

REFERENCES

- [1] A. Klačnja-Milićević, B. Vesin, M. Ivanović, Z. Budimac, L. C. Jain, A. Klačnja-Milićević, B. Vesin, M. Ivanović, Z. Budimac, and L. C. Jain, "Introduction to e-learning systems," *E-learning systems: Intelligent techniques for personalization*, pp. 3–17, 2017.
- [2] T. Kattoua, M. Al-Lozi, and A. Alrowwad, "A review of literature on E-learning systems in higher education," *International Journal of Business Management and Economic Research*, vol. 7, no. 5, pp. 754–762, 2016.
- [3] H. Rana and M. Lal, "E-learning: Issues and challenges," *International Journal of Computer Applications*, vol. 97, no. 5, 2014.
- [4] S. Singh, "An analysis of factors responsible for the rapid growth of E-learning in india," *PalArch's Journal of Archaeology of Egypt/Egyptology*, vol. 17, no. 12, pp. 1454–1466, 2020.
- [5] M. V. Manickam, M. Mohanapriya, S. Kale, M. Uday, P. Kulkarni, Y. Khandagale, and S. P. Patil, "Research study on applications of artificial neural networks and E-learning personalization," *International Journal of Civil Engineering and Technology*, vol. 8, no. 8, pp. 1422–1432, 2017.
- [6] P. FRANEK, "Secure software development process and tools for android applications," Ph.D. dissertation, Masarykova univerzita, Fakulta informatiky, 2017.
- [7] N. Subashini, L. Udayanga, L. De Silva, J. Edirisinghe, and M. Nafla, "Undergraduate perceptions on transitioning into E-learning for continuation of higher education during the covid pandemic in a developing country: a cross-sectional study from sri lanka," *BMC Medical Education*, vol. 22, no. 1, pp. 1–12, 2022.
- [8] P. Haththotuwa and R. Rupasinghe, "Adapting to online learning in higher education system during the covid-19 pandemic: a case study of universities in sri lanka," *Sri Lanka Journal of Social Sciences and Humanities*, vol. 1, no. 2, pp. 147–152, 2021.
- [9] J. Larreamendy-Joerns and G. Leinhardt, "Going the distance with online education," *Review of educational research*, vol. 76, no. 4, pp. 567–605, 2006.
- [10] P. Qiao, X. Zhu, Y. Guo, Y. Sun, and C. Qin, "The development and adoption of online learning in pre-and post-covid-19: Combination of technological system evolution theory and unified theory of acceptance and use of technology," *Journal of Risk and Financial Management*, vol. 14, no. 4, p. 162, 2021.

- [11] M. Z. Hoq, "E-learning during the period of pandemic (covid-19) in the kingdom of saudi arabia: an empirical study," *American Journal of Educational Research*, vol. 8, no. 7, pp. 457–464, 2020.
- [12] J. Derrac, S. Garcia, L. Sanchez, and F. Herrera, "Keel data-mining software tool: Data set repository, integration of algorithms and experimental analysis framework," *J. Mult. Valued Logic Soft Comput*, vol. 17, 2015.
- [13] V. Cantoni, M. Cellario, and M. Porta, "Perspectives and challenges in E-learning: towards natural interaction paradigms," *Journal of Visual Languages & Computing*, vol. 15, no. 5, pp. 333–345, 2004.
- [14] Sunil and M. Doja, "An improved recommender system for E-learning environments to enhance learning capabilities of learners," in *Proceedings of ICETIT 2019: Emerging Trends in Information Technology*. Springer, 2020, pp. 604–612.
- [15] R. Kaur, D. Gupta, M. Madhukar, A. Singh, M. Abdelhaq, R. Alsaqour, J. Breñosa, and N. Goyal, "E-learning environment based intelligent profiling system for enhancing user adaptation," *Electronics*, vol. 11, no. 20, p. 3354, 2022.
- [16] M. M. Althobaiti and P. Mayhew, "Assessing the usability of learning management system: User experience study," in *E-learning, E-Education, and On-line Training: Second International Conference, eLEOT 2015, Novedrate, Italy, September 16-18, 2015, Revised Selected Papers 2*. Springer, 2016, pp. 9–18.
- [17] S. F. Abd Hamid, N. A. Bakar, N. Hussin *et al.*, "Information management in E-learning education," *International Journal of Academic Research in Business and Social Sciences*, vol. 7, no. 12, pp. 2222–6990, 2017.
- [18] S. Bhaskaran and P. Swaminathan, "Intelligent adaptive E-learning model for learning management system," *Research Journal of Applied Sciences, Engineering and Technology*, vol. 7, no. 16, pp. 3298–3303, 2014.
- [19] A. E. Amin, "An intelligent synchronous E-learning management system based on multi-agents of linked data, ontology, and semantic service," *International Journal of Intelligent Computing and Information Sciences*, vol. 19, no. 1, pp. 25–37, 2019.
- [20] A. Akram, M. Aslam, A. Martinez-Enriquez, Z. ul Qayyum, and A. Z. Syed, "Agent based intelligent learning management system for heterogeneous learning environment," in *2011 IEEE 14th International Multitopic Conference*. IEEE, 2011, pp. 76–81.

- [21] M. Rey-López, P. Brusilovsky, M. Meccawy, R. Díaz-Redondo, A. Fernández-Vilas, and H. Ashman, “Resolving the problem of intelligent learning content in learning management systems,” in *International Journal on E-learning*, vol. 7, no. 3. Association for the Advancement of Computing in Education (AACE), 2008, pp. 363–381.
- [22] H. B. Santoso, M. Schrepp, R. Isal, A. Y. Utomo, and B. Priyogi, “Measuring user experience of the student-centered E-learning environment.” *Journal of Educators Online*, vol. 13, no. 1, pp. 58–79, 2016.
- [23] B. A. Buhari and A. Roko, “An improved E-learning system,” *Saudi Journal of Engineering and Technology*, vol. 2, no. 2, pp. 114–118, 2017.
- [24] N. Partheeban and N. SankarRam, “E-learning management system using web services,” in *International Conference on Information Communication and Embedded Systems (ICICES2014)*. IEEE, 2014, pp. 1–7.
- [25] J. Zhang, F. Qiu, W. Wu, J. Wang, R. Li, M. Guan, and J. Huang, “E-learning behavior categories and influencing factors of stem courses: A case study of the open university learning analysis dataset (oulad),” *Sustainability*, vol. 15, no. 10, p. 8235, May 2023. [Online]. Available: <http://dx.doi.org/10.3390/su15108235>
- [26] T. D. Pham Thi and N. T. Duong, “E-learning behavioral intention among college students: A comparative study,” *Education and Information Technologies*, Mar. 2024. [Online]. Available: <http://dx.doi.org/10.1007/s10639-024-12592-4>
- [27] P. Zhang, “Understanding digital learning behaviors: Moderating roles of goal setting behavior and social pressure in large-scale open online courses,” *Frontiers in Psychology*, vol. 12, Nov. 2021. [Online]. Available: <http://dx.doi.org/10.3389/fpsyg.2021.783610>
- [28] F. Qiu, L. Zhu, G. Zhang, X. Sheng, M. Ye, Q. Xiang, and P.-K. Chen, “E-learning performance prediction: Mining the feature space of effective learning behavior,” *Entropy*, vol. 24, no. 5, p. 722, 2022.
- [29] K. Abhirami and M. Devi, “Student behavior modeling for an E-learning system offering personalized learning experiences.” *Computer Systems Science & Engineering*, vol. 40, no. 3, 2022.
- [30] M. Liu and D. Yu, “Towards intelligent E-learning systems,” *Education and Information Technologies*, vol. 28, no. 7, p. 7845–7876, Dec 2022.
- [31] M. N. Hasnine, H. T. Bui, T. T. T. Tran, H. T. Nguyen, G. Akçapınar, and H. Ueda, “Students’ emotion extraction and visualization for engagement detection in on-line learning,” *Procedia Computer Science*, vol. 192, pp. 3423–3431, 2021.

- [32] M. Liu and D. Yu, "Towards intelligent E-learning systems," *Education and Information Technologies*, vol. 28, no. 7, pp. 7845–7876, 2023.
- [33] K. P. Sinaga and M.-S. Yang, "Unsupervised k-means clustering algorithm," *IEEE Access*, vol. 8, pp. 80 716–80 727, 2020.
- [34] X. Chen, B. Li, R. Proietti, Z. Zhu, and S. J. B. Yoo, "Self-taught anomaly detection with hybrid unsupervised/supervised machine learning in optical networks," *Journal of Lightwave Technology*, vol. 37, no. 7, pp. 1742–1749, Apr. 2019. [Online]. Available: <https://doi.org/10.1109/jlt.2019.2902487>
- [35] N. Köhl, M. Goutier, L. Baier, C. Wolff, and D. Martin, "Human vs. supervised machine learning: Who learns patterns faster?" *Cognitive Systems Research*, vol. 76, pp. 78–92, Dec. 2022. [Online]. Available: <https://doi.org/10.1016/j.cogsys.2022.09.002>
- [36] A. Ashraf and M. G. Khan, "Effectiveness of data mining approaches to e-learning system: A survey," *NFC IEFR Journal of Engineering and Scientific Research*, vol. 4, 2017.
- [37] S. Trivedi and N. Patel, "Clustering students based on virtual learning engagement, digital skills, and E-learning infrastructure: Applications of k-means, db-scan, hierarchical, and affinity propagation clustering," *Sage Science Review of Educational Technology*, vol. 3, no. 1, pp. 1–13, 2020.
- [38] A. Moubayed, M. Injadat, A. Shami, and H. Lutfiyya, "Student engagement level in an E-learning environment: Clustering using k-means," *American Journal of Distance Education*, vol. 34, no. 2, pp. 137–156, Mar. 2020. [Online]. Available: <https://doi.org/10.1080/08923647.2020.1696140>
- [39] S. Kausar, X. Huahu, I. Hussain, Z. Wenhao, and M. Zahid, "Integration of data mining clustering approach in the personalized E-learning system," *IEEE Access*, vol. 6, pp. 72 724–72 734, 2018. [Online]. Available: <https://doi.org/10.1109/access.2018.2882240>
- [40] O. El Aissaoui, Y. E. A. El Madani, L. Oughdir, and Y. El Alloui, "Combining supervised and unsupervised machine learning algorithms to predict the learners' learning styles," *Procedia computer science*, vol. 148, pp. 87–96, 2019.
- [41] O. El Aissaoui, Y. El Madani El Alami, L. Oughdir, and Y. El Alloui, "A hybrid machine learning approach to predict learning styles in adaptive e-learning system," in *Advanced Intelligent Systems for Sustainable Development (AI2SD'2018) Volume 5: Advanced Intelligent Systems for Computing Sciences*. Springer, 2019, pp. 772–786.

- [42] D. PEROVIĆ, “Data mining influence on E-learning,” in *The Sixth International Conference on E-learning (eLearning-2015)*, 2015.
- [43] M. M. Al-Tarabily, R. F. Abdel-Kader, G. A. Azeem, and M. I. Marie, “Optimizing dynamic multi-agent performance in E-learning environment,” *IEEE access*, vol. 6, pp. 35 631–35 645, 2018.
- [44] O. El Aissaoui, Y. El Alami El Madani, L. Oughdir, and Y. El Alloui, “A fuzzy classification approach for learning style prediction based on web mining technique in E-learning environments,” *Education and Information Technologies*, vol. 24, pp. 1943–1959, 2019.
- [45] O. Gushchina and A. Ochepovsky, “Data mining of students’ behavior in e-learning system,” in *Journal of Physics: Conference Series*, vol. 1553, no. 1. IOP Publishing, 2020, p. 012027.
- [46] Y. M. Tashtoush, M. Al-Soud, M. Fraihat, W. Al-Sarayrah, and M. A. Alsmirat, “Adaptive E-learning web-based english tutor using data mining techniques and jackson’s learning styles,” in *2017 8th International Conference on Information and Communication Systems (ICICS)*. IEEE, 2017, pp. 86–91.
- [47] S. V. Kolekar, R. M. Pai, and M. P. MM, “Prediction of learner’s profile based on learning styles in adaptive E-learning system.” *International Journal of Emerging Technologies in Learning*, vol. 12, no. 6, 2017.
- [48] P. K. Udupi, N. Sharma, and S. Jha, “Educational data mining and big data framework for E-learning environment,” in *2016 5th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions)(ICRITO)*. IEEE, 2016, pp. 258–261.
- [49] K. Grigorova, E. Malysheva, and S. Bobrovskiy, “Application of data mining and process mining approaches for improving E-learning processes,” 2017, pp. 1952–1958.
- [50] B. Al Kurdi, M. Alshurideh, and S. A. Salloum, “Investigating a theoretical framework for E-learning technology acceptance,” *International Journal of Electrical and Computer Engineering (IJECE)*, vol. 10, no. 6, pp. 6484–6496, 2020.
- [51] F. Rasheed and A. Wahid, “Learning style detection in E-learning systems using machine learning techniques,” *Expert Systems with Applications*, vol. 174, p. 114774, 2021.
- [52] M. El Mabrouk, S. Gaou, and M. K. Rtili, “Towards an intelligent hybrid recommendation system for E-learning platforms using data mining,”

International Journal of Emerging Technologies in Learning (Online), vol. 12, no. 6, p. 52, 2017.

- [53] I. Bouchrika, N. Harrati, V. Wanick, and G. Wills, “Exploring the impact of gamification on student engagement and involvement with E-learning systems,” *Inter-active Learning Environments*, vol. 29, no. 8, pp. 1244–1257, 2021.
- [54] N. Harrati, I. Bouchrika, A. Tari, and A. Ladjailia, “Exploring user satisfaction for E-learning systems via usage-based metrics and system usability scale analysis,” *Computers in Human Behavior*, vol. 61, pp. 463–471, 2016.
- [55] J. Li, T. Tang, W. X. Zhao, and J.-R. Wen, “Pretrained language models for text generation: A survey,” *arXiv preprint arXiv:2105.10311*, 2021.
- [56] M. K. Afify, “E-learning content design standards based on interactive digital concepts maps in the light of meaningful and constructivist learning theory,” *JOTSE: Journal of Technology and Science Education*, vol. 8, no. 1, pp. 5–16, 2018.
- [57] K. Premlatha, B. Dharani, and T. Geetha, “Dynamic learner profiling and automatic learner classification for adaptive E-learning environment,” *Interactive Learning Environments*, vol. 24, no. 6, pp. 1054–1075, 2016.
- [58] Y. A. Gomaa, R. AbuRaya, and A. Omar, “The effects of information technology and E-learning systems on translation pedagogy and productivity of efl learners,” in *2019 International Conference on Innovation and Intelligence for Informatics, Computing, and Technologies (3ICT)*. IEEE, 2019, pp. 1–6.
- [59] E. Baralis and L. Cagliero, “Learning from summaries: Supporting E-learning activities by means of document summarization,” *IEEE Transactions on Emerging Topics in Computing*, vol. 4, no. 3, pp. 416–428, 2015.
- [60] et al. Gunathilaka and, “Individual learning path personalization approach in a virtual learning environment according to the dynamically changing learning styles and knowledge levels of the learner,” *International Journal of ADVANCED AND APPLIED SCIENCES*, vol. 5, no. 5, pp. 10–19, May 2018. [Online]. Available: <https://doi.org/10.21833/ijaas.2018.05.002>
- [61] M. J. Hazar, M. Zrigui, and M. Maraoui, “Learner comments-based recommendation system,” *Procedia Computer Science*, vol. 207, pp. 2000–2012, 2022.
- [62] P. Okoro, “Upholding integrity in the management of E-learning in institutions of higher learning,” *EPRA International Journal of Multidisciplinary Research (IJMR)*, vol. 8, no. 8, pp. 301–305, 2022.

- [63] G. A. A. J. Alkubaisi, N. S. Al-Saifi, and A. R. Al-Shidi, "Recommended improvements for online learning platforms based on users' experience in the sultanate of oman," *Higher Education*, vol. 12, no. 3, 2022.
- [64] A. Ouatiq, K. El-Guemmat, K. Mansouri, and M. Qbadou, "A design of a multi-agent recommendation system using ontologies and rule-based reasoning: pandemic context." *International Journal of Electrical & Computer Engineering (2088-8708)*, vol. 12, no. 1, 2022.
- [65] P. K. Balasamy and K. Athiyappagounder, "An optimized feature selection method for E-learning recommender system using deep neural network based on multilayer perceptron," *International Journal of Intelligent Engineering and System-tem*, vol. 15, no. 5, p. 461, 2022.
- [66] R. Marappan and S. Bhaskaran, "Analysis of recent trends in E-learning personalization techniques," *The Educational Review, USA*, vol. 6, no. 5, pp. 167–170, 2022.
- [67] F. S. Tseng, C.-T. Yeh, and A. Y. Chou, "A collaborative framework for customized E-learning services by analytic hierarchy processing," *Applied Sciences*, vol. 12, no. 3, p. 1377, 2022.
- [68] O. Bourkoukou and E. El Bachari, "A big-data oriented recommendation method in E-learning environment." *International Journal of Emerging Technologies in Learning*, vol. 17, no. 10, 2022.
- [69] Z. Shahbazi and Y.-C. Byun, "Agent-based recommendation in E-learning environment using knowledge discovery and machine learning approaches," *Mathematics*, vol. 10, no. 7, p. 1192, 2022.
- [70] W. Bagunaid, N. Chilamkurti, and P. Veeraraghavan, "Aisar: Artificial intelligence-based student assessment and recommendation system for E-learning in big data," *Sustainability*, vol. 14, no. 17, p. 10551, 2022.
- [71] S. Reddy, I. Labutov, and T. Joachims, "Latent skill embedding for personalized lesson sequence recommendation," *arXiv preprint arXiv:1602.07029*, 2016.
- [72] V. Gonzalez-Barbone and L. Anido-Rifon, "From scorm to common cartridge: A step forward," *Computers & Education*, vol. 54, no. 1, pp. 88–102, 2010.
- [73] Y.-H. Shen, "Design of digital network shared learning platform based on scorm standard." *International Journal of Emerging Technologies in Learning*, vol. 13, no. 7, 2018.

- [74] A. Kirkova-Bogdanova, “Standards in E-learning. scorm,” *KNOWLEDGE-International Journal*, vol. 47, no. 3, pp. 473–477, 2021.
- [75] B. Standl, “A web-application for building common cartridge learning objects,” in *EdMedia+ Innovate Learning*. Association for the Advancement of Computing in Education (AACE), 2013, pp. 1461–1466.
- [76] D. Udugahapattuwa and M. Fernando, “A model for enhancing user experience in an E-learning system: A review on student behavior and content formatting,” in *2023 7th SLAAI International Conference on Artificial Intelligence (SLAAI-ICAI)*. IEEE, 2023, pp. 1–6.
- [77] D. P. D. Udugahapattuwa and M. S. D. Fernando, “An intelligent model to enhance user experience in e-learning systems,” in *2024 International Research Conference on Smart Computing and Systems Engineering (SCSE)*, IEEE, Apr, 2024.
- [78] “moviepy — pypi.org,” <https://pypi.org/project/moviepy/>, [Accessed 31-01-2024].
- [79] V. Lempitsky, A. Vedaldi, and D. Ulyanov, “Deep image prior,” *2018 IEEE/CVF Conference on Computer Vision and Pattern Recognition*, Jun 2018.
- [80] A. Alokla, W. Gad, W. Nazih, M. Aref, and A.-b. Salem, “Pseudocode generation from source code using the bart model,” *Mathematics*, vol. 10, no. 21, p. 3967, Oct 2022.
- [81] [Online]. Available: <https://openai.com/blog/openai-api>
- [82] H. Hosseini, B. Xiao, and R. Poovendran, “Google’s cloud vision API is not robust to noise,” in *2017 16th IEEE International Conference on Machine Learning and Applications (ICMLA)*. IEEE, Dec. 2017.