

intelligent algorithms and approaches have to be exploited. Multi-agent technology offers effective tools for modelling real systems and environments where the adaptability to current needs is a crucial issue. The proposed framework uses agents for modelling the scaffolding support services in terms of skills, knowledge and concept understanding. The initial tested model supports two different student performance levels (acceptable-H or not acceptable-L) and thus the adaptability grade is not high. This limitation can be simply overcome if the student performance is described with more grade levels. The proposed framework tries to support effectively the dynamic adaptive computer based scaffolding. Moreover, adaptive learning-scaffolding has to offer much more than traditional e-learning due to the fact that such a system can be trained to be adapted more accurately in different and unique student profiles and needs. Finally, this paper constitutes a basic background knowledge in the scientific area for investigating further the implementation and the future of such a framework.

REFERENCES

- [1] Wood, D., Bruner, J., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 17, 89–100.
- [2] Puntambekar, S., & Hubscher, R. (2005). Tools for scaffolding students in a complex learning environment: what have we gained and what have we missed? *Educational Psychologist*, 40(1), 1–12.
- [3] Molenaar, I., & Roda, C. (2008). Attention management for dynamic and adaptive scaffolding. *Pragmatics & Cognition*, 16(2), 224–271.
- [4] Belland, B.R. (2017). *Instructional Scaffolding in STEM Education Strategies and Efficacy Evidence*. Springer
- [5] Proske, A., & Narciss, S. (2012). Computer-based scaffolding to facilitate students' development of expertise in academic writing. *Journal of Research in Reading*, 35(2), 136-152
- [6] Kim, N. J., et al. (2018). Effectiveness of Computer-Based Scaffolding in the Context of Problem-Based Learning for STEM Education: Bayesian Meta-Analysis. *Educational Psychology Review*, 30(2), 397-429
- [7] Molenaar, I., et al. (2012). Dynamic scaffolding of socially regulated learning in a computer-based learning environment, *Computers & Education*, 59, 515-523
- [8] Rashid, A.H., et al. (2016). Using Computer-based Scaffolding to Improve Students' Reasoning Skills in Collaborative Learning, ICEED
- [9] Hu, L.-L., Tseng, S.-S. (2018). Building an e-PBL Platform for the Collaborative Design in Capstone Project WSEAS TRANSACTIONS on INFORMATION SCIENCE and APPLICATIONS, pp.7-17, Volume 15
- [10] Maes, P. (1995). Artificial Life Meets Entertainment: Life like Autonomous Agents. *Communications of the ACM*, 38 (11), 108-114.
- [11] Smith, D.C. (1994). KidSim: Programming Agents Without a Programming Language. *Communications of the ACM*, 37 (7), 55-67.
- [12] Hayes-Roth, B. (1995). An Architecture for Adaptive Intelligent Systems. *Artificial Intelligence: Special Issue on Agents and Interactivity*, 72, 329-365.
- [13] Nobel Khandaker, N. & Soh, L-K. (2009). Multiagent Simulation of Collaboration and Scaffolding of a CSCL Environment. University of Nebraska–Lincoln, Computer Science and Engineering, Technical Report TR-UNL-CSE-2009-0002, (6)
- [14] Basu, S. et al. (2015). A Scaffolding Framework to Support Learning of Emergent Phenomena Using Multi-Agent-Based Simulation Environments. *Res Sci Educ*, Springer, 45,293–324
- [15] Khosravifar, B. et al. (2013). Adaptive multi-agent architecture to track students' self-regulated learning. *CEUR Workshop Proceedings*. 1009. 49-52.
- [16] Splunter, S., et al. (2003). Structuring Agents for Adaptation. In E. Alonso et al. (Eds.), *Adaptive Agents and Multi-Agent Systems* (pp. 174-186), LNAI, Vol. 2636.
- [17] Russell, S., & Norvig, P. (2002). *Artificial Intelligence: A Modern Approach* (2nd ed.). Prentice Hall.
- [18] Huhns, M., & Singh, M. (Eds.). (1998). *Agents and Multiagent Systems: Themes, Approaches, and Challenges*. Readings in Agents, (pp. 1-23). USA: Morgan Kaufmann Publishers.
- [19] Norman, T., & Long, D. (1995). *Goal Creation in Motivated Agents*. Wooldridge, [21] Jennings (Eds.), *Intelligent Agents: Theories, Architectures, and Languages* (LNAI Volume 890).
- [20] Ekdahl, B. (2001). How Autonomous is an Autonomous Agent? *Proceedings of the 5th Conference on Systemic, Cybernetics and Informatics (SCI 2001)*. Orlando, USA.
- [21] Jennings, N.R. (2000). On agent-base software engineering. *Artificial Intelligence*, 117, 277-296.
- [22] Sycara, K. (1998). Multi-Agent Systems. *Artificial Intelligence Magazine*, 19(2).
- [23] Papazoglou, P.M., et al. (2009). On Cellular Network Channels Data Mining and Decision Making through Ant Colony Optimization and Multi Agent Systems Strategies”, *Advances in Data Mining. Applications and Theoretical Aspects*, LNCS, Springer