IEEE Access • Open Access • Volume 11, Pages 48392 - 48409 • 2023

Personalized Adaptive Learning Technologies Based on Machine Learning Techniques to Identify Learning Styles: A Systematic Literature Review

Essa, Saadia Gutta[a, b] ; Celik, Turgay[a, c];
Human-Hendricks, Nadia Emelia[d]
Save all to author list

[a] University of the Witwatersrand, School of Electrical and Information Engineering, Johannesburg, 2000, South Africa
[b] Tshwane University of Technology, Department of Computer Science, Polokwane, 0700, South Africa
[c] University of Agder, Faculty of Engineering and Science, Kristiansand, 4630, Norway
[d] Tshwane University of Technology, Curriculum Development and Support, Pretoria, 0183, South Africa

Document type
Article • *Gold Open Access*
Source type
Journal
ISSN
21693536
DOI
10.1109/ACCESS.2023.3276439

Abstract

Artificial intelligence (AI) approaches have been used in personalised adaptive education systems to overcome the limitations of statically determined learning styles (LSs). These approaches utilise algorithms from machine learning (ML) to tackle the challenge of personalising e-learning by mapping students' behavioural attributes to a particular LS automatically and dynamically to optimise the individual learning process. Motivated by the many influential studies in this field and the current developments in ML and AI, a comprehensive systematic literature review was conducted from 2015 to 2022. Influential scientific literature was analysed to identify the emerging trends and gaps in the literature in terms of LS models and possible ML techniques employed for personalised adaptive learning platforms. The outcomes of this paper include a review and analysis of the current trends of this emerging field in terms of the applications and developments in using ML approaches to implement more intelligent and adaptive e-learning environments to detect learners' LSs automatically for enhancing learning. In addition, the following issues were also investigated: the platforms that stimulated research; identifying LS models utilised in e-learning; the evaluation methods used; and the learning supports provided. The results indicated an increasing interest in using artificial neural network approaches to identify LSs. However, limited work has been conducted on the comparison of deep learning methods in this context. The findings suggest the need to consider and stimulate further empirical investigation in documenting the adoption and comparison of deep learning algorithms in classifying LSs to provide higher adaptability. © 2013 IEEE.

Author keywords

Artificial intelligence; e-learning; learning style; machine learning; personalized adaptive learning; systematic literature review

Goals 2023

SciVal Topics

Metrics

67 Maaliw, R.R.

A Personalized Virtual Learning Environment Using Multiple Modeling Techniques

(2021) *2021 IEEE 12th Annual Ubiquitous Computing, Electronics and Mobile Communication Conference, UEMCON 2021*, pp. 8-15. Cited 4 times.
http://ieeexplore.ieee.org.mapua.idm.oclc.org/xpl/mostRecentIssue.jsp?punumber=9666478
ISBN: 978-166540690-1
doi: 10.1109/UEMCON53757.2021.9666645

View at Publisher

68 Kolekar, S.V., Pai, R.M., Manohara Pai, M.M.

Adaptive User Interface for Moodle based E-learning System using Learning Styles (Open Access)

(2018) *Procedia Computer Science*, 135, pp. 606-615. Cited 49 times.
http://www.sciencedirect.com.mapua.idm.oclc.org/science/journal/18770509
doi: 10.1016/j.procs.2018.08.226

View at Publisher

Sustainable Development Goals 2023

SciVal Topics

Metrics

69 Abdullah, M., Daffa, W.H., Bashmail, R.M., Alzahrani, M., Sadik, M.
The impact of learning styles on learner's performance in e-learning environment
(2015) *Int. J. Adv. Comput. Sci. Appl.*, 6 (9), pp. 24-31. Cited 27 times.

70 Christudas, B.C.L., Kirubakaran, E., Thangaiah, P.R.J.

An evolutionary approach for personalization of content delivery in e-learning systems based on learner behavior forcing compatibility of learning materials

(2018) *Telematics and Informatics*, 35 (3), pp. 520-533. Cited 51 times.
https://www.journals.elsevier.com/telematics-and-informatics
doi: 10.1016/j.tele.2017.02.004

View at Publisher

Sustainable Development Goals 2023

SciVal Topics

Metrics

71 El Aissaoui, O., El Madani El Alami, Y., Oughdir, L., El Allioui, Y.

Integrating web usage mining for an automatic learner profile detection: A learning styles-based approach

(2018) *2018 International Conference on Intelligent Systems and Computer Vision, ISCV 2018*, 2018-May, pp. 1-6. Cited 20 times.
http://ieeexplore.ieee.org.mapua.idm.oclc.org/xpl/mostRecentIssue.jsp?punumber=8351627
ISBN: 978-153864396-9
doi: 10.1109/ISACV.2018.8354021

View at Publisher

Sustainable Development Goals 2023

SciVal Topics

Metrics

72 El Aissaoui, O., El Alami El Madani, Y., Oughdir, L., El Allioui, Y.

A fuzzy classification approach for learning style prediction based on web mining technique in e-learning environments

(2019) *Education and Information Technologies*, 24 (3), pp. 1943-1959. Cited 38 times.
http://www.kluweronline.com/issn/1360-2357
doi: 10.1007/s10639-018-9820-5

View at Publisher

73 Ferreira, L.D., Spadon, G., Carvalho, A.C., Rodrigues, J.F.

A comparative analysis of the automatic modeling of Learning Styles through Machine Learning techniques

(2019) *Proceedings - Frontiers in Education Conference, FIE*, 2018-October, art. no. 8659191. Cited 8 times.
ISBN: 978-153861173-9
doi: 10.1109/FIE.2018.8659191

View at Publisher

Sustainable Development Goals 2023

SciVal Topics

74 Hidayat, A., Adi, K., Surarso, B.