

Editorial Preface

Emerging Information Technology Trends

Francisco José García-Peñalvo, Computer Science Department Research Institute for Educational Sciences, GRIAL Research Group, University of Salamanca, Spain

Recently from JITR scope, the book “Global Implications of Emerging Technology Trends” has been published (García-Peñalvo, 2018b). It is focused on the Information Technology Research as a fully multicultural, multidisciplinary and interdisciplinary research filed, which has a broad scope of application areas, with the aim to face up the complex Knowledge Society problems and challenges we currently have to solve (García-Peñalvo, 2014, 2015b, 2015c, 2013) and several JITR authors have participated in its contents.

The book comprises fourteen chapters that are organized in three main sections: information, media and coding literacy (Lee & So, 2014; National Research Council Committee on Information Technology Literacy, 1999; Vee, 2013), educational and learning technologies (Herold, 2016; Robinson, Molenda, & Rezabek, 2008; Spector, 2015) and data-driven intelligent ecosystems (Bogdanova & Ackovska, 2010; Cruz-Benito, Therón, & García-Peñalvo, 2016).

Information literacy may be defined as the capacity of people to recognize their information needs; locate and evaluate que quality of information; store and retrieve information; make effective and ethical use of information; and apply information to create and communicate knowledge (Catts & Lau, 2008), or the ability to recognize the need for information and knowing how to access, evaluate, synthesize and communicate it (Moeller, Joseph, Lau, & Carbo, 2011).

This situation presents an increasing approach for introduce digital or information technology (IT) literacy from the early beginning of the individual development (Bers, Flannery, Kazakoff, & Sullivan, 2014; Kazakoff & Bers, 2012; Pinto-Llorente, Casillas-Martín, Cabezas-González, & García-Peñalvo, 2017). The most frequent approach to teaching digital literacy has been to gradually encourage the learning of programming, and the term code-literacy (diSessa, 2000; Prensky, 2008) has been coined to referer the process of teaching children programming tasks, from the simplest and most entertaining to the most complex.

A code-literate person means that can read and write in programming languages (Román-González, 2014), computational thinking is referred to the underlying problem-solving cognitive process that allows it. Thus, coding is a key way to enable computational thinking (García-Peñalvo & Mendes, 2018; Lye & Koh, 2014) and computational thinking may be applied to various kinds of problems that do not directly involve coding tasks (García-Peñalvo, 2016c; García-Peñalvo & Cruz-Benito, 2016; García-Peñalvo, Reimann, Tuul, Rees, & Jormanainen, 2016; Wing, 2006). An example of this is TACCLE 3 – Coding European Project that is devoted to promoting computational thinking and coding in pre-university studies, especially in primary schools, all around Europe (García-Peñalvo, 2016a; García-Peñalvo, Hughes, et al., 2016; TACCLE 3 Consortium, 2017), taking into account the teacher training (Villalba Condori, 2018; Villalba Condori, Castro Cuba, Deco, Bender, & García-Peñalvo, 2017).

Educational technology is defined as the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources (Richey, 2008).

Taking this into account, educational technology is an inclusive term for both the material tools and the theoretical foundations for supporting learning and teaching, thus it refers to all valid and reliable applied education sciences, such as equipment, as well as processes and procedures that are derived from scientific research, and in a given context may refer to theoretical, algorithmic or heuristic processes. This means that educational technology is not restricted to high technology and is anything that enhances learning in a blended or online context (García-Peñalvo, 2015a; Herold, 2016).

Nevertheless, a modern notion of technology education means electronic and plays an important role in current society (Selwyn, 2011). Education technology or EdTech, refers to an area of technology devoted to the development and application of tools (including software, hardware, and processes) intended to promote education (Lazaro, 2014).

Educational technology encompasses different approaches in the literature: eLearning (García-Peñalvo & Seoane-Pardo, 2015; Gros & García-Peñalvo, 2016), instructional technology (Molenda, 1997), information and communication technology (ICT) in education (García-Peñalvo, 2008a), EdTech (Lazaro, 2014), learning technology (Berlanga & García-Peñalvo, 2005a, 2005b), multimedia learning (García-Peñalvo & García Carrasco, 2005), technology-enhanced learning (TEL) (Kirkwood & Price, 2014), computer-based instruction (CBI) (Kulik & Kulik, 1991), computer managed instruction (Day & Payne, 1987), computer-based training (CBT) (Williams & Zahed, 1996), computer-assisted instruction or computer-aided instruction (CAI) (Suppes & Morningstar, 1969), Internet-based training (IBT) or Web-based training (WBT) (Driscoll, 1997), flexible learning (Hill, 2006), virtual education, online education or digital education (García-Peñalvo, 2008b; Seoane Pardo & García-Peñalvo, 2014), collaborative learning (Dillenbourg, 1999a, 1999b), distributed learning (Oblinger & Maruyama, 1996), computer-mediated communication (Walther, 1996), cyberlearning (Frechette, 2006), multi-modal instruction (Steil, Röthling, Haschke, & Ritter, 2004), personal learning environments (Wilson et al., 2007), networked learning (Goodyear, 2005), virtual learning environments (VLE) or learning platforms (García-Peñalvo & García Carrasco, 2002), m-learning (Casany et al., 2012; Ramírez-Montoya & García-Peñalvo, 2017; Sánchez-Prieto, Olmos-Migueláñez, & García-Peñalvo, 2014), ubiquitous learning (Conde González, Muñoz Martín, & García-Peñalvo, 2008; Joo-Nagata, Martínez Abad, García-Bermejo Giner, & García-Peñalvo, 2017; Yang, 2006) and Massive Open On-line Courses (MOOC) (García-Peñalvo, 2015d; García-Peñalvo, Fidalgo-Blanco, & Sein-Echaluze, 2018; López Meneses, Vázquez-Cano, & Román Graván, 2015; Martínez Abad, Rodríguez Conde, & García-Peñalvo, 2014; Martínez-Núñez, Borrás-Gene, & Fidalgo-Blanco, 2016).

A technological ecosystem is a metaphor to express a needed evolution of the traditional information systems (García-Peñalvo, 2016b, 2018a). These are solutions based on the composition of different software components and services that share a set of semantically defined data flows. The result is a complex ecosystem that provides a set of services that each component separately does not offer and is able to evolve as a whole in a better way when its components does or when some components are dropped out or when new components are included. Moreover, the technological ecosystem is thought to offer a better user experience in the way that users are also part or components of the ecosystem.

The internal structure of the technological ecosystems is more complex than a traditional information system (García-Holgado & García-Peñalvo, 2017a, 2017b), this implies that these solutions should be taken into account in those cases in which the knowledge management (Fidalgo-Blanco, Sein-Echaluze, & García-Peñalvo, 2014, 2015; Rubio Royo, Cranfield McKay, Nelson-Santana, Delgado Rodríguez, & Ocon-Carreras, 2018) and solution-making processes are based on heterogeneous and complex data-driven architectures (García-Peñalvo et al., 2015).

The technological ecosystem metaphor comes from the Biology field and it has been transferred into software development because it reflects so well the evolutionary nature of software. There

are several authors that use the definition of natural ecosystem to support their own technological ecosystem definition systems (W. Chen & Chang, 2007; Dhungana, Groher, Schludermann, & Biffli, 2010; Mens, Claes, Grosjean, & Serebrenik, 2014; Yu & Deng, 2011). This way, a technological ecosystem may be defined through a mapping with the main elements that appear in every natural ecosystem (García-Holgado & García-Peñalvo, 2014, 2016), i.e., the organisms or biotic factors, the physical environment in which they inhabit or abiotic factors and the relationships between organisms and organisms with the environment. Specifically, within a technological ecosystem there are a set of persons and software components that represent the role of the biotic factors; a set of elements that allow that ecosystem runs (hardware, communications, etc.), these are the abiotic factors; and a set of data flows that mean the relationships among the software components and among these components and the involved users (Cruz-Benito et al., 2018).

This JITR issue is comprises ten research papers.

Chen et al. (2018) model a multilevel object template set that can be stratified by different updating time spans in order to solve visual tracking problems by linearly representing objects with a few templates.

Balasaraswathi and Kalpana (2018) present a technique that performs classification on huge data using PSO.

Krishna Kumar Mohbey (2018) uses utility as the preference of the accessed mobile web services. In particular, the proposed approach obtains more accurate and filtered mobile web service sequences. The experimental results show that the proposed approach has a good performance in terms of execution efficiency and memory utilization.

Kumar and Kumar (2018) investigate the initial center selection process for the categorical data and after that present a new support based initial center selection algorithm. The proposed algorithm measures the weight of unique data points of an attribute with the help of support and then integrates these weights along the rows, to get the support of every row. Further, a data object having the largest support is chosen as an initial center followed by finding other centers that are at the greatest distance from the initially selected center.

Chandani and Gupta (2018) have the objective to make requirement analysis phase exhaustive by estimating risk at requirement level using requirement defect information and execution flow dependency as early as possible to inhibit them from being incorporated in design and implementation. The proposed approach works as a two-fold process which computes risk involved with each requirement twice. The whole process is divided into a three-layered framework to finalize requirements with clear vision and scope of a project.

Vidyarathi and Jha (2018) apply a hybrid heuristic using College Admission Problem and Analytical Hierarchical Process for stable matching of the users' job with cloud's virtual machine.

Suruchi Chawla (Chawla, 2018) proposes a method that uses hybrid of genetic algorithm and trust for generating the optimal ranking of trusted clicked URLs for web page recommendations.

Gupta and Gupta (2018) present a systematic approach to prioritize requirements and estimate risk associated with each requirement. It first aims at providing a short training to both developers and stakeholders to bridge the gap of understanding and comprehending requirements so that a refined priority value for each requirement can be obtained. Secondly, it presents a requirement risk and re-prioritization estimation model to make sure that a right decision has been taken by stakeholder and developers.

Kumar and Sarkar (2018) have designed a hybrid prediction model for medical domain data sets by combining the decision tree based classifier (mainly C4.5) and the decision table based classifier.

Finally, Kim and Kim (2018) present a method of developing a text warehouse that provides a machine-learning-based text classification service.

REFERENCES

- Balasaraswathi, M., & Kalpana, B. (2018). Fast and Effective Classification using Parallel and Multi-start PSO. *Journal of Information Technology Research*, 18(2).
- Berlanga, A. J., & García-Peñalvo, F. J. (2005a). IMS LD reusable elements for adaptive learning designs. *Journal of Interactive Media in Education*, 11.
- Berlanga, A. J., & García-Peñalvo, F. J. (2005b). Learning Technology Specifications: Semantic Objects for Adaptive Learning Environments. *International Journal of Learning Technology*, 1(4), 458–472. doi:10.1504/IJLT.2005.007155
- Bers, M. U., Flannery, L., Kazakoff, E. R., & Sullivan, A. (2014). Computational thinking and tinkering: Exploration of an early childhood robotics curriculum. *Computers & Education*, 72, 145–157. doi:10.1016/j.compedu.2013.10.020
- Bogdanova, A. M., & Ackovska, N. (2010). Data Driven Intelligent Systems. In M. Gusev (Ed.), *Proceedings of the ICT Innovations 2010*, Ohrid, Macedonia, September 12-15. ICT ACT.
- Casany, M. J., Alier, M., Mayol, E., Piguillem, J., Galanis, N., García-Peñalvo, F. J., & Conde, M. Á. (2012). Moodbile: A Framework to Integrate m-Learning Applications with the LMS. *Journal of Research and Practice in Information Technology*, 44(2), 129–149.
- Catts, R., & Lau, J. (2008). *Towards Information Literacy Indicators*. Paris: UNESCO.
- Chandani, P., & Gupta, C. (2018). An Exhaustive Requirement Analysis Approach to Estimate Risk Using Requirement Defect and Execution Flow Dependency for Software Development. *Journal of Information Technology Research*, 18(2).
- Chawla, S. (2018). Web Page Recommender System using hybrid of Genetic Algorithm and Trust for Personalized Web Search. *Journal of Information Technology Research*, 18(2).
- Chen, B., Peng, M., Liu, L., & Lu, T. (2018). Visual Tracking with Multilevel Sparse Representation and Metric Learning. *Journal of Information Technology Research*, 18(2).
- Chen, W., & Chang, E. (2007). Exploring a Digital Ecosystem Conceptual Model and Its Simulation Prototype In *Proceedings of IEEE International Symposium on Industrial Electronics, 2007 (ISIE 2007)* (pp. 2933 - 2938). USA: IEEE.
- Conde González, M. Á., Muñoz Martín, C., & García-Peñalvo, F. J. (2008). M-learning, towards U-learning. In I. Arnedillo Sánchez, & P. Isaías (Eds.), *Proceedings of the IADIS International Conference Mobile Learning 2008*, Algarve, Portugal, April 11-13 (pp. 196-200). Portugal: IADIS Press.
- Cruz-Benito, J., Therón, R., & García-Peñalvo, F. J. (2016). Software Architectures Supporting Human-Computer Interaction Analysis: A Literature Review. In P. Zaphiris & I. Ioannou (Eds.), *Learning and Collaboration Technologies. Third International Conference, LCT 2016, Held as Part of HCI International 2016, Toronto, ON, Canada, July 17-22, 2016, Proceedings* (pp. 125-136). Switzerland: Springer International Publishing. doi:10.1007/978-3-319-39483-1_12
- Cruz-Benito, J., Vázquez-Ingelmo, A., Sánchez-Prieto, J. C., Therón, R., García-Peñalvo, F. J., & Martín-González, M. (2018). Enabling adaptability in web forms based on user characteristics detection through A/B testing and machine learning. *IEEE Access: Practical Innovations, Open Solutions*. doi:10.1109/ACCESS.2017.2782678
- Day, R., & Payne, L. (1987). Computer-managed instruction: An alternative teaching strategy. *The Journal of Nursing Education*, 26(1), 30–36. doi:10.3928/0148-4834-19870101-08 PMID:3029349
- Dhungana, D., Groher, I., Schludermann, E., & Biffi, S. (2010). Software ecosystems vs. natural ecosystems: learning from the ingenious mind of nature. In *ECSA '10 Proceedings of the Fourth European Conference on Software Architecture* (pp. 96-102). New York, NY: ACM.
- Dillenbourg, P. (1999a). *Collaborative Learning: Cognitive and Computational Approaches* (2nd ed.). New York, NY: Elsevier Science.
- Dillenbourg, P. (1999b). What do you mean by collaborative learning? In P. Dillenbourg (Ed.), *Collaborative-learning: Cognitive and Computational Approaches*. Oxford: Elsevier.

- diSessa, A. A. (2000). *Changing minds: Computers, learning, and literacy*. Cambridge: MIT Press.
- Driscoll, M. (1997). Defining Internet-based and Web-based training. *Performance Improvement*, 36(4), 5–9. doi:10.1002/pfi.4140360403
- Fidalgo-Blanco, Á., Sein-Echaluce, M. L., & García-Peñalvo, F. J. (2014). Knowledge Spirals in Higher Education Teaching Innovation. *International Journal of Knowledge Management*, 10(4), 16–37. doi:10.4018/ijkm.2014100102
- Fidalgo-Blanco, Á., Sein-Echaluce, M. L., & García-Peñalvo, F. J. (2015). Epistemological and ontological spirals: From individual experience in educational innovation to the organisational knowledge in the university sector. *Program: Electronic library and information systems*, 49(3), 266–288. doi:10.1108/PROG-06-2014-0033
- Frechette, J. (2006). Cyber-censorship or cyber-literacy? Envisioning cyber-learning through media education. In D. Buckingham & R. Willett (Eds.), *Digital Generations: Children, Young People, and the New Media*. New York, NY: Routledge.
- García-Holgado, A., & García-Peñalvo, F. J. (2014). Architectural pattern for the definition of eLearning ecosystems based on Open Source developments. In J. L. Sierra-Rodríguez, J. M. Doderó-Beardo, & D. Burgos (Eds.), *Proceedings of 2014 International Symposium on Computers in Education (SIIE)*, Logrono, La Rioja, Spain, November 12–14 (pp. 93–98). USA: Institute of Electrical and Electronics Engineers. doi:10.1109/SIIE.2014.7017711
- García-Holgado, A., & García-Peñalvo, F. J. (2016). Architectural pattern to improve the definition and implementation of eLearning ecosystems. *Science of Computer Programming*, 129, 20–34. doi:10.1016/j.scico.2016.03.010
- García-Holgado, A., & García-Peñalvo, F. J. (2017a). A metamodel proposal for developing learning ecosystems. In P. Zaphiris & A. Ioannou (Eds.), *Learning and Collaboration Technologies. Novel Learning Ecosystems. In Proceedings of the 4th International Conference, LCT 2017. Held as Part of HCI International 2017, Vancouver, BC, Canada, July 9–14 (Part 1)*, pp. 100–109). Switzerland: Springer International Publishing. doi:10.1007/978-3-319-58509-3_10
- García-Holgado, A., & García-Peñalvo, F. J. (2017b). Preliminary validation of the metamodel for developing learning ecosystems. In J. M. Doderó, M. S. Ibarra Sáiz, & I. Ruiz Rube (Eds.), *Fifth International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM'17) (Cádiz, Spain, October 18–20, 2017)* (pp. Article 91). New York, NY: ACM. doi:10.1145/3144826.3145439
- García-Peñalvo, F. J. (2008a). Docencia. In J. Laviña Orueta & L. Mengual Pavón (Eds.), *Libro Blanco de la Universidad Digital 2010* (pp. 29–61). Barcelona, España: Ariel.
- García-Peñalvo, F. J. (Ed.). (2008b). *Advances in E-Learning: Experiences and Methodologies*. Hershey, PA: IGI Global. doi:10.4018/978-1-59904-756-0
- García-Peñalvo, F. J. (Ed.). (2013). *Multiculturalism in Technology-Based Education: Case Studies on ICT-Supported Approaches*. Hershey, PA, USA: IGI Global. doi:10.4018/978-1-4666-2101-5
- García-Peñalvo, F. J. (2014). Managing the Knowledge Society Construction. *International Journal of Knowledge Management*, 10(4), iv–vii.
- García-Peñalvo, F. J. (2015a). Cómo entender el concepto de presencialidad en los procesos educativos en el siglo XXI. *Education in the Knowledge Society*, 16(2), 6–12. doi:10.14201/eks2015162612
- García-Peñalvo, F. J. (2015b). Engineering contributions to a Knowledge Society multicultural perspective. *IEEE Revista Iberoamericana de Tecnologías del Aprendizaje*, 10(1), 17–18. doi:10.1109/RITA.2015.2391371
- García-Peñalvo, F. J. (2015c). Information Technology Research. *Journal of Information Technology Research*, 8(1), iv–v.
- García-Peñalvo, F. J. (2015d). Massive Open Online Courses as Data Sources for Making Decisions in Learning Processes. *Journal of Information Technology Research*, 8(4), iv–vii.
- García-Peñalvo, F. J. (2016a). A brief introduction to TACCLE 3 – Coding European Project. In F. J. García-Peñalvo & J. A. Mendes (Eds.), *2016 International Symposium on Computers in Education (SIIE 16)*. USA: IEEE. doi:10.1109/SIIE.2016.7751876

- García-Peñalvo, F. J. (2016b). Technological Ecosystems. *IEEE Revista Iberoamericana de Tecnologías del Aprendizaje*, 11(1), 31–32. doi:10.1109/RITA.2016.2518458
- García-Peñalvo, F. J. (2016c). What Computational Thinking Is. *Journal of Information Technology Research*, 9(3), v–viii.
- García-Peñalvo, F. J. (2018a). Technological Ecosystems for Enhancing the Interoperability and Data Flows. *Journal of Information Technology Research*, 11(1), vi–x.
- García-Peñalvo, F. J. (Ed.). (2018b). *Global Implications of Emerging Technology Trends*. Hershey, PA: IGI Global. doi:10.4018/978-1-5225-4944-4
- García-Peñalvo, F. J., & Cruz-Benito, J. (2016). Computational thinking in pre-university education. In F. J. García-Peñalvo (Ed.), *Proceedings of the Fourth International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM'16)* (Salamanca, Spain, November 2-4, 2016) (pp. 13-17). New York, NY, USA: ACM. doi:10.1145/3012430.3012490
- García-Peñalvo, F. J., Fidalgo-Blanco, Á., & Sein-Echaluce, M. L. (2018). (in press). An adaptive hybrid MOOC model: Disrupting the MOOC concept in higher education. *Telematics and Informatics*. doi:10.1016/j.tele.2017.09.012
- García-Peñalvo, F. J., & García Carrasco, J. (2002). Los espacios virtuales educativos en el ámbito de Internet: Un refuerzo a la formación tradicional. *Education in the Knowledge Society*, 3.
- García-Peñalvo, F. J., & García Carrasco, J. (2005). Educational hypermedia resources facilitator. *Computers & Education*, 44(3), 301–325. doi:10.1016/j.compedu.2004.02.004
- García-Peñalvo, F. J., Hernández-García, Á., Conde-González, M. Á., Fidalgo-Blanco, Á., Sein-Echaluce Lacleta, M. L., Alier-Forment, M., & Iglesias-Pradas, S. et al. (2015). Learning services-based technological ecosystems. In G. R. Alves, & M. C. Felgueiras (Eds.), *Proceedings of the Third International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM'15)*, Porto, Portugal, October 7-9 (pp. 467-472). New York, USA: ACM. doi:10.1145/2808580.2808650
- García-Peñalvo, F. J., Hughes, J., Rees, A., Jormanainen, I., Toivonen, T., Reimann, D., . . . Virnes, M. (2016). *Evaluation of existing resources (study/analysis)*. Belgium: TACCLE3 Consortium. doi:10.5281/zenodo.163112
- García-Peñalvo, F. J., & Mendes, J. A. (2018). Exploring the computational thinking effects in pre-university education. *Computers in Human Behavior*, 80, 407–411. doi:10.1016/j.chb.2017.12.005
- García-Peñalvo, F. J., Reimann, D., Tuul, M., Rees, A., & Jormanainen, I. (2016). *An overview of the most relevant literature on coding and computational thinking with emphasis on the relevant issues for teachers*. Belgium: TACCLE3 Consortium. doi:10.5281/zenodo.165123
- García-Peñalvo, F. J., & Seoane-Pardo, A. M. (2015). An updated review of the concept of eLearning. Tenth anniversary. *Education in the Knowledge Society*, 16(1), 119–144. doi:10.14201/eks2015161119144
- Goodyear, P. (2005). Educational design and networked learning: Patterns, pattern languages and design practice. *Australasian Journal of Educational Technology*, 21(1), 82–101. doi:10.14742/ajet.1344
- Gros, B., & García-Peñalvo, F. J. (2016). Future trends in the design strategies and technological affordances of e-learning. In M. Spector, B. B. Lockee, & M. D. Childress (Eds.), *Learning, Design, and Technology. An International Compendium of Theory, Research, Practice, and Policy*. Switzerland: Springer International Publishing. doi:10.1007/978-3-319-17727-4_67-1
- Gupta, A., & Gupta, C. (2018). A Collaborative Approach for Improvisation and Refinement of Requirement Prioritization Process. *Journal of Information Technology Research*, 18(2).
- Herold, B. (2016). Technology in Education: An Overview. *Education Week*.
- Hill, J. R. (2006). Flexible Learning Environments: Leveraging the Affordances of Flexible Delivery and Flexible Learning. *Innovative Higher Education*, 31(3), 187–197. doi:10.1007/s10755-006-9016-6
- Joo-Nagata, J., Martínez Abad, F., García-Bermejo Giner, J., & García-Peñalvo, F. J. (2017). Augmented reality and pedestrian navigation through its implementation in m-learning and e-learning: Evaluation of an educational program in Chile. *Computers & Education*, 111, 1–17. doi:10.1016/j.compedu.2017.04.003

- Kazakoff, E., & Bers, M. (2012). Programming in a robotics context in the kindergarten classroom: The impact on sequencing skills. *Journal of Educational Multimedia and Hypermedia*, 21(4), 371–391.
- Kim, H., & Kim, J. (2018). Multidimensional Text Warehousing for Automated Text Classification. *Journal of Information Technology Research*, 18(2).
- Kirkwood, A., & Price, L. (2014). Technology-enhanced learning and teaching in higher education: What is ‘enhanced’ and how do we know? A critical literature review. *Learning, Media and Technology*, 39(1), 6–36. doi:10.1080/17439884.2013.770404
- Kulik, C. C., & Kulik, J. A. (1991). Effectiveness of computer-based instruction: An updated analysis. *Computers in Human Behavior*, 7(1-2), 75–94. doi:10.1016/0747-5632(91)90030-5
- Kumar, A., & Kumar, S. (2018). A Support Based Initialization Algorithm for Categorical Data Clustering. *Journal of Information Technology Research*, 18(2).
- Kumar, A., & Sarkar, B. K. (2018). A Hybrid Predictive Model Integrating C4.5 and Decision Table Classifiers for Medical Data Sets. *Journal of Information Technology Research*, 18(2).
- Lazaro, H. (2014). What is EdTech and why should it matter to you? Retrieved from <https://goo.gl/7sPm62>
- Lee, A. Y. L., & So, C. Y. K. (2014). Media Literacy and Information Literacy: Similarities and Differences. *Comunicar*, 21(42), 137–145. doi:10.3916/C42-2014-13
- López Meneses, E., Vázquez-Cano, E., & Román Graván, P. (2015). Análisis e implicaciones del impacto del movimiento MOOC en la comunidad científica: JCR y Scopus (2010-13). *Comunicar*, 44, 73–80. doi:10.3916/C44-2015-08
- Lye, S. Y., & Koh, J. H. L. (2014). Review on teaching and learning of computational thinking through programming: What is next for K-12? *Computers in Human Behavior*, 41, 51–61. doi:10.1016/j.chb.2014.09.012
- Martínez Abad, F., Rodríguez Conde, M. J., & García-Peñalvo, F. J. (2014). Evaluación del impacto del término “MOOC” vs “eLearning” en la literatura científica y de divulgación. *Profesorado. Revista de currículum y formación del profesorado*, 18(1), 185-201.
- Martínez-Núñez, M., Borrás-Gene, O., & Fidalgo-Blanco, Á. (2016). Virtual Learning Communities in Google Plus, implications and sustainability in MOOCs. *Journal of Information Technology Research*, 9(3), 18–36. doi:10.4018/JITR.2016070102
- Mens, T., Claes, M., Grosjean, P., & Serebrenik, A. (2014). Studying evolving software ecosystems based on ecological models. In T. Mens, A. Serebrenik, & A. Cleve (Eds.), *Evolving Software Systems* (pp. 297–326). Berlin, Heidelberg: Springer. doi:10.1007/978-3-642-45398-4_10
- Moeller, S., Joseph, A., Lau, J., & Carbo, T. (2011). Towards Media and Information Literacy Indicators (Background Document). In *Proceedings of Expert Meeting, November 4-6, Bangkok (Thailand)*. Paris: UNESCO.
- Mohbey, K. K. (2018). Utility based frequent pattern extraction from mobile web services sequence. *Journal of Information Technology Research*, 18(2).
- Molenda, M. (1997). Historical and philosophical foundations of instructional design: A North American view. In R. D. Tennyson, F. Schott, N. M. Seel, & S. Dijkstra (Eds.), *Instructional design. International perspectives: Theory, Research, and Models* (Vol. 1, pp. 41–54). Mahwah, New Jersey: Lawrence Erlbaum Associates.
- National Research Council Committee on Information Technology Literacy. (1999). *Being Fluent with Information Technology*. Washington, DC: National Academy Press.
- Oblinger, D. G., & Maruyama, M. K. (1996). *Distributed learning*. Boulder, Colorado: CAUSE. Retrieved from <https://goo.gl/5Qw24y>
- Pinto-Llorente, A. M., Casillas-Martín, S., Cabezas-González, M., & García-Peñalvo, F. J. (2017). (in press). Building, coding and programming 3D models via a visual programming environment. *Quality & Quantity*. doi:10.1007/s11135-017-0509-4
- Prensky, M. (2008). Programming Is the New Literacy. Retrieved from <http://www.edutopia.org/literacy-computer-programming>

- Ramírez-Montoya, M. S., & García-Peñalvo, F. J. (2017). La integración efectiva del dispositivo móvil en la educación y en el aprendizaje. *Revista Iberoamericana de Educación a Distancia*, 20(2), 29–47. doi:10.5944/ried.20.2.18884
- Richey, R. C. (2008). Reflections on the 2008 AECT Definitions of the Field. *TechTrends*, 52(1), 24–25. doi:10.1007/s11528-008-0108-2
- Robinson, R., Molenda, M., & Rezabek, L. (2008). Facilitating Learning. In A. Januszewski & M. Molenda (Eds.), *Educational Technology: A Definition with Commentary* (pp. 15–48). New York: Routledge.
- Román-González, M. (2014). Aprender a programar ‘apps’ como enriquecimiento curricular en alumnado de alta capacidad. *Bordón. Revista de Pedagogía*, 66(4), 135–155. doi:10.13042/Bordon.2014.66401
- Rubio Royo, E., Cranfield McKay, S., Nelson-Santana, J. C., Delgado Rodríguez, R. N., & Ocon-Carreras, A. A. (2018). Web Knowledge Turbine as a Proposal for Personal and Professional Self-organisation in Complex Times. *Journal of Information Technology Research*, 11(1), 70–90. doi:10.4018/JITR.2018010105
- Sánchez-Prieto, J. C., Olmos-Migueláñez, S., & García-Peñalvo, F. J. (2014). Understanding mobile learning: Devices, pedagogical implications and research lines. *Education in the Knowledge Society*, 15(1), 20–42.
- Selwyn, N. (2011). *Education and Technology: Key Issues and Debates*. London: Continuum International Publishing Group.
- Seoane Pardo, A. M., & García-Peñalvo, F. J. (2014). Pedagogical Patterns and Online Teaching. In F. J. García-Peñalvo & A. M. Seoane Pardo (Eds.), *Online Tutor 2.0: Methodologies and Case Studies for Successful Learning* (pp. 298–316). Hershey, PA: IGI Global. doi:10.4018/978-1-4666-5832-5.ch015
- Spector, J. M. (2015). *Foundations of educational technology: Integrative approaches and interdisciplinary perspectives*. New York: Routledge.
- Steil, J. J., Röthling, F., Haschke, R., & Ritter, H. (2004). Situated robot learning for multi-modal instruction and imitation of grasping. *Robotics and Autonomous Systems*, 47(2), 129–141. doi:10.1016/j.robot.2004.03.007
- Suppes, P., & Morningstar, M. (1969). Computer-Assisted Instruction. *Science*, 166(3903), 343–350. doi:10.1126/science.166.3903.343 PMID:5812034
- TACCLE 3 Consortium. (2017). TACCLE 3: Coding Erasmus + Project website. Retrieved from <http://www.taccle3.eu/>
- Vee, A. (2013). Understanding Computer Programming as a Literacy. *LiCS. Literacy in Composition Studies*, 1(2), 42–64. doi:10.21623/1.1.2.4
- Vidyarthi, D. P., & Jha, D. N. (2018). A Hybrid Heuristic for QoS Aware Matching of User’s Job and Virtual Machines in Cloud Environment. *Journal of Information Technology Research*, 18(2).
- Villalba Condori, K. O. (2018). Teaching Formation to develop Computational thinking. In F. J. García-Peñalvo (Ed.), *Global Implications of Emerging Technology Trends* (pp. 59–72). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-4944-4.ch004
- Villalba Condori, K. O., Castro Cuba, S., Deco, C., Bender, C., & García-Peñalvo, F. J. (2017). A Recommender System of Open Educational Resources based on the Purpose of Learning. In A. Díaz, A. Casali, M. Chacón Rivas, & A. Silva Sprock (Eds.), *Proceedings of 2017 Twelfth Latin American Conference on Learning Technologies - LACLO 2017, La Plata, Argentina, October 9-12* (pp. 104-107). EEUU: IEEE. doi:10.1109/LACLO.2017.8120899
- Walther, J. B. (1996). Computer-Mediated Communication: Impersonal, Interpersonal, and Hyperpersonal Interaction. *Communication Research*, 23(1), 3–43. doi:10.1177/009365096023001001
- Williams, T. C., & Zahed, H. (1996). Computer-based training versus traditional lecture: Effect on learning and retention. *Journal of Business and Psychology*, 11(2), 297–310. doi:10.1007/BF02193865
- Wilson, S., Liber, O., Johnson, M., Beauvoir, P., Sharples, P., & Milligan, C. (2007). Personal Learning Environments: Challenging the dominant design of educational systems *Journal of e-Learning and Knowledge Society*, 3(3), 27-38.

Wing, J. M. (2006). Computational Thinking. *Communications of the ACM*, 49(3), 33–35. doi:10.1145/1118178.1118215

Yang, S. J. H. (2006). Context Aware Ubiquitous Learning Environments for Peer-to-Peer Collaborative Learning. *Journal of Educational Technology & Society*, 9(1), 188–201.

Yu, E., & Deng, S. (2011). Understanding Software Ecosystems: A Strategic Modeling Approach. In S. Jansen, J. Bosch, P. Campbell, & F. Ahmed (Eds.), *IWSECO-2011 Software Ecosystems 2011. Proceedings of the Third International Workshop on Software Ecosystems*, Brussels, Belgium, June 7 (pp. 65-76). Aachen, Germany: CEUR Workshop Proceedings.