a cloud-based e-learning platform. The majority of respondents (58.9%) said that their institution does not use any "Cloud-based e-Learning Platform" (Table.4). This demonstrates that the majority of colleges and institutions in Rohtak and Haryana have yet to implement cloud-based technologies. This broadens the scope of the study and encourages more research.

Table 4: Is your college/ university providing any Cloud-based e-Learning platform?

	No of Responses	Percentage
Yes	162	41.1%
No	232	58.9%

Table 5 reveals that, with a p-value (t-test) of 0.20, the respondent's demographic location has practically little influence on their use of CBeLS. Furthermore, Table 6 shows that colleges and universities in Rohtak and Haryana use comparable types of cloud services, since the p-value of the test is 0.76. These statistics demonstrate that the demography selected for the research, namely the colleges and universities of Rohtak and Haryana, may adequately reflect the situation of higher education in India.

Table 5: t-test to show the effect of Demographic Location on the usage of CBeLS

	Mean ± Standard error	Confidence interval	t-test (p-value)

Rohtak	63.40 ± 0.72	[-3.50, 1.07]	0.20
Haryana	64.61 ± 0.91		

Table 6: t-test based on the type of CC services used by the respondents

	Mean ± Standard error	Confidence interval	t-test (p-value)
Rohtak	53.36 ± 0.70	[-3.27, 1.09]	0.76
Haryana	54.45 ± 0.86		

After determining the sample's acceptability, the data acquired from the primary survey (N= 394) served as the source of input for the factor analysis. Before doing any further analysis, the replies were coded in MS Excel using the technique indicated below:

Once coded, the sheet is utilised as an input database for FA. Appendix B has a frequency table for the responses to each variable. Factor analysis refers to the "data reduction technique that is used to lessen the number of determinants or factors to a practicable number, to almost one-fourth the number of actual variables". These controllable or managed components identified from factor analysis would be the crucial success or barrier factors for implementing a Cloud-based e-Learning System in India's higher education institutions.

APPLICATION OF FACTOR ANALYSIS

The current research used factor analysis to identify the many variables that influence the adoption of a CBeLS in higher education in India in general, and specifically in colleges and universities in Rohtak and Haryana. As a result, in the first step, an Exploratory Factor Analysis (EFA) was conducted to identify the most effective elements that support or serve as a barrier to the adoption of CBeLS in Higher Education in India in general, specifically in colleges and universities in Rohtak and Haryana. After finding the most important variables influencing adoption, CFA was used to assess the fitness and relationships among the elements identified by EFA.

For factor analysis to be useful, the assertions or determinants must be connected. For this aim, a correlation matrix between the variables was generated (see Appendix C). The numbers in the correlation matrix represent the correlation coefficients between the variables, where the correlation coefficient of the variable with itself is 1. The variables in the research were found to be strongly associated, as seen by the correlation coefficient matrix, suggesting that the data is suitable for factor analysis.

Cronbach's Alpha Reliability Analysis

Before starting the factor analysis, the Cronbach's Alpha test was utilised to assess the reliability of the various constructs employed in the research. Cronbach's alpha values greater than 0.70 are indicative of a high level of dependability, according to Viswanath Venkatesh et al. As a result, the Cronbach's Alpha test score of 0.923, as given in Table 4.7, demonstrates that the data is very consistent and valid for FA.

Table 7: Cronbach's Alpha Reliability Statistics

Cronbach's alpha	Number of items
.923	37

Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy

"KMO measure of sampling adequacy is an index that is used to test the relevance of factor analysis in the study" . The KMO score of 0.5 to 1.0 (Malhotra and Dash, 2011) suggests that the factor analysis is congruous. A KMO score less than 0.5 indicates that the factor analysis is not appropriate for application. In this investigation, the "KMO measure of sampling adequacy" yielded a value of 0.930 (Table 8), which is much more than suitable for carrying out the FA.

Bartlett's Test of Sphericity

The Bartlett test for Sphericity is a "statistical test that is used to examine the hypothesis that the variables included for the study are uncorrelated in the population, i.e., the population correlation matrix is an identity matrix". This means that each variable has an excellent relationship with itself (r = 1) but no association with the other variables. A high Chi-square value favored the rejection of the null hypothesis.

The estimated chi-square value is 8118 with 666 degrees of freedom, which is significant at the 0.05 level (Table 7). This significant number contradicts the null hypothesis that the correlation coefficient matrix is an identity matrix, indicating that the FA is appropriate to use.

Table 8: KMO and Bartlett's Test

Kaiser-meyer-olkin measure of sampling		.930
Adequacy.		8.118E3
Bartlett's test of	approx. chi- square	666
Sphericity	df	.000
	Sig.	

Furthermore, it is recommended that the sample size be at least four to five times the number of variables utilised for factor analysis. The sample size for this research was 394, which was much more than the minimum recommended number of around 10 samples per variable.

Finally, all of the communalities were more than 0.3 (refer to Appendix D), confirming that each variable had some shared variation with other variables. As a result, all of these factors guarantee that the data is sufficient for factor analysis.

RESULTS OF THE FACTOR ANALYSIS

The FA is a data reduction process that assists the examiner in reducing the number of variables or parameters (which impact the current research) to a manageable quantity. After confirming the data's suitability for factor analysis, a set of 37 variables describing the critical success factors/barriers to the adoption of a "Cloud-based e-Learning System" in Higher Education in India in general, specifically in colleges and universities in Rohtak and Haryana, were subjected to factor analysis.

Exploratory Factor Analysis (EFA) groups variables with similar properties to determine the factors with the greatest influence. These extracted components may stay in the model, whereas those with little or no influence can be removed. As a result, a model of the most important elements influencing the success or failure of adoption is developed.

Principal Components Analysis (PCA) and Varimax Rotation techniques were used to extract the factors based on the 37 variables, and the number of factors to be retained was determined using the "Latent Root Criterion (Eigenvalue Criterion) and the Scree Plot".

Convergent validity: Convergent validity is the degree to which two or more measurements in a concept are connected to one another. In other words, all of the statements/items in a construct measure the same variable that they are theoretically designed to. In this research, the convergent validity of the constructs was examined using "Average Variance Extracted (AVE)". AVE denotes the average variance that a latent construct may explain in the model. The value of AVE for a latent construct is calculated by dividing the sum of the squares of the factor loadings by the total number of statements used to assess the latent construct. Equation 6.2 contains the formula for calculating AVE.

$$Average\ Variance\ Explained(AVE) = \frac{\sum_{i=1}^{n} \lambda_i^2}{n}$$

In the aforementioned calculation, 'λ' represents the factor loading of statements on their predicted construct (see table 8), and 'n' is the total number of statements used to assess the same latent construct. Table 9 shows that the Average Variance Extracted (AVE) for each construct was larger than 0.5, which is the lowest cut-off value for a construct's convergent validity (Fornell & Larcker, 1981) [183]. These results demonstrated the convergent validity of the study's constructs.

Discriminant validity: Discriminant validity implies that the constructs utilised in research are considerably diverse from one another. In other words, various conceptions assess distinct aspects of the investigation. In the table below, diagonal numbers reflect the square root of AVE, whereas off-diagonal values show the pairwise correlations between respective constructs. The correlations between constructs (off-diagonal values) were discovered to be lower than the square root of AVE (diagonal values). These results provided evidence for the discriminant validity of the model's components. Furthermore, each item inside a certain construct was shown to have factor loading larger than 0.5 (Fornell & Larcker, 1981) [183]. This result demonstrates the scales' convergent validity.

Nomological validity: Nomological validity refers to the existence of strong theoretical links between distinct claims used to define a concept. This form of validity is assessed qualitatively with the assistance of specialists in the relevant field. The questionnaire created to gather data on the underlying components was presented to two experts in the field of "Cloud-based e-Learning". A person with more than ten years of experience teaching or researching "Cloud-based e-Learning" was regarded an expert in this field. These experts found that the statements used to test certain constructs were appropriate for measuring the specified variables. Therefore, the constructions utilised in the investigation were found to be valid nosologically.

Table 9: Statistics showing reliability and validity of the model

	CR	AVE	TU	DSR	EIU	CSQ	CTC	ATT	ITM

TU	0.932	0.666	0.816						
DSR	0.924	0.506	0.707	0.711					
EIU	0.815	0.528	0.154	0.116	0.726				
CSQ	0.858	0.670	0.526	0.583	0.130	0.819			
CTC	0.898	0.746	0.077	0.057	0.037	0.107	0.864		
ATT	0.921	0.719	0.532	0.485	0.373	0.381	0.381	0.847	
ITM	0.874	0.703	0.419	0.409	0.291	0.420	0.290	0.462	0.838

Fit Indices of the Measurement Model

As stated in Table 10, SEM comprises of multiple fit indices of the measurement model to demonstrate "the strength of the model towards data analysis". The fit indices assess how well the measured model fits with the sample data in comparison to an alternative model that serves as the baseline (reference) model. The baseline model, also known as the NULL model or NULL hypothesis, assumes that the study variables/statements have no correlation with one another. Table 10 displays the results of the measurement model's various fit indices as well as the recommended acceptance values supplied by statisticians on a regular basis. The findings show that the measurement model fits well, as shown by many data.

Table 10: Fit indices of the measurement model for successful implementation of "Cloud- based e-Learning system"

S. No.	Indices with value	Recommended value	References
1	Chi-square = 1524.26, p < 0.001; dof = 563; chi-square/dof = 2.707	chi-square/dof < 3	Hair et al., 2006 [135]
2	Goodness of Fit Index (GFI) = 0.886	GFI > 0.8	Baumgartner & Homburg, 1996 [184]
3	Comparative Fit Index (CFI) = 0.924	CFI > 0.9	Hair et al. 2006 [135]
4	Tucker-Lewis Index (TLI) = 0.913	TLI > 0.9	Hair et al. 2006 [135]
5	Root Mean Square Error of Approximation (RMSEA) = 0.061	RMSEA < 0.08	Steiger, 1990 [185]
Note: dof: degrees of freedom			

The findings revealed that the figures shown in the above table fit the standards established by various writers. For example, the chi-square value was determined to be 1524.26, whereas the degree of freedom was discovered to be 563. Dividing the chi-square value by the associated degree of freedom yields 2.707, which is less than 3. This test assesses the model's overall fit by measuring the difference between the observed and independent covariance matrices. This test takes into consideration sample size, and a lower chi-square result suggests a smaller difference between the observed and independent covariance matrices. The null hypothesis in this scenario is expressed as follows:

CONCLUSION

The survey included 20 colleges and universities from Rohtak and Haryana, with 10 from each area. To summaries, the study indicated that out of 37 variables, 07 components were identified as Critical Success or Barrier factors impacting the adoption of CBeLS in higher education in India.

These variables are: Technical Usefulness (TU); Data Security Risk (DSR); Educational and Institutional Use (EIU); Cost-Saving and Quality Standard (CSQ); Compatibility with Traditional Classroom (CTC); Cost of Usage and Content Unavailability (CUU); and Personal Barriers (PB). The suggested model (F2CI Model) will assess the efficiency of each component in ensuring the successful implementation of CBeLS by considering the viewpoints of stakeholders. In addition, the LCB-eGyan model will make it easier for educators and students to contribute to and utilise different cloud-based learning tools or e-content.

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