Cloud Based Learning Management System

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Abstract: With the continually changing face of education, cloud-based Learning Management Systems (LMS) have emerged as a necessity in streamlining academic processes. This project offers a user-friendly, cloud-based LMS that enables students, teachers, administrators, and parents to be connected to work well. Every user in the system is also given a certain role. By providing student grades and attendance records, which are then immediately delivered to their parents via email, teachers may effortlessly manage any daily tasks. This guarantees prompt and transparent communication, keeping the parents informed about their child's development.To further facilitate teaching, there is also a smart question generator in the LMS. With this, generating quizzes and tests will be faster without taking much time away from teachers- so they could give more personalized learning experiences to their students. There is also a calendar built into the system which tracks important dates such as exams, assignment, and school events, and helps everyone stay organized.Because of the cloud-based configuration, the LMS is always available, safe, and scalable, allowing for real-time access and updates from any location. Routine is automated, parent, teacher, and student collaboration is encouraged, and education management is made much easier, more interesting, and more efficient for all parties.

1 INTRODUCTION

The cloud-based LMS is currently transforming the educational landscape by making available scalable, flexible, and cost-efficient platforms to manage academic activities and deliver educational content. It provides educational institutions, organizations, and individual learners with the facilities to access courses, assessments, and resources at any time and from anywhere, with internet connectivity. The great benefit of cloud computing makes cloud-based LMS solutions avoid complicated on-premises infrastructure and operational costs, and makes update and integrations smoothly implementable so they form the backbone of education in modern times.This is the vision of developing a cloud-based LMS application specifically for the use in institutions of learning with the learner-centric and role-based approach that the system would streamline the academic workflow and maintain separate functionalities for the students, teachers, and administrators. Teachers can manage attendance and grades recorded there, which are automatically transmitted via e-mail to parents using SMTP and HMTP protocols. Other inbuilt features are a dynamic question generator in tests and an integrated calendar for scheduling. This robust architecture was used that was built with React on the frontend, Firebase on the backend, and is hosted on Netlify.This results in the adoption of all the advantages of cloud computing, including performance, security, and scalability.The Firebase real-time database makes data instantaneously available and synchronized across all platforms.Furthermore, Netlify's serverless deployment lowers complexity and increases system reliability. As a result, the project provides a responsive, flexible, and safe platform designed to satisfy the ever-changing demands of contemporary educational establishments.

Project illustrates the potential benefits of cloud-based solutions in education in addition to how to improve teamwork, streamline procedures, and increase student connection with teachers and other parents. This cloud-based learning management system will set the standard for innovation in e-learning and academic administration by resolving the problems with conventional solutions.

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2 LITERATURE SURVEY

The adoption of cloud computing has revolutionized E-Learning systems by addressing the limitations of traditional education models, such as high infrastructure costs, scalability challenges, and limited collaboration tools. Various studies have demonstrated the advantages of integrating cloud computing into E-Learning platforms, offering insights into its transformative potential.

Several researchers have proposed frameworks and architectures for cloud-based E-Learning systems. For example, (Wu and Plakhtii, 2021) highlights how cloud-based LMS like Blackboard Learn enable collaborative and distance learning, improving content organization, knowledge monitoring, and communication in higher education. Similarly (Eljak et al., 2024) introduces the concept of an E-Learning cloud, leveraging cloud service providers for scalable and cost-effective system construction, thus creating a sustainable development cycle. To further enhance these systems (Guoli and Wanjun, 2010) integrates technologies like IoT, Fog Computing, and big data streams to improve scalability, real-time analytics, and resource utilization.

Hybrid cloud architectures have emerged as a practical solution for achieving cost efficiency and scalability. (Chuang et al., 2011) presents a hybrid cloud model for enterprise E-Learning, employing multi-tenancy, data compression, and load balancing to optimize resource use. Similarly, (et al., 2019) combines public and private clouds using Eucalyptus and Openshift, supported by open-source tools such as WordPress and Nginx, to create a scalable and cost-effective platform with robust load management capabilities.

The integration of Multi-Agent Systems (MAS) into cloud-based LMSs has also been explored to enhance student collaboration. (A. E. Mhouti and Vasquèz, 2016) proposes a collaborative E-Learning platform that tracks student productivity and engagement, allowing tutors to promote interactive learning while reducing student isolation. This aligns with findings in (Aldheleai et al., 2017), which emphasize the role of cloud computing in improving educational opportunities in resource-limited regions by enabling institutions to share scalable computing resources. (Laisheng and Zhengxia, 2011)brought cloud computing to the field of e-learning by suggesting an e-learning cloud system that overcomes issues like exorbitant prices and constrained scalability in conventional web-based e-learning. They discussed problems and solutions as they looked into its design, construction, interfaces, and business plan. According to their findings, cloud computing enhances e-learning systems' sustainability, manageability, and efficiency.

(Lone et al., 2018) Examined modern cloud-based e-learning platforms and their structures to compare them to newer technologies: big data, fog computing, and the Internet of Things, in terms of how these can provide scalability, near real-time processing, and better sustainability for the e-learning environments. They identified changes to modify cloud-based systems for better big data management for education.

(Singh and Sharma, 2023)provided an overview of recent advancements in cloud-based e-learning, emphasizing how cloud computing and architecture enhance e-learning by offering scalable computing power, storage, and application development platforms. Findings highlight the benefits of cloud technology for implementing and managing learning management systems effectively.

(Watfa, 2016) suggested a cloud computing model combined with e-learning for colleges and institutions based on the need to reduce expenses. Their research supports your project on cloud-based learning management systems based on highlighting possible advantages and difficulties in applying cloud-based solutions in educational settings.

(Alam, 2022) analyzed the benefits and challenges, as well as potential implementations of cloud computing in educational contexts to enhance e-learning technology. Along with issues of bandwidth and management, they discussed advantages such as cost-effectiveness, scalability, and security offered by cloud-based solutions.

(S. Neela and Kumar, 2021) used WordPress with Amazon Web Services (AWS) to develop an interactive e-learning portal for the engineering students. The project provides courses by putting together Google Firebase with ten other AWS services - RDS, S3, and LightSail, thus making it a scalable, safe, and efficient way of using courses. Therefore, this particular project is applied to improve infrastructure in e-learning through cloud technology.

Utilizing distributed, parallel, and grid computing, (Chen and Du, 2023)s' cloud-based learning management system offers a cutting-edge e-learning platform. They emphasize the advantages of creating scalable, reasonably priced online training environments with cloud services. Using online technologies like HTML5, CSS3, and JavaScript, the method allows a variety of organizations, including government agencies and educational institutions, to offer programs and courses without the requirement for physical infrastructure.

For improving the performance, scalability, and cost-effectiveness of the hospital, (A. Gupta and

Bansal, 2020)provide for cloud-based hospital administration that utilizes Google Cloud Platform. Using GCP, three main parts of the system—doctor management, patient information, and room assignment—are centrally accessible and controllable by the administrators. It addresses an approach toward enhancing hospital operations using GCP's multiple services, databases, storage, secure networking, and machine learning.

(J. Ariza and Capacho, 2021)proposed a model for CPU and RAM utilization of cloud-hosted e-learning systems like Moodle to predict its forecasting. A neural network-based model achieves high accuracy with the aid of actual data from a high school setting. The approach makes cloud-based learning management systems offer computing resources effectively and on-demand.

(Akram and Kumar, 2020) emphasizes how cloud computing can offer scalable, affordable solutions for higher education to support individualized, self-paced learning environments. The use of cloud services reduces the investment that educational institutions have to make to meet infrastructure needs.

The use of AWS services such as S3, EC2, IAM, and RDS is explained by (U. K and M, 2024) for constructing an Automobile Database Management System that helps manage data regarding automobiles effectively, which has emphasis on scalability, safe access management, and the improvement of the user experience via monitoring and real-time communication.

Using AWS, (P. P. Reddy and Beena, 2024)built a machine learning model to predict energy efficiency in the data center by allocating resources at peak times for lesser energy usage. To increase energy efficiency of the cloud infrastructures, they have implemented the model on AWS EC2 encased in Docker. (K. P. Sah and Beena, 2024)discuss the benefits of Docker for web hosting, such as efficiency, scalability, and security, while discussing possible future integrations like Kubernetes and machine learning. This may improve security and performance.

With an emphasis on performance parameters involving latency, usage of resources and energy efficiency, (Tiwari and M, 2022)proceeded to carry a detailed analysis concerning load balancing algorithms and job scheduling algorithms across layers in the Cloud, Edge and Fog.

(Nadaf and M, 2023) put light on why green computing should be important and highlight the findings that can potentially minimize the harmful effect of these learning management systems.

(Saha and M, 2022)examine the evolution and application of green computing within various sectors but focus on the impact that will be experienced toward environmentally friendly practices in computing. Their findings might guide the building of energy-effective cloud-based learning management systems so that education-related technology will eventually be more green.

In addition to architectural innovations, studies like (Pocatilu et al., 2010) have introduced efficiency metrics to monitor and optimize the implementation of cloud-based E-Learning systems, highlighting their cost-effectiveness and long-term sustainability. Meanwhile, (Ramkumar Lakshminarayanan, 2013) reviews the benefits of cloud service models such as IaaS, PaaS, and SaaS, demonstrating how platforms like AWS, Google Cloud, and Microsoft Azure can improve resource delivery, collaboration, and content accessibility for both students and educators.

The reviewed studies collectively emphasize the versatility and potential of cloud computing to transform E-Learning. By addressing critical challenges such as scalability, resource optimization, and collaboration, cloud-based architectures create a more effective, accessible, and sustainable ecosystem for modern education. These findings pave the way for future innovations, particularly in integrating emerging technologies like IoT and big data, to further enhance the capabilities of E-Learning platforms.

3 METHODOLOGY

3.1 Planning and Requirement Analysis

The development process began with a detailed analysis of the platform's requirements to address the needs of its primary stakeholders: administrators, instructors, and learners. The LMS was designed to include essential features such as user authentication, course creation and management, progress tracking, and automated notifications. Accessibility across devices and scalability were prioritized to ensure a seamless user experience. Based on these requirements, the technology stack was defined to leverage modern tools like React, Firebase, Netlify, and SMTP/HMTP protocols for communication.

3.2 System Architecture Design

The system architecture was designed to provide a seamless interaction between its various components while maintaining scalability and efficiency.

Frontend: React was selected for its capability to create dynamic and interactive user interfaces.

A modular design approach was used to ensure reusability and maintainability of components. Responsive design principles were implemented to make the LMS accessible across devices.

Backend: Firebase was used to provide a real-time database, secure user authentication, and scalable storage for multimedia content such as videos, documents, and images.

Hosting: Netlify was chosen for hosting due to its seamless deployment capabilities, continuous integration features, and ability to handle high traffic efficiently.

Communication: SMTP and HMTP protocols were incorporated for automated email services, enabling reliable communication for tasks such as registration confirmations, course notifications, and progress updates.

3.3 Implementation

The implementation phase involved developing the platform based on the defined system architecture.

The frontend was built using React to create a responsive and user-friendly interface. Routing was implemented to provide seamless navigation across the LMS features such as dashboards, course pages, and progress tracking modules. The backend was integrated using Firebase, which managed real-time synchronization of user data, course content, and progress logs. Firebase Authentication was implemented for secure user login and registration, while Cloud Storage handled the storage of large multimedia files. Automated email services were set up using SMTP and HMTP protocols, allowing for the delivery of timely notifications and updates to users.

3.4 Testing and Quality Assurance

A rigorous testing process was conducted to ensure the platform met its performance and usability standards.

Unit testing was performed for individual React components to validate functionality. End-to-end testing ensured smooth interaction between the frontend, backend, and email services. Cross-device and cross-browser testing verified the responsiveness and compatibility of the platform. Load testing simulated high user traffic to ensure the platform's scalability and stability.

3.5 Deployment and Maintenance

The LMS was deployed on Netlify, leveraging its continuous deployment pipelines for automatic updates and improvements. Security measures, such as HTTPS and Firebase security rules, were implemented to protect user data. Ongoing maintenance involved monitoring system performance through Firebase and Netlify analytics, updating dependencies, and addressing user feedback to enhance functionality and user experience.

4 IMPLEMENTATION

The implementation of the cloud-based Learning Management System (LMS) involves integrating a range of modern technologies to provide a robust, scalable, and user-friendly platform for e-learning. This section outlines the steps and technologies used in building the system, focusing on the frontend, backend, hosting, email communication, and overall system functionality.

4.1 Frontend Development with React

The front end of the LMS was developed using React, a JavaScript library known for its efficiency in creating dynamic and responsive user interfaces. React's component-based architecture allowed for modular development, ensuring reusability and ease of maintenance. Key features of the frontend include:
User Registration and Login: The user interface supports easy registration and login for students, instructors, and administrators, with secure authentication and authorization mechanisms in place.
Dashboard: A dynamic, user-specific dashboard displays course details, progress tracking, and notifications, enabling users to manage their learning experience effectively.
Responsive Design: The platform is fully responsive, ensuring optimal user experience across devices, from desktops to mobile phones, using CSS frameworks like Bootstrap or Material-UI.
Interactive Course Management: Instructors can create and manage courses, upload content such as videos, PDFs, and quizzes, and track student progress through an intuitive interface.

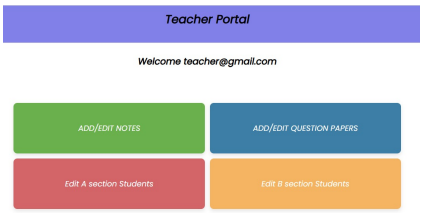

Figure 1: Teacher Dashboard

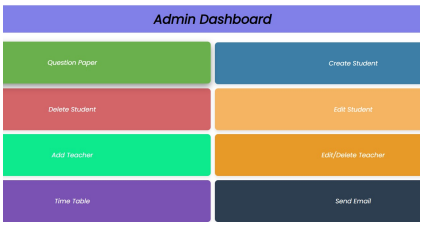

Figure 2: Admin Dashboard

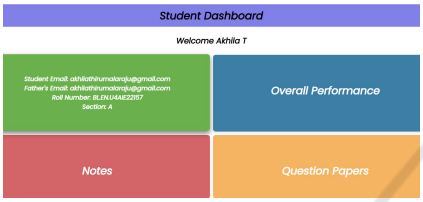

Figure 3: Student Dashboard

4.2 Backend Development with Firebase

The backend of the LMS is powered by Firebase, a platform providing a suite of services that includes real-time databases, authentication, and storage. Firebase was chosen for its ability to handle real-time data synchronization and ease of integration with the frontend. Key backend functionalities include:

Authentication: Firebase Authentication ensures secure user login and registration, supporting email/password-based authentication and OAuth login options like Google and Facebook.

Real-Time Database: Firebase Realtime Database stores course content, student progress, and other data, updating in real-time across all connected devices without requiring manual refresh.

Cloud Storage: Firebase Cloud Storage handles the upload and storage of multimedia files, such as course videos, images, and documents, providing scalable storage solutions.

Security Rules: Firebase's security rules ensure that data is securely managed, with user roles (admin, instructor, student) governing access to specific parts of the system.

4.3 Hosting on Netlify

The LMS is hosted on Netlify, a platform known for its fast and reliable hosting capabilities, continuous integration, and seamless deployment processes. Netlify simplifies the process of deploying and managing static and dynamic web applications. It provides:

Continuous Deployment: Integration with GitHub allows for continuous deployment, meaning that updates to the codebase are automatically pushed to production whenever changes are made.

Global CDN: Netlify offers a global Content Delivery Network (CDN), ensuring fast loading times and high availability for users across the world.

SSL Encryption: Netlify provides free SSL certificates, ensuring that all data exchanged between users and the platform is encrypted and secure.

4.4 Email Communication with SMTP and HMTP

Email functionality within the LMS is managed using SMTP and HMTP protocols, which allow for reliable email communication between the system and users. Automated emails are sent for:

Registration and Login: Users receive confirmation emails after registration or password reset requests.

Course Updates: Students are notified about new course material, upcoming assignments, and deadlines.

Progress Notifications: Instructors can send progress updates and feedback to students on their course performance. The email system is integrated using an SMTP provider for efficient, high-volume email delivery.

4.5 Testing and Quality Assurance

The platform underwent rigorous testing to ensure its functionality and performance:

Unit Testing: React components and Firebase functions were tested individually to ensure they perform as expected.

Integration Testing: The integration of the frontend, backend, and email system was thoroughly tested to ensure smooth communication and data flow between different system components.

Cross-Browser and Cross-Device Testing: The platform was tested across various browsers and devices to ensure consistent performance and appearance.

Load Testing: The system was stress-tested to handle multiple concurrent users to ensure scalability and responsiveness under high-traffic conditions.

4.6 Deployment and Maintenance

Once development and testing were completed, the LMS was deployed on Netlify. The continuous de-

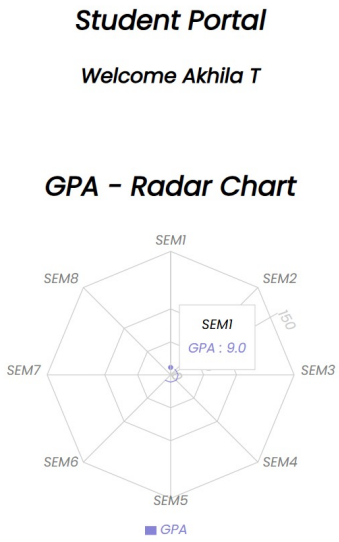

Figure 4: Showing student GPA using radar chart

ployment feature ensured that any code changes were automatically pushed to production. Regular updates, including feature enhancements and bug fixes, are rolled out seamlessly, ensuring that the platform remains up to date with the latest requirements. Firebase's real-time database and cloud storage ensure that the system remains stable and scalable as user data and content grow over time.

5 RESULTS

The development of the cloud-based Learning Management System (LMS) successfully met its objectives, delivering a robust, feature-rich, and scalable platform tailored for modern e-learning environments. The React-based frontend provided a dynamic and responsive user interface, ensuring seamless access across devices, including desktops, tablets, and smartphones. Firebase served as a reliable backend, enabling real-time data synchronization and management, ensuring that learners and instructors could access up-to-date information, such as course content and progress, without delays. Hosting on Netlify ensured a fast, reliable, and scalable deployment infrastructure, with the platform demonstrating excellent performance under load testing and high-traffic conditions.

User authentication was securely handled using Firebase Authentication, supported by HTTPS and robust security rules to safeguard sensitive data and ensure compliance with industry standards. Automated email communication, facilitated by SMTP and HMTP protocols, proved efficient in delivering notifications, such as registration confirmations, password resets, and course updates. The LMS also provided smooth and efficient course management functionalities, including course creation, learner enrollment, and progress tracking, offering an optimal experience for both instructors and learners.

The platform underwent rigorous testing, including unit testing for React components and end-to-end testing to validate the seamless integration of all components. Cross-device compatibility and load testing further verified the platform's reliability and scalability. Overall, the cloud-based LMS achieved its intended goals, providing a secure, scalable, and user-friendly solution for modern e-learning needs.

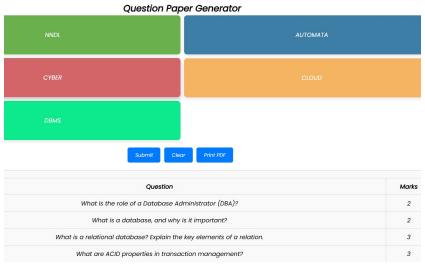

Figure 5: Question Paper Generator

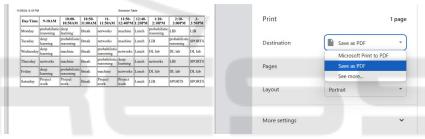

Figure 6: Timetable Generator

6 FUTURE SCOPE

The incorporation of Artificial Intelligence (AI) and Machine Learning (ML) into the project presents a significant opportunity to enhance its capabilities. In the future, AI-driven personalization can provide students with adaptive learning paths tailored to their individual strengths and weaknesses, ensuring a more effective and engaging educational experience. Additionally, ML models could be employed to dynamically adjust quiz difficulties based on a student's progress, promoting continuous improvement.

7 CONCLUSION

The cloud-based Learning Management System (LMS) developed in this project successfully integrates modern technologies to deliver a scalable, secure, and user-friendly platform for e-learning. By combining a React-based frontend, Firebase backend,

Netlify hosting, and SMTP/HMTP protocols for communication, the system meets the demands of educators, learners, and administrators. The LMS offers key features such as real-time data synchronization, secure user authentication, automated email notifications, and seamless course management, ensuring an engaging and efficient learning experience.

The platform's performance was validated through rigorous testing, demonstrating responsiveness across devices, reliable data handling, and scalability to support growing user bases. Hosting on Netlify further ensured a seamless deployment process with high availability and minimal downtime. Overall, the LMS represents a significant step forward in leveraging cloud technologies to enhance the accessibility and effectiveness of digital education. It provides a strong foundation for addressing the current and future challenges of the e-learning ecosystem.

REFERENCES

A. E. Mhouti, A. Nasseh, M. E. and Vasquèz, J. M. (2016). Using cloud computing and a multi-agents system to improve collaborative e-learning in lms. In *2016 11th International Conference on Intelligent Systems: Theories and Applications (SITA)*, pages 1–6, Mohammedia, Morocco. IEEE.

A. Gupta, P. Goswami, N. C. and Bansal, R. (2020). Deploying an application using google cloud platform. In *2020 2nd International Conference on Innovative Mechanisms for Industry Applications (ICIMIA)*, pages 236–239, Bangalore, India. IEEE.

Akram, F. and Kumar, R. (2020). Analysis of collaborative and convenient e-learning on cloud computing. In *2020 International Conference on Smart Electronics and Communication (ICOSEC)*, pages 805–808, Trichy, India. IEEE.

Alam, A. (2022). Cloud-based e-learning: scaffolding the environment for adaptive e-learning ecosystem based on cloud computing infrastructure. In *Computer Communication, Networking and IoT: Proceedings of 5th ICICC 2021, Volume 2*, pages 1–9, Singapore. Springer Nature Singapore.

Aldheleai, H. F., Bokhari, M. U., and Alammari, A. (2017). Overview of cloud-based learning management system. *International Journal of Computer Applications*, 162(11).

Chen, X. and Du, S. (2023). Construction of network learning platform based on cloud service. In *2023 3rd International Conference on Mobile Networks and Wireless Communications (ICMNWC)*, pages 1–5, Tumkur, India. IEEE.

Chuang, S.-M., Chang, K.-E., and Sung, Y.-T. (2011). The cost effective structure for designing hybrid cloud based enterprise e-learning platform. In *2011 IEEE International Conference on Cloud Computing and Intelligence Systems*, pages 523–525, Beijing, China.

Eljak, H. I., Saeed, A., Hashem, F., Abdelmaboud, I., Syed, A., Abulfaraj, H., Ismail, A., and Elsafi, M. (2024). E-learning-based cloud computing environment: A systematic review, challenges, and opportunities. *IEEE Access*, 12:7329–7355.

et al., F. C. C. (2019). Implementation of an e-learning platform in hybrid clouds. In *2019 IEEE Eurasia Conference on Biomedical Engineering, Healthcare and Sustainability (ECBIOS)*, pages 91–94, Okinawa, Japan. IEEE.

Guoli, Z. and Wanjun, L. (2010). The applied research of cloud computing platform architecture in the e-learning area. In *2010 The 2nd International Conference on Computer and Automation Engineering (ICCAE)*, pages 356–359, Singapore.

J. Ariza, M. Jimeno, R. V.-P. and Capacho, J. (2021). Provisioning computational resources for cloud-based e-learning platforms using deep learning techniques. *IEEE Access*, 9:89798–89811.

K. P. Sah, N. Jain, P. J. J. H. and Beena, B. M. (2024). Advancing of microservices architecture with dockers. In *2024 15th International Conference on Computing Communication and Networking Technologies (ICCCNT)*, pages 1–6, Kamand, India. IEEE.

Laisheng, X. and Zhengxia, W. (2011). Cloud computing: A new business paradigm for e-learning. In *2011 Third International Conference on Measuring Technology and Mechatronics Automation*, pages 716–719, Shanghai, China.

Lone, Z. A., Chawla, P., and Rana, A. (2018). E-learning system architecture for cloud computing – a review. In *2018 3rd International Conference on Contemporary Computing and Informatics (IC3I)*, pages 252–256, Gurgaon, India.

Nadaf, A. and M, B. B. (2023). Green computing: Optimized underutilized host detection in iqr vm allocation policy. In *2023 4th International Conference on Intelligent Engineering and Management (ICIEM)*, pages 1–4, London, United Kingdom. IEEE.

P. P. Reddy, P. S. Shruthi, P. T. and Beena, B. M. (2024). Improvising energy efficiency of heterogeneous servers using aws services and machine learning approaches. In *2024 15th International Conference on Computing Communication and Networking Technologies (ICCCNT)*, pages 1–7, Kamand, India. IEEE.

Pocatilu, P., Alecu, F., and Vetrici, M. (2010). Measuring the efficiency of cloud computing for e-learning systems. *WSEAS Transactions on Computers*, 9(1):42–51.

Ramkumar Lakshminarayanan, Binod Kumar, M. R. (2013). Cloud computing benefits for educational institutions. *arXiv preprint arXiv:1305.2616*.

S. Neela, Y. Neyyala, V. P. K. P. and Kumar, V. V. (2021). Cloud computing based learning web application through amazon web services. In *2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS)*, pages 472–475, Coimbatore, India. IEEE.

Saha, S. and M, B. (2022). Power cognizant optimization techniques for green cloud systems. In *2022 OITS International Conference on Information Technology (OCIT)*, pages 507–512, Bhubaneswar, India. IEEE.

Singh, S. K. and Sharma, A. (2023). An evaluation on e-learning with cloud computing. In *2023 2nd International Conference for Innovation in Technology (INOCON)*, pages 1–5, Bangalore, India. IEEE.

Tiwari, S. and M, B. B. (2022). Energy cognizant scheduling in three-layer cloud architecture: A systematic review. In *2022 3rd International Conference on Issues and Challenges in Intelligent Computing Techniques (ICICT)*, pages 1–6, Ghaziabad, India. IEEE.

U. K, N. K. Sai Keerthan, N. K. M. and M, B. B. (2024). Cloud-infused aws services: Automobile database management system. In *2024 2nd International Conference on Networking, Embedded and Wireless Systems (ICNEWS)*, pages 1–7, Bangalore, India. IEEE.

Watfa, M. (2016). Cloud computing and e-learning: Potential pitfalls and benefits. In *2016 Sixth International Conference on Innovative Computing Technology (INTECH)*, pages 140–144, Dublin, Ireland. IEEE.

Wu, W. and Plakhtii, A. (2021). E-learning based on cloud computing. *International Journal of Emerging Technologies in Learning (iJET)*, 16(10):4–17. Retrieved November 20, 2024.