

ACKNOWLEDGMENT

This work was supported by the National Research Foundation of Korea Grant funded by the Korean Government (NRF-2018R1D1A1B07045838) and by Hankuk University of Foreign Studies Research Fund of 2021. The author to whom correspondence should be addressed is ChangHak Moon.

REFERENCES

- [1] S. ElMassah and M. Mohieldin, "Digital transformation and localizing the Sustainable Development Goals (SDGs)," *Ecological Economics*, vol. 169, p. 106490, 2020, doi: <https://doi.org/10.1016/j.ecolecon.2019.106490>.
- [2] J. Kaur, R. Shedge, and B. Joshi, "Survey of Big Data Warehousing Techniques," *Inventive Communication and Computational Technologies*. Springer Singapore, Singapore, pp. 471–481, 2020.
- [3] H. B. Santoso and P. O. H. Putra, "Bridging the Gap between IT Graduate Profiles and Job Requirements: A Work in Progress," 2017 7th World Engineering Education Forum (WEEF). pp. 145–148, 2017, doi: [10.1109/WEEF.2017.8467146](https://doi.org/10.1109/WEEF.2017.8467146).
- [4] M. H. ur Rehman, I. Yaqoob, K. Salah, M. Imran, P. P. Jayaraman, and C. Perera, "The role of big data analytics in industrial Internet of Things," *Future Generation Computer Systems*, vol. 99, pp. 247–259, 2019, doi: <https://doi.org/10.1016/j.future.2019.04.020>.
- [5] S. Kim and H. Y. Kim, "A Computational Thinking Curriculum and Teacher Professional Development in South Korea," in *Computational Thinking in the STEM Disciplines: Foundations and Research Highlights*, M. S. Khine, Ed. Cham: Springer International Publishing, 2018, pp. 165–178.
- [6] A. Pürbudak and E. Usta, "Collaborative group activities in the context of learning styles on web 2.0 environments: An experimental study," *Participatory Educational Research*, vol. 8, no. 2, pp. 407–420, 2021, doi: [10.17275/per.21.46.8.2](https://doi.org/10.17275/per.21.46.8.2).
- [7] S. Siva, T. Im, T. McKlin, J. Freeman, and B. Magerko, "Using Music to Engage Students in an Introductory Undergraduate Programming Course for Non-Majors," *Proceedings of the 49th ACM Technical Symposium on Computer Science Education*. ACM, Baltimore, Maryland, USA, pp. 975–980, 2018, doi: [10.1145/3159450.3159468](https://doi.org/10.1145/3159450.3159468).
- [8] P. Dempster, D. Onah, and L. Blair, "Increasing academic diversity and inter-disciplinarity of Computer Science in Higher Education," *Proceedings of the 4th Conference on Computing Education Practice 2020*. Association for Computing Machinery, Durham, United Kingdom, p. Article 10, 2020, doi: [10.1145/3372356.3372366](https://doi.org/10.1145/3372356.3372366).
- [9] A. v Arzhanovskaya, E. A. Eltanskaya, and L. M. Generalova, "Convergence of Technologies in Education: New Determinant of the Society Development," *Lecture Notes in Networks and Systems*, vol. 155. Springer Science and Business Media Deutschland GmbH, Volgograd State University, Volgograd, Russian Federation, pp. 619–624, 2021, doi: [10.1007/978-3-030-59126-7_69](https://doi.org/10.1007/978-3-030-59126-7_69).
- [10] R. F. DeMara, T. Tian, and W. Howard, "Engineering assessment strata: A layered approach to evaluation spanning Bloom's taxonomy of learning," *Education and Information Technologies*, vol. 24, no. 2, pp. 1147–1171, 2019, doi: [10.1007/s10639-018-9812-5](https://doi.org/10.1007/s10639-018-9812-5).
- [11] J. Q. Dawson, M. Allen, A. Campbell, and A. Valair, "Designing an Introductory Programming Course to Improve Non-Majors' Experiences," *Proceedings of the 49th ACM Technical Symposium on Computer Science Education*. Association for Computing Machinery, Baltimore, Maryland, USA, pp. 26–31, 2018, doi: [10.1145/3159450.3159548](https://doi.org/10.1145/3159450.3159548).
- [12] A. Mohamed, "Designing a CS1 Programming Course for a Mixed-Ability Class," *Proceedings of the Western Canadian Conference on Computing Education*. Association for Computing Machinery, Calgary, AB, Canada, p. Article 8, 2019, doi: [10.1145/3314994.3325084](https://doi.org/10.1145/3314994.3325084).
- [13] H.-C. Hung, I.-F. Liu, C.-T. Liang, and Y.-S. Su, "Applying Educational Data Mining to Explore Students' Learning Patterns in the Flipped Learning Approach for Coding Education," *Symmetry*, vol. 12, no. 2, p. 213, 2020, [Online]. Available: <https://www.mdpi.com/2073-8994/12/2/213>.
- [14] J. S. Saltz and I. Shamshurin, "Exploring pair programming beyond computer science: a case study in its use in data science/data engineering," *International Journal of Higher Education and Sustainability*, vol. 2, no. 4, pp. 265–278, 2019, doi: [10.1504/IJHES.2019.103360](https://doi.org/10.1504/IJHES.2019.103360).
- [15] T. Ketenci, B. Calandra, L. Margulieux, and J. Cohen, "The Relationship Between Learner Characteristics and Student Outcomes in a Middle School Computing Course: An Exploratory Analysis Using Structural Equation Modeling," *Journal of Research on Technology in Education*, vol. 51, no. 1, pp. 63–76, 2019, doi: [10.1080/15391523.2018.1553024](https://doi.org/10.1080/15391523.2018.1553024).
- [16] A. Alammery, "Blended learning models for introductory programming courses: A systematic review," *PloS one*, vol. 14, no. 9, pp. 1–26, 2019, doi: [10.1371/journal.pone.0221765](https://doi.org/10.1371/journal.pone.0221765).
- [17] P. Atzeni, F. Bugiotti, L. Cabibbo, and R. Torlone, "Data modeling in the NoSQL world," *Computer Standards & Interfaces*, vol. 67, p. Article 103149, 2020, doi: <https://doi.org/10.1016/j.csi.2016.10.003>.
- [18] A. I. Sanka, M. H. Chowdhury, and R. C. C. Cheung, "Efficient High-Performance FPGA-Redis Hybrid NoSQL Caching System for Blockchain Scalability," *Computer Communications*, vol. 169, pp. 81–91, 2021, doi: [10.1016/j.comcom.2021.01.017](https://doi.org/10.1016/j.comcom.2021.01.017).
- [19] M. T. Özsu and P. Valduriez, "NoSQL, NewSQL, and Polystores," in *Principles of Distributed Database Systems*, M. T. Özsu and P. Valduriez, Eds. Cham: Springer International Publishing, 2020, pp. 519–557.
- [20] I. Astrova, A. Koschel, N. Wellermann, and P. Klostermeyer, "Performance Benchmarking of NewSQL Databases with Yahoo Cloud Serving Benchmark," vol. 1289. Springer Science and Business Media Deutschland GmbH, Department of Software Science, School of IT, Tallinn University of Technology, Akadeemia Tee 21, Tallinn, 12618, Estonia, pp. 271–281, 2021, doi: [10.1007/978-3-030-63089-8_17](https://doi.org/10.1007/978-3-030-63089-8_17).
- [21] R. R. Asaad, H. B. Ahmad, and R. I. Ali, "A Review: Big Data Technologies with Hadoop Distributed Filesystem and Implementing M/R," *Academic Journal of Nawroz University*, vol. 9, no. 1, 2020, [Online]. Available: <http://journals.nawroz.edu.krd/index.php/ajnu/article/view/530>.
- [22] B. Elghadyry, F. Ouardi, and S. Verel, "Composition of weighted finite transducers in MapReduce," *Journal of Big Data*, vol. 8, no. 1, 2021, doi: [10.1186/s40537-020-00397-4](https://doi.org/10.1186/s40537-020-00397-4).
- [23] G. Cheng, S. Ying, B. Wang, and Y. Li, "Efficient Performance Prediction for Apache Spark," *Journal of Parallel and Distributed Computing*, vol. 149, pp. 40–51, 2021, doi: [10.1016/j.jpdc.2020.10.010](https://doi.org/10.1016/j.jpdc.2020.10.010).
- [24] D. Lunga, J. Gerrand, L. Yang, C. Layton, and R. Stewart, "Apache Spark Accelerated Deep Learning Inference for Large Scale Satellite Image Analytics," *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, vol. 13, pp. 271–283, 2020, doi: [10.1109/JSTARS.2019.2959707](https://doi.org/10.1109/JSTARS.2019.2959707).
- [25] J. I. Requeno, J. Merseguer, S. Bernardi, D. Perez-Palacin, G. Giotis, and V. Papanikolaou, "Quantitative Analysis of Apache Storm Applications: The NewsAsset Case Study," *Information Systems Frontiers*, vol. 21, no. 1, pp. 67–85, 2019, doi: [10.1007/s10796-018-9851-x](https://doi.org/10.1007/s10796-018-9851-x).
- [26] A. Muhammad and M. Aleem, "A3-Storm: topology-, traffic-, and resource-aware storm scheduler for heterogeneous clusters," *Journal of Supercomputing*, vol. 77, no. 2, pp. 1059–1093, 2021, doi: [10.1007/s11227-020-03289-9](https://doi.org/10.1007/s11227-020-03289-9).
- [27] A. Katiyar et al., "Timestamp Anomaly Detection Using IBM Watson IoT Platform," 2020, pp. 771–782.
- [28] K. Khalil et al., "Cognitive Computing for Human-Machine Interaction: An IBM Watson Implementation," vol. 1201 AISC. Springer, School of Mechanical and Manufacturing Engineering (SMME), National University of Sciences and Technology (NUST), H-12, Islamabad, 44000, Pakistan, pp. 400–406, 2021, doi: [10.1007/978-3-030-51041-1_53](https://doi.org/10.1007/978-3-030-51041-1_53).