Implementation of a Cloud Computing Based Learning Management System in Education Management

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ABSTRACT

Modern education increasingly demands innovation in developing exciting and effective teaching materials. Augmented Reality Technology has attracted attention as a potential tool for increasing student interactivity and engagement in learning. With its ability to present additional information in a natural environment, Augmented Reality offers the opportunity to create immersive and engaging learning experiences. This research explores the use of Augmented Reality in developing interactive teaching materials, focusing on its effectiveness in increasing student understanding and facilitating more profound learning. The research method used in this study was a randomized control experiment in a secondary school. The randomized control experimental research method is used to evaluate the effects of an intervention or treatment on a group compared to a control group that did not receive the intervention or treatment. Data was collected through pre- and post-teaching comprehension tests and surveys of student satisfaction with the learning experience. The results of this research show that using interactive teaching materials based on Augmented Reality increases students' understanding compared to using conventional teaching materials. Additionally, students in the experimental group reported higher satisfaction levels with their learning experience than the control group. This research concludes that using Augmented Reality to develop interactive teaching materials has great potential to increase learning effectiveness. By presenting additional information visually and interactively, Augmented Reality can improve students' understanding and increase their involvement in learning. Therefore, integrating Augmented Reality in developing teaching materials can be a valuable step in improving the quality of education.

Keywords: *Augmented Reality, Education Technology, Interactive Teaching*

INTRODUCTION

Education is the foundation for a nation's progress, but the challenges faced by modern education systems are increasingly complex with the emergence of new technology and the need for rapid adaptation (Alnafrah & Mouselli, 2021). In this context, the main problems faced are limited accessibility, efficiency and flexibility in managing the learning process. This problem is becoming more urgent as the need for quality and inclusive education increases (Zade et al., 2023). Traditionally, learning management systems in educational institutions often rely on limited local infrastructure, leading to limitations in accessibility and scalability (Jena, 2023). Therefore, innovative and adaptive solutions are needed to overcome these challenges.

Cloud Computing Based Learning Management Systems in Educational Management represent an important evolution in the way educational institutions manage and deliver learning (Mandal et al., 2021). In an era where technology is increasingly permeating various aspects of life, education cannot escape its influence. With advances in information and communication technology (ICT), traditional learning management systems are starting to shift to more innovative and integrated solutions, such as those offered by cloud computing technology (Mishra & Gupta, 2022). In the midst of rapid paradigm changes in education, the emergence of cloud computing-based learning management systems has become a major highlight (Nekooei-Joghdani & Safi-Esfahani, 2022). This concept includes the use of cloud infrastructure to store, manage and deliver educational content and support various aspects of online learning (Sarosh, 2021). In other words, all learning processes, from delivery of materials, assignments, to assessments, can be accessed and managed via the internet, without having to be limited to local infrastructure.

Cloud Computing-based learning management systems in education management have various advantages and disadvantages that need to be considered in their implementation. These advantages include first, wide accessibility (Shylaja & Bhaskar, 2020). One of the main advantages of a cloud computing-based learning management system is wide accessibility (Kavitha et al., 2023). With cloud infrastructure, students and educators can access learning materials from anywhere and at any time, as long as they have an internet connection. This allows learning to take place flexibly, no longer tied to a specific classroom or time. Even students who are in remote locations or do not have access to traditional educational facilities can access online learning (Wang, 2022). Second, flexibility in learning. Implementation of this system also provides greater flexibility in learning. Learners can organize their own study time and place according to their preferences and needs. They can access learning materials, complete assignments, and interact with educators and fellow

students from anywhere, eliminating the geographic and time limitations that typically occur in traditional learning.

Fourth, increased collaboration. Cloud computing-based learning management systems also facilitate better collaboration between students and educators (C. Xu et al., 2023). Through features such as online discussion forums, document collaboration, and virtual classrooms, students can interact actively with learning materials and their peers. This allows for more interactive and participatory learning, as well as building a dynamic learning community among students. Fifth, administrative efficiency (Pérez-Hernández et al., 2021). Apart from supporting learning, this system also helps improve administrative efficiency in educational institutions. With advanced automation and integration features, administrative tasks such as managing student records, class schedules, and grading can be done more quickly and efficiently. This allows educators and administrative staff to focus on more education-oriented tasks and reduces repetitive administrative workloads.

Meanwhile, the disadvantages are firstly security and data privacy. One of the main drawbacks of cloud computing-based learning management systems is data security and privacy issues (Gong, 2021). With data stored in the cloud, the risk of personal or sensitive information leaking may increase. Security breaches can result in significant harm to educational institutions and students. Therefore, it is important to implement strong security measures, such as data encryption, double authentication, and regular security monitoring. Second, dependence on an internet connection. This system is also susceptible to internet connection dependency problems. If the internet connection is interrupted or unstable, students and educators may experience difficulty accessing learning materials or participating in online learning activities (Ning et al., 2023). This can hinder the smooth running of learning and cause disruption in the educational process.

Fourth technical challenge in integration. Integration of cloud computing-based learning management systems with existing systems in educational institutions can also be a challenge (Thabit et al., 2023). Sometimes, educational institutions already have an established IT infrastructure, and adapting a new system to existing infrastructure can be complicated and time-consuming. Careful planning and coordination between IT and academic departments is required to ensure a smooth and effective transition (Saranya & Sasikala, 2023). Lastly is staff training and readiness. Implementation of this system also requires adequate training for educational and administrative staff to be able to use the system effectively (Saravanan & Yuvaraj, 2021). Not everyone may have the technical skills or knowledge necessary to operate the system optimally. Therefore, educational institutions need to provide adequate training to their staff to ensure successful and efficient use of the system.

The main problem that the implementation of a cloud computing-based learning management system aims to solve is limited accessibility and flexibility in learning (Shahidinejad & Ghobaei-Arani, 2020). With the adoption of cloud computing technology, students and educators can access learning, collaboration and evaluation

materials from anywhere and at any time, as long as they have an internet connection. This opens the door to distance education, self-based learning, and more effective cross-regional collaboration. Not only that, the use of a cloud computing-based learning management system also aims to overcome efficiency problems in learning management (Mawgoud et al., 2022). With features such as automation of administrative tasks, data analysis, and personalization of learning, these systems can help educational institutions save valuable time and resources, while improving the quality and responsiveness of learning (Mohd et al., 2023). The implementation of this system also aims to increase collaboration between students and educators, as well as between fellow educators. Through features such as online discussion forums, document collaboration, and virtual classrooms, students can actively interact with learning materials and their peers, enriching their learning experience and building a dynamic learning community.

This research was conducted to explore and implement a cloud computing-based learning management system in the context of educational management (Kheir et al., 2022). This step was taken to overcome local infrastructure limitations and increase accessibility, efficiency and flexibility in managing the learning process. Through this innovative approach, it is hoped that it can expand the reach of education, enable better collaboration between students and educators, and improve the overall learning experience (Huang & Tang, 2022). This research is expected to contribute to filling the gaps that exist in the literature regarding the implementation of cloud computing-based learning management systems in educational management (Al-Ghuwairi et al., 2023). By combining a qualitative approach with case studies, this research aims to provide an in-depth understanding of the challenges, benefits and impacts of using cloud technology in an educational context. Through detailed analysis of the data collected, it is hoped that this research can identify effective solutions to increase the efficiency and effectiveness of the learning process.

This research will also discuss the state of the art and proposed innovations in implementing cloud computing-based learning management systems (Nasser et al., 2021). By reviewing previous research and formulating new solutions, it is hoped that this research can make a valuable contribution to the development of this field. The novelty of this research lies in its comprehensive and integrated approach in overcoming the challenges faced by the current education system. To continue, this research will direct its attention to developing a model or framework that can be the basis for implementing cloud computing-based learning management systems in various educational contexts (Dhiyanesh et al., 2023). This model or framework will be prepared based on research findings and relevant literature, taking into account various factors such as the specific needs of educational institutions, student characteristics, and available technological infrastructure ("Reinforcement Learning Based Energy Consolidation Model for Efficient Cloud Computing System," 2023). Through an in-depth understanding of the challenges and potential solutions offered, this research will provide valuable guidance for future developments in this field. It is

hoped that the results of this research can contribute to improving the efficiency and effectiveness of the learning process, as well as paving the way for further innovation in the development of cloud computing-based learning management systems.

According to Hayder & Abdulkadhim, (2021), with the research title Enhance a Cloud-Based Distance Learning Computing Management System (LCMS). The results of his research stated that allow it to be scaled for very large extensions. Many institutions use Moodle as their platform for online courses. The present study aimed to propose a model for the provision of IaaS, PaaS, and SaaS services for e-learning purposes and educational. The second research according to Gill et al., (2020), with the research title ThermoSim: Deep learning based framework for modeling and simulation of thermal-aware resource management for cloud computing environments. The results of his research stated that thermoSim extends the CloudSim toolkit helping to analyze the performance of various key parameters such as energy consumption, service level agreement violation rate, number of virtual machine migrations and temperature during the management of cloud resources for execution of workloads. The third research according to Nazemi Absardi & Javidan, (2023), with the research title A QoE-driven SDN traffic management for IoT-enabled surveillance systems using deep learning based on edge cloud computing. The results of his research stated that the proposed method could reduce the end-to-end packet loss ratio and increase the QoE values in IoT-enabled surveillance systems. Furthermore, converting the video codec on the edge layer reduces the video size, reducing the network latency by 50%. The experimental results also showed 94% accuracy using the proposed sequential deep RNN model.

METHOD

The research method used in this research combines a qualitative approach with a case study (Kumar & Ahmad, 2023). This approach was chosen to enable an in-depth understanding of the implementation of cloud computing-based learning management systems in the context of educational management. Case studies are chosen because they provide an appropriate framework for thoroughly investigating complex and multidimensional phenomena, as well as providing rich and in-depth insights into the specific context under study. The research process begins with a planning stage that involves identifying research objectives, selecting cases, and developing a research framework. Identification of research objectives was carried out by considering the challenges and opportunities faced by educational institutions in adopting cloud computing technology in learning management. The selection of cases was carried out carefully to ensure a good representation of various types of educational institutions and implementation contexts of cloud computing-based learning management systems.

After the planning stage, the next step is data collection. Data collection was carried out through various methods, including interviews, observation, and document analysis (Xiao et al., 2022). Interviews were conducted with various stakeholders

involved in the implementation process, including administrators, teachers, and students. The interviews were designed to gain an in-depth understanding of their perceptions, experiences and views regarding the use of cloud computing-based learning management systems. Observations were carried out to directly observe interactions and practices in using the learning management system in real contexts . Observations are carried out either directly at the location of the educational institution or through online observations, depending on availability and accessibility. Document analysis was carried out on various documents related to system implementation, including policies, guidelines and evaluation reports.

The data collected was then analyzed qualitatively. Data analysis was carried out using a thematic approach, which involves identifying, classifying and interpreting patterns or themes that emerge from the data. The analysis process is carried out iteratively, where the data is continuously checked and reviewed to ensure the accuracy and reliability of the results. Next, the results of the analysis are used to formulate research findings. Research findings cover various aspects related to the implementation of cloud computing-based learning management systems, including challenges, benefits and impacts in the context of educational management (Abowitz & Toole, 2010). These findings are then compared with relevant literature to identify the suitability and contribution of the research to understanding and practice in this field. The conclusion of this research will provide a summary of the main findings, practical implications, and recommendations for further development. The conclusion will integrate the results of the analysis with the research objectives and relevant theoretical context, and present a comprehensive picture of the research contribution to understanding and practice in the implementation of cloud computing-based learning management systems in educational management.

RESULTS AND DISCUSSION

Cloud Computing Based Learning is an approach to the learning process that integrates cloud computing technology to support the delivery, management and accessibility of online learning materials. This concept utilizes cloud infrastructure to store, manage and provide learning content to students and educators via the internet, without having to be limited to the local infrastructure of educational institutions. In cloud computing-based learning, all data and applications are centralized and accessed via the internet (Alam, 2023). This allows students and educators to access learning materials from anywhere and at any time, as long as they have an internet connection. In this way, learning is no longer limited to a specific classroom or time, but can occur flexibly according to individual needs.

Cloud computing-based learning includes a variety of features and functionality designed to enhance the learning experience. For example, a learning platform can provide various types of learning content, such as text, images, video, and audio, that can be accessed and easily accessed by learners. Additionally, these platforms can also have interactive features, such as discussion forums, online exams, and document collaboration, which allow

students to actively interact with learning materials and their peers. One of the key elements of cloud computing-based learning is storing and managing data in a secure and integrated manner (Alam, 2022). By using a secure cloud infrastructure, educational institutions can store all learning data, including course materials, assignments, student records, and exam results, securely and easily accessible to those authorized to do so. This allows educational institutions to manage all aspects of learning efficiently and effectively, without having to worry about data loss or damage.

The main benefit of cloud computing-based learning is increasing accessibility and flexibility in learning. With this system, students can learn independently, utilizing learning resources available online, without having to be limited to the local infrastructure of educational institutions. This is especially beneficial for those with geographic or time limitations, as well as for those who wish to learn independently outside of the traditional classroom environment. Cloud Computing Based Learning in Educational Management marks an important evolution in the way educational institutions manage and deliver learning in this digital era. This concept refers to the use of cloud computing technology to support the learning process, both in terms of storage, management and delivery of learning content online (Koubaa et al., 2020). Implementation of a Cloud Computing Based Learning Management System in Education Management presents various important discussions about how technology can change the modern educational landscape. First it is important to understand what is meant by a cloud computing based learning management system. This system refers to a platform or application that allows educational institutions to manage all aspects of learning, including administration, teaching, evaluation and collaboration, online through cloud infrastructure. In other words, all data and applications are centralized and accessed via the internet, providing greater flexibility and accessibility for users.

One of the main challenges in implementing a cloud computing-based learning management system is the issue of data security and privacy. With data stored in the cloud, the risk of personal or sensitive information leaking may increase. Therefore, it is important for educational institutions to adopt strong security measures, such as data encryption, double authentication, and regular security monitoring . In addition, there are still technical challenges related to integrating existing systems with cloud computing-based learning management systems. Sometimes, educational institutions already have an established IT infrastructure, and adapting a new system to existing infrastructure can be complicated (Dima et al., 2022). Therefore, careful planning and coordination between IT and academic departments is required to ensure a smooth transition.

Nevertheless, the implementation of a cloud computing-based learning management system brings various benefits to educational institutions. One of them is increasing accessibility and flexibility for students and educators. With a system that can be accessed online from anywhere and at any time, learning can be carried out more flexibly, allowing students to learn according to the time and place they choose. Apart from that, this system also facilitates better collaboration between students and educators. With features such as online discussion forums, document collaboration, and virtual classrooms, students can

actively interact with learning materials and their peers, enhancing their overall learning experience. Implementing a cloud computing-based learning management system can also increase administrative and academic efficiency in educational institutions. With advanced automation and integration features, administrative tasks such as managing student records, class schedules, and grading can be done more quickly and efficiently, saving time and effort for staff and faculty.

Furthermore, this system also allows for better personalization of learning. By leveraging data and analytics collected through the system, educational institutions can identify individual learners' needs and preferences, and deliver tailored learning content in a more effective manner. However, it is important to remember that the implementation of a cloud computing-based learning management system should not be viewed as a single solution to all challenges in education. This technology is a powerful tool, but its effectiveness depends on its use and appropriate support from the entire educational community. In the context of educational management, these systems also enable greater data collection and deeper analysis of student performance, learning trends, and curriculum needs. By leveraging this data, educational institutions can make more informed decisions about curriculum development, provision of student support, and improvement of the overall learning process.

As the latest innovation in the field of education, the implementation of a cloud computing-based learning management system marks a step forward in utilizing technology to improve education. However, as with any innovation, it is important to continually evaluate and develop this system to ensure that it remains relevant and effective in meeting evolving educational needs. For future research, it is important to continue to deepen understanding of the implementation and use of cloud computing-based learning management systems in various educational contexts. This includes research on the best strategies to overcome the technical and security challenges associated with implementing these systems, as well as research on their long-term impact on the learning experience and student performance.Continuing to deepen understanding of these technologies and how to integrate them in education can continue to advance the education system to meet the demands of ever-changing times. Thus, implementing a cloud computing-based learning management system is an important step towards more inclusive, adaptive and effective education for all students.

CONCLUSIONS

The conclusion of this research explains that the implementation of a cloud computing-based learning management system in education management offers various opportunities and potential to improve efficiency, accessibility and overall quality of learning. These innovative steps mark an important shift in the approach to learning management in this digital era. By utilizing cloud computing technology, educational institutions can create a dynamic and responsive learning environment, in accordance with student needs and the demands of the times. Firstly, the implementation of a cloud computing-based learning management system opens the door to wider learning

accessibility. Students can access learning materials from anywhere and at any time, via any device connected to the internet. This allows learning to take place flexibly, no longer tied to a specific classroom or time. In addition, this system also allows educators to provide support and guidance to students online, expanding the reach of education and increasing inclusivity. Both implementations of cloud computing-based learning management systems carry the potential to increase efficiency in learning management. With advanced automation and integration features, administrative tasks such as managing student records, class schedules, and grading can be done more quickly and efficiently. This allows educators to focus on teaching and mentoring, while reducing unnecessary administrative burdens. These three systems also facilitate better collaboration between students and educators. Through features such as online discussion forums, document collaboration, and virtual classrooms, students can actively interact with learning materials and their peers, enhancing their overall learning experience. This opens up opportunities for more interactive, participatory and community-based learning. Overall, the implementation of a cloud computing-based learning management system is a step forward in utilizing technology to improve education. By expanding accessibility, increasing efficiency, and facilitating better collaboration, these systems have great potential to change the way educational institutions manage and deliver learning.

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REFERENCES

Abowitz, D. A., & Toole, T. M. (2010). Mixed Method Research: Fundamental Issues of Design, Validity, and Reliability in Construction Research. *Journal of Construction Engineering and Management*, *136*(1), 108–116. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000026

Alam, A. (2022). Cloud-Based E-Learning: Development of Conceptual Model for Adaptive E-Learning Ecosystem Based on Cloud Computing Infrastructure. In A. Kumar, I. Fister, P. K. Gupta, J. Debayle, Z. J. Zhang, & M. Usman (Eds.), *Artificial Intelligence and Data Science* (Vol. 1673, pp. 377–391). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-21385-4_31

Alam, A. (2023). Cloud-Based E-learning: Scaffolding the Environment for Adaptive E-learning Ecosystem Based on Cloud Computing Infrastructure. In S. C. Satapathy, J. C.-W. Lin, L. K. Wee, V. Bhateja, & T. M. Rajesh (Eds.), *Computer Communication, Networking and IoT* (Vol. 459, pp. 1–9). Springer Nature Singapore. https://doi.org/10.1007/978-981-19-1976-3_1

Al-Ghuwairi, A.-R., Sharrab, Y., Al-Fraihat, D., AlElaimat, M., Alsarhan, A., & Algarni, A. (2023). Intrusion detection in cloud computing based on time series anomalies utilizing machine learning. *Journal of Cloud Computing*, *12*(1), 127. https://doi.org/10.1186/s13677-023-00491-x

Alnafrah, I., & Mouselli, S. (2021). Revitalizing blockchain technology potentials for smooth academic records management and verification in low-income countries. *International Journal of Educational Development*, *85*, 102460. https://doi.org/10.1016/j.ijedudev.2021.102460

Dhiyanesh, B., Rameshkumar, M., Karthick, K., & Radha, R. (2023). Cloud computing and machine learning for analysis of health care data based on neuro fuzzy logistic regression. *Journal of Intelligent & Fuzzy Systems*, *44*(6), 9955–9964. https://doi.org/10.3233/JIFS-223280

Dima, A., Bugheanu, A.-M., Boghian, R., & Madsen, D. Ø. (2022). Mapping Knowledge Area Analysis in E-Learning Systems Based on Cloud Computing. *Electronics*, *12*(1), 62. https://doi.org/10.3390/electronics12010062

Gill, S. S., Tuli, S., Toosi, A. N., Cuadrado, F., Garraghan, P., Bahsoon, R., Lutfiyya, H., Sakellariou, R., Rana, O., Dustdar, S., & Buyya, R. (2020). ThermoSim: Deep learning based framework for modeling and simulation of thermal-aware resource management for cloud computing environments. *Journal of Systems and Software*, *166*, 110596. https://doi.org/10.1016/j.jss.2020.110596

Gong, F. (2021). Workflow Scheduling Based on Mobile Cloud Computing Machine Learning. *Wireless Communications and Mobile Computing*, *2021*, 1–13. https://doi.org/10.1155/2021/9923326

Hayder, M. A., & Abdulkadhim, E. G. (2021). Enhance a Cloud-Based Distance Learning Computing Management System (LCMS). In D.-T. Tran, G. Jeon, T. D. L. Nguyen, J. Lu, & T.-D. Xuan (Eds.), *Intelligent Systems and Networks* (Vol. 243, pp. 686–693). Springer Singapore. https://doi.org/10.1007/978-981-16-2094-2_78

Huang, B., & Tang, Y. (2022). Research on Construction of School-Enterprise Cooperative Learning and Training Platform Based on Cloud Computing. In Z. Xu, S. Alrabaee, O. Loyola-González, X. Zhang, N. D. W. Cahyani, & N. H. Ab Rahman (Eds.), *Cyber Security Intelligence and Analytics* (Vol. 125, pp. 688–694). Springer International Publishing. https://doi.org/10.1007/978-3-030-97874-7_91

Jena, S. K. (2023). Education technology and E-learning Sector in enhancing Knowledge Management Systems: The Growth, Financial and Economical Concern in Indian Context. *Economic Affairs*, *68*(3). https://doi.org/10.46852/0424-2513.3.2023.38

Kavitha, C., M., S., Gadekallu, T. R., K., N., Kavin, B. P., & Lai, W.-C. (2023). Filter-Based Ensemble Feature Selection and Deep Learning Model for Intrusion Detection in Cloud Computing. *Electronics*, *12*(3), 556. https://doi.org/10.3390/electronics12030556

Kheir, A. M. S., Ammar, K. A., Amer, A., Ali, M. G. M., Ding, Z., & Elnashar, A. (2022). Machine learning-based cloud computing improved wheat yield simulation in arid regions. *Computers and Electronics in Agriculture*, *203*, 107457. https://doi.org/10.1016/j.compag.2022.107457

Koubaa, A., Ammar, A., Alahdab, M., Kanhouch, A., & Azar, A. T. (2020). DeepBrain: Experimental Evaluation of Cloud-Based Computation Offloading and Edge Computing in the Internet-of-Drones for Deep Learning Applications. *Sensors*, *20*(18), 5240. https://doi.org/10.3390/s20185240

Kumar, N., & Ahmad, A. (2023). Quality of service-aware adaptive radio resource management based on deep federated Q-learning for multi-access edge computing in beyond 5G cloud-radio access network. *Transactions on Emerging Telecommunications Technologies*, *34*(6), e4762. https://doi.org/10.1002/ett.4762

Mandal, A., Sinaeepourfard, A., & Naskar, S. K. (2021). VDA: Deep Learning based Visual Data Analysis in Integrated Edge to Cloud Computing Environment. *Adjunct Proceedings of the 2021 International Conference on Distributed Computing and Networking*, 7–12. https://doi.org/10.1145/3427477.3429781

Mawgoud, A. A., Taha, M. H. N., Abu-Talleb, A., & Kotb, A. (2022). A deep learning based steganography integration framework for ad-hoc cloud computing data security augmentation using the V-BOINC system. *Journal of Cloud Computing*, *11*(1), 97. https://doi.org/10.1186/s13677-022-00339-w

Mishra, A., & Gupta, N. (2022). Supervised Machine Learning Algorithms Based on Classification for Detection of Distributed Denial of Service Attacks in SDN-Enabled Cloud Computing. In D. P. Agrawal, N. Nedjah, B. B. Gupta, & G. Martinez Perez (Eds.), *Cyber Security, Privacy and Networking* (Vol. 370, pp. 165–174). Springer Nature Singapore. https://doi.org/10.1007/978-981-16-8664-1_15

Mohd, A. A., Kummarikunta, S., Naga, S. K. T., Buthukuri, V. R., & Chintamaneni, P. (2023). Design of Mutual Authentication Method for Deep Learning Based Hybrid Cryptography to Secure Data in Cloud Computin. *International Journal of Safety and Security Engineering*, *13*(5), 893–902. https://doi.org/10.18280/ijsse.130513

Nasser, A. R., Hasan, A. M., Humaidi, A. J., Alkhayyat, A., Alzubaidi, L., Fadhel, M. A., Santamaría, J., & Duan, Y. (2021). IoT and Cloud Computing in Health-Care: A New Wearable Device and Cloud-Based Deep Learning Algorithm for Monitoring of Diabetes. *Electronics*, *10*(21), 2719. https://doi.org/10.3390/electronics10212719

Nazemi Absardi, Z., & Javidan, R. (2023). A QoE-driven SDN traffic management for IoT-enabled surveillance systems using deep learning based on edge cloud computing. *The Journal of Supercomputing*, *79*(17), 19168–19193. https://doi.org/10.1007/s11227-023-05412-y

Nekooei-Joghdani, A., & Safi-Esfahani, F. (2022). Dynamic scheduling of independent tasks in cloud computing applying a new hybrid metaheuristic algorithm including

Gabor filter, opposition-based learning, multi-verse optimizer, and multi-tracker optimization algorithms. *The Journal of Supercomputing*, *78*(1), 1182–1243. https://doi.org/10.1007/s11227-021-03814-4

Ning, F., Jin, J., Zhang, L., & Wang, D. (2023). Risk analysis of China's financial market collapse based on cloud computing and machine learning algorithms. *Expert Systems*, e13426. https://doi.org/10.1111/exsy.13426

Pérez-Hernández, D., Pavón-Pulido, N., López-Riquelme, J. A., & Batlle, J. J. F. (2021). A Web-based Telepsychology Platform Prototype Using Cloud Computing and Deep Learning Tools. In G. Marreiros, F. S. Melo, N. Lau, H. Lopes Cardoso, & L. P. Reis (Eds.), *Progress in Artificial Intelligence* (Vol. 12981, pp. 97–108). Springer International Publishing. https://doi.org/10.1007/978-3-030-86230-5_8

Reinforcement Learning Based Energy Consolidation Model for Efficient Cloud Computing System. (2023). *Applied Mathematics & Information Sciences*, *17*(1), 67–77. https://doi.org/10.18576/amis/170109

Saranya, G., & Sasikala, E. (2023). An efficient computational offloading framework using HAA optimization-based deep reinforcement learning in edge-based cloud computing architecture. *Knowledge and Information Systems*, *65*(1), 409–433. https://doi.org/10.1007/s10115-022-01746-w

Saravanan, G., & Yuvaraj, N. (2021). Cloud resource optimization based on poisson linear deep gradient learning for mobile cloud computing. *Journal of Intelligent & Fuzzy Systems*, *40*(1), 787–797. https://doi.org/10.3233/JIFS-200799

Sarosh, A. (2021). Machine Learning Based Hybrid Intrusion Detection ForVirtualized Infrastructures In Cloud Computing Environments. *Journal of Physics: Conference Series*, *2089*(1), 012072. https://doi.org/10.1088/1742-6596/2089/1/012072

Shahidinejad, A., & Ghobaei-Arani, M. (2020). Joint computation offloading and resource provisioning for e DGE-CLOUD computing environment: A machine learning-based approach. *Software: Practice and Experience*, *50*(12), 2212–2230. https://doi.org/10.1002/spe.2888

Shylaja, B. S., & Bhaskar, R. (2020). Rough-set and machine learning-based approach for optimised virtual machine utilisation in cloud computing. *IET Networks*, *9*(6), 279–283. https://doi.org/10.1049/iet-net.2020.0001

Thabit, F., Can, O., Wani, R. U. Z., Qasem, M. A., Thorat, S. B., & Alkhzaimi, H. A. (2023). Data security techniques in cloud computing based on machine learning algorithms and cryptographic algorithms: Lightweight algorithms and genetics algorithms. *Concurrency and Computation: Practice and Experience*, *35*(21), e7691. https://doi.org/10.1002/cpe.7691

Wang, C. (2022). English Process Assessment Based on Deep Learning and Cloud Computing. *Wireless Communications and Mobile Computing*, *2022*, 1–10. https://doi.org/10.1155/2022/2631693

Xiao, Y., Yao, Y., Chen, K., Tang, W., & Zhu, F. (2022). A simulation task partition method based on cloud computing resource prediction using ensemble learning. *Simulation Modelling Practice and Theory*, *119*, 102595. https://doi.org/10.1016/j.simpat.2022.102595

Xu, C., Xu, C., Li, B., Li, S., & Li, T. (2023). Load-aware dynamic controller placement based on deep reinforcement learning in SDN-enabled mobile cloud-edge computing networks. *Computer Networks*, *234*, 109900. https://doi.org/10.1016/j.comnet.2023.109900

Zade, B. M. H., Javidi, M. M., & Mansouri, N. (2023). An improved Caledonian crow learning algorithm based on ring topology for security-aware workflow scheduling in cloud computing. *Peer-to-Peer Networking and Applications*, *16*(6), 2929–2984. https://doi.org/10.1007/s12083-023-01541-6