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Exploration on Sustainable Cloud Computing System with Special Reference to Educational Institution

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Abstract

Cloud computing in education refers to the use of internet-based platforms and services to store, manage, and access educational resources and tools. It eliminates the need for physical hardware and infrastructure, enabling students, educators, and institutions to access data and applications anytime, anywhere. This technology fosters collaboration and makes education more flexible, efficient, and inclusive. Hence this study helps us to cover the awareness of using cloud computing tools and the impact of using cloud computing engines in education system. Furthermore, it covers the possibility of integrating AI tool with cloud computing engines which can help the educators to manage their time efficiently and effectively. Cloud computing in education system will also help the institute to align with SDG goals and boost the performance of the students in institution. Objective of this study is to analyse the impact of using cloud computing tools, to analyse the possibility of integrating AI and machine learning cloud computing system and to cover the barriers of implementing the cloud computing system. This research will address the gap of using AI tools. Methodology used in this study is descriptive analysis.

Introduction

Cloud computing is an on-demand model for delivering a wide range of IT services—including servers (infrastructure as a service or IaaS), software applications (software as a service or SaaS), storage, databases, analytics tools, and development platforms (platform as a service or PaaS)—all accessible over the internet. These services operate in massive, geographically distributed remote data centres collectively referred to as "the cloud." The companies that design, build, operate, and secure these facilities are known as cloud service providers (CSPs), such as Amazon Web Services (AWS), Microsoft Azure, or Google Cloud Platform. Instead of purchasing, installing, and maintaining expensive on-premises hardware and software, businesses rent precisely the resources they need from these providers. Billing is typically usage-based—like paying for electricity—allowing small startups to scale like enterprises without massive upfront investments. CSPs achieve dramatic cost efficiencies through economies of scale: by serving millions of customers worldwide, they spread fixed costs (e.g., data centre construction) across vast user bases, passing savings back to clients. In accounting contexts, this means firms can instantly provision tools for financial modelling or ledger management without buying servers.

Key Benefits and User Experience

The cloud model excels in scalability, lower capital expenditures (no hardware purchases), and reduced operational overhead (no in-house IT teams for maintenance). When an institution adopts cloud computing, its employees, customers, partners, and suppliers seamlessly access essential IT tools online from any device—desktops, laptops, tablets, or smartphones—making it feel indistinguishable from local applications. CSPs provide vast ecosystems of ready-to-use options, from HR systems like Workday, sales tools like Salesforce, engineering platforms like AutoCAD, logistics software like SAP, to finance apps such as QuickBooks Online or Xero for real-time invoicing and compliance. For infrastructure-heavy users, the cloud mimics a traditional remote data centre, manageable via intuitive web-based dashboards, Application Programming Interface, and consoles. CSPs fully own and handle the underlying infrastructure—including servers, networking gear, power systems, advanced cooling, high-speed connectivity, and round-the-clock physical security (e.g., biometric access and 24/7 surveillance)—freeing customers to customise features like data encryption or auto-scaling without operational headaches. In your field, this supports cloud-based accounting systems for GST compliance or multi-entity financial reporting.

Strategic Advantages for Businesses

Ultimately, cloud computing delivers unmatched agility, massive scalability, and operational flexibility, transforming how organisations compete. Teams escape the sunk costs and rigidity of legacy IT systems—think outdated on-premises ERP software requiring years to deploy—redirecting time and budget toward high-value activities like financial forecasting, fraud detection via AI, or strategic advisory services. Without large upfront investments in hardware or software licenses, staff can spin up computing resources in minutes: an educational institution might launch virtual machines for year-end audits or integrate AI-driven analytics for students' progression in academic, scaling down time spent towards progression of the students in academic. This pay-as-you-go ethos aligns perfectly with the modern education system, enabling precise time management and helping the organisation to monitor the students in their academic, with real-time visibility. For educators, it opens doors to demo cloud tools for Arts students, preparing students for fintech realities.

Cloud computing in the education system

Could computing play a vital role in the education system, not only for students but also for faculty and administrative staff working in educational institutions. Cloud computing helps the management to reduce the burden imposed on the faculty to concentrate on the administrative work like such as the Internal Quality Assurance Cell IQAC and audit work, etc. This might also help the educational institution focus more on teaching techniques rather than administrative work. This study investigates the level of awareness surrounding cloud computing tools—such as Google Workspace for Education, Microsoft Azure for Learning, or AWS Educate—and evaluates their transformative impact on the education system. By leveraging scalable, on-demand resources like virtual classrooms, collaborative platforms (e.g., Moodle or Canvas hosted in the cloud), and data analytics engines, these tools streamline teaching, assessment, and administrative processes. Furthermore, the research delves into the promising possibilities of integrating artificial intelligence (AI) tools with cloud computing engines. For instance, AI-powered features like automated grading via Google Cloud's Vertex AI or personalised learning paths through Azure Machine Learning can empower educators to manage their time more efficiently and effectively—freeing them from repetitive tasks to focus on mentorship, curriculum innovation, and student engagement.

Review of literature

There are ample of literature available on the subjects of Cloud Computing Systems. Many of the previous works in the field of cloud computing have discussed the benefits and barriers of cloud computing in the education system. Here some of few previous studies provided below.

Cloud computing services represent the most viable and rapidly growing portion of different fields of endeavour including education. Implementing Cloud computing will continuously increase the exposure of the student to the new technology. It is certainly a point of significance in Information Technology that helps educational institutions develop an improved and dynamic student-interactive environment for the students at a very reasonable cost has been discussed in the article published by.- F. J. Olaloye, A. D. Adeyemo, E. Edikan, C. O. Lawal, April 2019. The ability to access data and applications from anywhere, at any time, has created a favourable environment for remote work and collaboration between globally distributed teams. This has resulted in a significant increase in students' progression and

creativity, driving innovation in previously unimaginable ways said in his article published by António Santos, March 2024. Mohammad Al Rawajbeh (2019) stated that, Cloud computing is a promising technology for higher education institutions. In their research, they have discussed the effects of adopting cloud computing in education, as well as models of services and deployments. By analysing the previous researches, lot and very valuable benefits could be derived. Tuncay Ercan 2010 stated in his article that cloud computing as an exciting development is a significant alternative today's educational perspective. Students and administrative personnel have the opportunity to quickly and economically access various application platforms and resources through the web pages on-demand. This automatically reduces the cost of organizational expenses and offers more powerful functional capabilities. Cloud computing has emerged as a transformative force in education, ready to redefine the learning environment and institutional functions. This thorough examination of cloud computing's impact on education has revealed its several advantages, including cost efficiency, improved collaboration, personalisation, and scalability said by Augustine Alakuu 2025 in his article. Hana Eljak 2024 stated that the direction is now for online learning as the development of the technology, on the other hand, with its on-demand, metered access to computing resources (Process, Memory, Storage, etc.), cloud computing is a new paradigm that is fostering technical advancement and enabling dispersed applications across different geographies.

Kiran Yadav 2014 mentioned that "the cloud allows us to access our work anywhere, anytime and share it with anyone. It frees us from needing a particular machine to access a file or an application like a word processor or spreadsheet program, the cloud education system is introduced for the beneficial for students, faculty and the educational institutes for providing quality education. Umar Ibrahim 2024 in his study delved into the transformative role of cloud computing in reshaping ICT infrastructure within educational institutions. The ever-evolving landscape of technology necessitates a revaluation of traditional approaches, and cloud computing emerges as a potent solution to address the challenges faced by educational institutions in managing their ICT resources. Somya Agrawal 2020 mentioned in his article that cloud infrastructure can be exploited by a several universities for the purposes of teaching, learning, and research at the same time by deploying an educational cloud model. significant gap in integrating CC within the education sector: the lack of a robust requirements elicitation model for CC e-learning platforms. This gap may hinder platforms from delivering optimal functionality and user experiences, particularly regarding cultural sensitivity. Future developments should prioritize integrating comprehensive requirements elicitation models to address these gaps and align with the evolving needs of educators and learners. Additionally, future research could involve comparative analyses of different CC e-learning models in diverse educational settings, exploring the effectiveness of addressing specific challenges and requirements. Aminah Rezqallah Malkawi, 2024.

Objective of the research

1. Derive the impact of using cloud computing tools.
2. Explore the possibility of integrating AI and machine learning cloud computing system.
3. Analyse the barriers of implementing the cloud computing system.

Research methodology

This study has been contemplated in the terms of descriptive study model. Resources and data have been extracted from the secondary data with the help of articles published previously and some of the data has been extracted from the web sources.

Cloud computing models

Cloud service models—IaaS, PaaS, SaaS and AIaaS—are revolutionizing the education industry by providing scalable, affordable digital tools that support hybrid learning, administrative efficiency, and innovative teaching for institutions like Indian colleges facing rising student numbers and budget constraints.

IaaS Applications in Depth

IaaS delivers virtualized compute, storage, and networking, enabling colleges to create on-demand virtual labs for accounting simulations, data analysis, or cybersecurity training without purchasing servers. Students can access bare-metal servers for real-time financial modelling or GST compliance exercises during peak exam periods, scaling instantly to handle thousands of users—crucial during events like semester-end rushes or campus-wide remote sessions. Institutions can save up to 30-50% on hardware costs, avoid maintenance downtime, and integrate with hybrid setups for disaster recovery, ensuring uninterrupted access even in areas with unreliable power grids common in

regions like Tamil Nadu [11]. Popular engines like Amazon web services, Microsoft azure, digital ocean and google compute engine [12] can be deployed in the educational institution to create a unique platform which can help administration to easily integrate with the students to automate the admission process, scholarship management, attendance register maintenance of the students and other administrative task in more efficient and effective manner.

PaaS for Educational Innovation

PaaS provides a full development platform with pre-configured OS, databases, and tools, ideal for faculty building custom apps like student portals or AI-driven grading systems. Higher education system can use integration PaaS to link legacy ERP systems with modern cloud tools, automating admissions, fee tracking, and performance analytics—as implemented at universities for seamless data flow across departments. In curriculum design, professors can deploy containerized apps via Kubernetes on PaaS for collaborative projects, such as group finance case studies, reducing deployment time from weeks to hours and enabling hyper-personalized content for diverse learners like students **[11]**. Cloud engines storage like Google cloud, IBM cloud and AWS lambda **[12]** are some of the online cloud spaces which can be rented to store the data of the students like academic progression and students initiatives taken during their academic training. This might be more helpful tool (storage tool) for the educators to monitor the student's progression without maintain any physical documents. In fact, PaaS can help the educators to search the documents in an efficient way by searching them with the keywords given to each student like roll number or register number of the students. Despite of being having a physical document, PaaS can enable the faculties and management to access the student's data according to their convenient time from their desired location without having any physical barriers. PaaS can also allow multiple users to access the data base of the students.

SaaS Tools and Benefits

SaaS dominates with ready-to-use apps like Moodle LMS, Google Workspace for Education, or ERP systems (e.g., Ellucian), managing course delivery, quizzes, attendance, and alumni relations on a subscription basis. Colleges track 150+ SaaS instances for CRM, virtual classrooms, and analytics, optimizing costs through usage monitoring and cutting IT staff needs by 40%. Key perks include mobile-first access for students, real-time collaboration on assignments, automated compliance reporting for UGC regulations, and seamless updates—perfect for social media-integrated content creation or event management in campus activities. [11]. Cloud system like Microsoft 365, Zoom and Slack can be utilized to examine the students understanding and reflective level which can be a platform to evaluate the course outcome and program outcome of the students. Simultaneously this act can reduce the usage of paper evaluation and increase the ecofriendly environment for the society. Usage of SaaS can help the organisation to reduce the evaluation process of the students in effective way with large number of data sets which can helps the educator to provide more attention and focus on the lower-level hierarchy students.

5.5 AIaaS Tools and Benefits

In today's fast-evolving classrooms, Artificial Intelligence as a Service (AIaaS) offers educational institutions a cloud-based gateway to AI tools without the hefty upfront costs or technical hurdles. Much like renting a fully equipped lab instead of building one from scratch, AIaaS lets professors and schools' experiment with AI for teaching, assessment, and student support—reducing risks and accelerating innovation. [12].

AIaaS changes that by delivering ready-to-use platforms on public clouds, complete with machine learning (ML) algorithms. These tools span AI technologies like natural language processing (NLP) for chatbots that tutor students, computer vision for analysing handwritten assignments, and cognitive computing for simulating financial scenarios. [5]

AI systems thrive on vast datasets, sifting through patterns to forecast outcomes—think predicting student performance from past grades or generating customized finance quizzes. Training these models demands massive data volumes; skimping here risks biases, like overlooking diverse learning styles.

AIaaS simplifies this by providing pre-trained models via the cloud. Educators in accounting and finance can integrate them with tools like Excel spreadsheets or learning management systems (LMS), scaling resources as enrollment fluctuates. Providers handle updates, security, and infrastructure, freeing faculty to focus on teaching [5].

In practice, an assistant professor could deploy AIaaS to automate B. Com tax law problem sets, where ML algorithms classify deductions under sections like 80G or 80IA, or simulate GST compliance scenarios—all without coding from scratch.

Key Benefits for Educators and Institutions

AIaaS democratizes advanced tech for education, delivering tailored advantages:

- Rapid Deployment. Launch AI tools in hours, not months. Test use cases like AI-driven feedback on financial statements or adaptive quizzes for corporate law—ideal when curricula demand quick iterations across multiple courses.
- No Coding Expertise Needed. Even without data scientists on staff, no-code interfaces let you set up AI tutors or analytics dashboards. Pair it with enterprise no-code platforms to analyze student data ethically and generate reports on learning gaps.
- Major Cost Savings. Pay only for what you use—no multimillion-rupee investments in servers or software. This stretches budgets for colleges in Chennai or beyond, funding more student projects instead.
- Transparent Pricing. Consumption-based models mean clear fees tied to usage, like processing 1,000 assignment analyses monthly. No hidden costs derail fiscal planning.
- Seamless Scalability. Handle peak loads, such as end-of-semester grading surges, without downtime. Automate routine tasks like fraud detection simulations in finance labs, so faculty tackle high-value work like mentoring on AI ethics in auditing. By embracing AIaaS, education leaders build adaptable, future-proof programs—equipping students for fintech roles while upholding compliance in data privacy and bias mitigation. AIaaS can provide 24*7 virtual assistance to the students to clarify their doubts in their convenient location with their smart phones. Machine learning and Natural language processing system can be implemented to advice the students to provide a best outcome and results in their academic without any time and physical barriers.

Integration of cloud computing with educational institution

Cloud computing offers powerful solutions to modern education challenges, empowering users to securely access and manage data over the internet. In a typical higher education setup, key stakeholders—students, faculty, administrative staff, the examination branch, and the admissions branch—connect seamlessly to a central cloud platform, as illustrated in Figure 1.

Each user group enjoys dedicated logins tailored to their roles, ensuring efficient workflows. Faculty can effortlessly upload class tutorials, assignments, tests, and resources—like accounting problem sets or tax law case studies—to the cloud server. Students access these materials anytime, anywhere (24/7), via computers, tablets, or smartphones, whether at home or on campus [2].

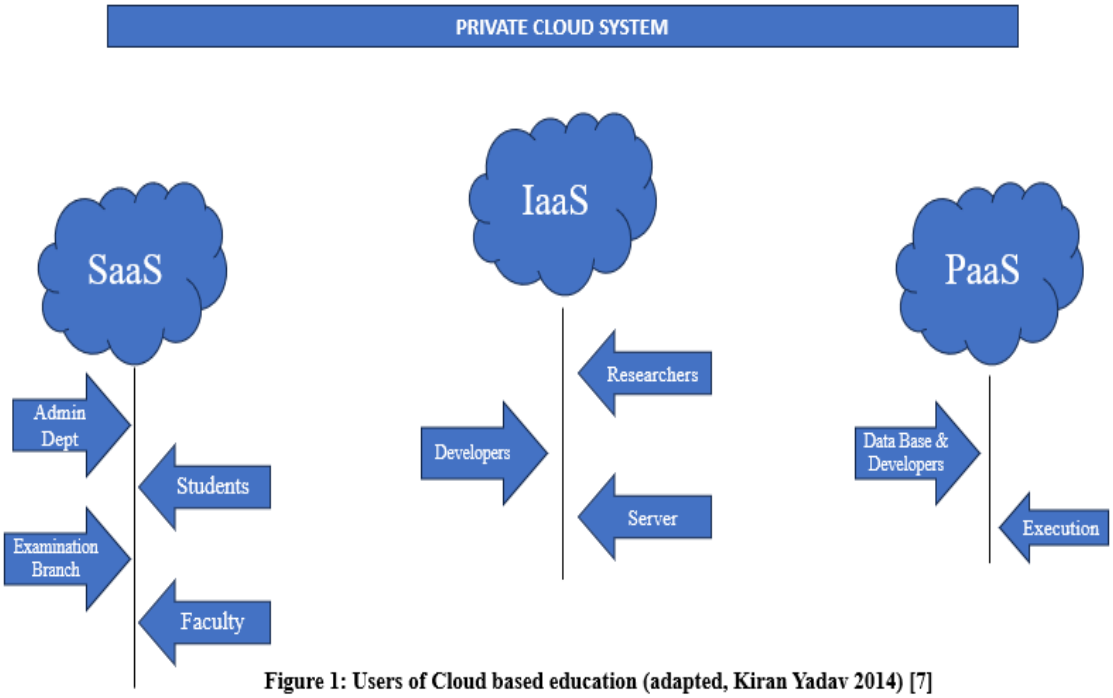

Figure 1: Users of Cloud based education (adapted, Kiran Yadav 2014) [7]

This system also analyses students' study records to

pinpoint common errors, such as frequent mistakes in GST calculations or financial forecasting [3]. Teachers gain actionable insights to refine materials and teaching methods, boosting learning outcomes across courses. This process will also eliminate the time spent towards evaluation process and allow the faculty to focus more towards the overall students' progression by introducing new teaching aids and methods to the students show less progression in their academic.

Findings

1. Revolutionizing Education: Findings from Cloud-Based Systems Study

Cloud-based education systems are transforming the sector by automating administrative burdens, enabling faculty to prioritize innovative teaching aids that boost student academic progression. This shift reduces time spent on tasks like paper evaluations, assignment distribution and grading, attendance tracking, IQAC reporting, and audits, fostering a seamless, effective learning environment.

2. Automation Through Cloud Models

PaaS streamlines physical documentation by providing barrier-free, multi-user access to student data for faculty and admins, regardless of location. SaaS and IaaS facilitate assignment deployment and automated evaluations based on educator inputs, allowing simultaneous handling across platforms. These models eliminate geographical constraints, enhancing collaboration in institutions like Techno India University, where Google Cloud optimized assessments and operations.

3. AIaaS and Advanced Integrations

AIaaS advances this revolution by embedding ML and NLP into bots and virtual assistants, offering 24/7 doubt resolution and productivity gains for students and faculty. ML automates routine tasks such as attendance registers and assignment follow-ups, while examination processes leverage ML-NLP for rapid, accurate grading. Chatbots and AI tools personalize support, as evidenced in higher education deployments improving learning outcomes.

4. Sustainability and Broader Impacts

Bypassing physical evaluations minimizes paper use, positioning cloud systems as eco-friendly solutions that cut carbon footprints via efficient data centers. Institutions adopting these technologies report greener operations, reduced printing, and alignment with ESG goals, contributing positively to society. Overall, findings affirm cloud computing's potential to create scalable, inclusive, and sustainable education ecosystems.

Discussion

Cloud based education system will create a revolution in the education industry by the means creating a smooth and effective environment. Rather than focusing on the evaluation process, faculty's can focus more towards their teaching aids which can help the students improve their progression in their academic. Process like paper evaluation, providing assignment to the students, assignment evaluation, maintaining attendance register of the students and the other administrative work like internal quality assurance cell (IQAC) and audit works can be automated by using the cloud computing system. Physical documentation process can be nourished down with help of PaaS system which enables the faculty and admin staff to access the data the students without any geographical barriers. Online cloud PaaS allows multiple users like administrative staff and faculty members to access the data at the same time without any geographical interference. SaaS and IaaS can be deployed from providing assignment task to the students and simultaneously these online servers can evaluate the assignment with the inputs given by the educators.

AIaaS is a step ahead in the educational institution where we can compress the system of machine learning (ML) and natural language processor (NLP) to provide assistance to the students for clarifying doubts with help of Bot systems and virtual AI assistance. This can improve the productivity of the students as well as faculty, by the way of improved assistance to the students on 24*7-time basis without any geographical barriers. Machine learning can be deployed to automate the regular activities of the faculties like maintenance of attendance register of the students, assignment follow ups etc. Examination branch can integrate the ML with NLP to give the better and quicker results to the students by automating the process of evaluation in cloud system. Physical evaluation process can be bypassed and through this cloud computing system, educational institution can become an eco-friendly environment to society.

Barriers of implementing cloud computing system

A primary hurdle is safeguarding data protection, security, and integrity—especially critical for research and development (R&D) departments handling intellectual property, patents, and sensitive financial datasets [7]. Not all applications suit cloud environments, limiting

full adoption. Many institutions lack full awareness of cloud benefits, fostering questionable readiness. This erodes confidence among end-users, including students, faculty, and administrative staff. Poor internet speeds and inadequate campus connectivity further disrupt seamless operations. Overall, cloud integration in educational settings remains nascent, brimming with untapped potential as infrastructure and awareness evolve [9].

While cloud computing centralizes vital data—like student records, exam results, and finance assignments—for easy access, it also heightens vulnerability to hacks. Storing everything in one location demands robust protection, making data security a top priority. Many educational institutions prefer on-premises hosting, believing it offers superior control over sensitive information [7]. Handing data to a third-party provider in a remote, unknown data centre introduces risks, including potential breaches or loss of oversight. Diversifying across multiple clouds minimizes downtime and enhances resilience. Another nuisance is unsolicited advertising, were providers bombard users with spam emails or pop-ups, disrupting academic workflows.

Limitation of the study

This study has been limited with 10 previously published articles and 3 website references. More reference and articles related to latest publications can contemplate some different results. Barriers of implementing cloud computing system can be narrowed in future which can affect the current results and conclusion. In short, this article has been limited with secondary data extracted from the previous articles. By using primary data, results can be interrupted in different way, since we can have clear and better understanding from the primary sources like educators and administrative staff in educational institution.

Conclusion

As higher education grapples with digital demands, AIaaS emerges as a game-changer—bridging resource gaps and empowering faculty to deliver personalized and efficient learning. By leveraging cloud-based AI without the burdens of custom development, institutions can foster innovation, from automated task simulations to predictive analytics for student success.

Yet, success hinges on addressing challenges like data security, infrastructure readiness, and user training. Forward-thinking Higher education institution should prioritize hybrid models, multi-vendor strategies, and ethical guidelines to build trust and resilience. Ultimately, AIaaS isn't just a tool—it's a catalyst for equitable, future-ready education. Colleges adopting it today will equip the students to AI-savvy skills for India's booming fintech landscape, ensuring they thrive amid rapid change.

In the education industry, AIaaS transforms traditional classrooms into adaptive ecosystems. Students receiving instant NLP-powered feedback on exam and assignment outcomes, computer vision grading handwritten ledgers, or Machine Learning models generating customized case studies on the topics related to their curriculum — all accessible 24/7 via mobile devices. Faculty save hours on routine tasks like assignment creation and analysis, redirecting energy toward teaching aids. Administrative teams leverage it for smarter admissions predictions, dropout risk modelling, and resource allocation, optimizing operations, scholarship management and other administrative task.

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