What Kinds of Innovations Do We Need in Education?

Klinge Orlando Villalba-Condori [1], Francisco José García-Peñalvo [2], Jari Lavonen[3] and Miguel Zapata-Ros [4]

1 Universidad Nacional de San Agustín de Arequipa, PERU,
2 Computer Science Department, Research Institute for Educational Sciences, University of Salamanca, GRIAL Research Group, University of Salamanca, SPAIN, 3 National Teacher Education Reform Program, University of Helsinki, FINLAND, 4 University of Murcia, SPAIN.
1 kvillalbac@unsa.edu.pe, 2 fgarcia@usal.es, 3 jari.lavonen@helsinki.fi, 4 mzapata@um.es

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Prologue

We are happy to contribute this prologue to the Proceedings of the International Congress on Educational Innovation Trends, CITIE 2018. The congress has created an enthusiastic environment within which scholars may discuss educational innovations and their nature. A very positive attitude dominated the discussions, and individuals were asking: 'Can we make things better?' In this type of discussion, it is important that we know the challenges in our education context as well as the processes that are appropriate to follow in the transfer or implementation of these innovations to our own context.

In all countries, challenges in education have been discussed in several forums, conferences, and national-level curriculum committees. The challenges may be recognised on the basis of international comparative studies, such as OECD, PISA [1] and TALIS [2] surveys, and national-level monitoring reports. Moreover, it is important that education challenges be analysed from the society's perspective, including changes in working life, gender gaps, and the environment (e.g., climate change). These recognised challenges may be summarised in different ways and at different levels.

The challenges may be classified, for example, at the student level, classroom level, school level, municipality level, and thus, the society level. In most countries, politicians and teachers are not happy with the level of learning outcomes and the amount of variation in those outcomes; the variation in learning outcomes between schools is namely considered an indication of inequality in the education system. Another common student-level challenge is the lack of engagement (interest) in learning and, more generally, the lack of mental well-being. The lack of students' interest in Science, Technology, Engineering and Mathematics (STEM) studies and careers [3] have been specifically considered a serious challenge for both the individual and society.

There have been discussions in many countries about the teaching and learning of 21st-century and/or generic competencies [4]. The learning of these competencies represents a classroom-level challenge and refers to the redefinition of educational goals and ways of organising learning in a classroom in order to meet the future's demands. These competencies have been defined in various ways (e.g., see an analysis of Voogt & Roblin [5]). The OECD [6] DeSeCo project analysed 21st-century competences in the context of the future working life and recognised that individuals need to be able to use a wide range of tools, including socio-cultural (language) and digital (technological) tools, to interact effectively with the environment, to engage and interact in a heterogeneous group, to engage in inquiry-oriented working and problem solving, and, moreover, to act autonomously and take responsibility for managing their own lives. In this context, as well as in the working context, critical and creative thinking and learning are necessary for one to learn competencies. Although DeSeCo focuses on the needs of working life, its ideas may be interpreted in the context of school. By this interpretation, it is important to remember that students are novices and are still learning these competencies. Consequently, the teacher should support the students in the learning of 21st-century competencies through active and collaborative learning processes in the diverse learning environments. Another classroom-level challenge is the support of individual learners' and the organisation of a heterogeneous and multicultural classroom that supports the learning processes of various learners.

At the school and city levels, there exist challenges in the planning of the local curriculum or annual work plan and within the physical and digital learning environments of teams of teachers and teacher networks. In order to overcome this type of challenge, high-quality pedagogical leadership is needed to support teachers' collaboration and professional development.

At a society level, artificial intelligence and robotization are changing working life; tasks or work responsibilities and roles disappear and change and, moreover, new tasks and roles appear about which we do not yet know. Computational thinking (CT) skills [7,8,9] have been determined a key competency for pre-university students [10,11]. However, due the fuzzy definition of CT [12], many voices defend a most pragmatical approach based on teaching coding [13], using robots [14,15,16] or constructing things [16,17] (e.g., see the EU project TACCLE 3 – Coding outcomes, in García-Peñalvo [18]; TACCLE 3 Consortium [19]). Moreover, there are proposals advocating to include programming [20] or computer science subjects [21,22] in the pre-university official curricula. The CT and/or computer science/programming introduction in schools has a significant, related challenge in these contexts: the training of kindergarten to high school pre-university teachers [23,24,25].

Another example of a society-level challenge, which is related to changes in working life and employability [26,27,28], is the number of young people who drop out from both education and the labour market. Furthermore, there is a need to continuously train adults in order to reflect the changes in working life, such as digitalisation.

In order to make progress and overcome the recognised challenges, national-level reform programs are needed. However, the designing and implementing of a national reform program are challenging processes. For example, Beach, Bagley, Eriksson, and Player-Koro [29] recognised, based on their long-term policy analysis from Sweden, that Swedish reforms are too strongly led by governments alone: 'governments too often become tempted to allow their ideological interests to predominate over scientific knowledge' (p. 167). Moreover, it is common that the aims of the reform program do not consider the research outcomes in the field. OECD

[30] have suggested that, in a national strategy context, certain characteristics are important. However, the OECD list does not include research orientation in planning and implementation, nor does it include continuous quality assurance (QA)—meaning, for example, a collection of progress data from the pilot projects and informing of the pilot projects. Moreover, collaboration and meetings that support pilot projects communicate the pilots' outcomes to other pilots and reflect on the missing outcomes. An updated OECD list explains the requirements for making progress and overcoming the recognised challenges at the national level:

- Have enough time for planning, careful timing, and implementation;
- Engage stakeholders, such as education providers, and employ organisations participate the strategy design;
- Engage researchers to actively implement the research-based knowledge in the strategy design;
- Be in partnership with the teacher union and employment union;
- Strive for consensus in the design;
- Serve sustainable resources for the planning and implementation of the strategy;
- Plan pilot projects according to the strategy and take research-based knowledge into account while planning and implementing the pilots, learning from the pilots, modifying the strategic aims (if needed), and, moreover, using pilots to implement the strategy. Researchers should encourage pilots to participate and use sustainable resources in thereof;
- Disseminate the pilots' outcomes.

This kind of approach for the implementation of educational reforms has many benefits in both the strategy design and implementation. The approach makes it possible for reforms to be accepted and implemented. The stakeholder engagement namely increases their ownership and assists with implementation. Also, it is essential that criteria and ideas be reflected upon and considered during the implementation of educational practices. We plan to do so for the purpose of increasing learning efficiency and the involved actors' and institutions' satisfaction through personalization and adaptability [31,32], which are the most important characteristics and objectives of the learning environments and are supported by not only social and ubiquitous technologies, but also detection and recommendation.

We need a response to an indisputable fact: the use of smart technologies [33] as a powerful means to adapt and include support in the delivery of help and resources in a relevant and pertinent way to the personal [34] and group learning [35] situations as well as the demand of students' knowledge and skills.

There is a need for a pedagogical model framework, instructional design, and guides that integrate students and help reach common and desirable learning outcomes. We also raise the need to analyse the necessary conditions regarding their validation. Finally, we propose the need for concrete answers to the insufficiency and resulting consequences of institutional policies that contemplate integration modalities, which may be achieved through an analysis based on experiences.

We are accustomed to literature that emphasizes the possibilities of an adaptive education as well as the possibilities for big data—combined with algorithms—to create unique and unprecedented opportunities for academic organizations to teach higher standards and innovative approaches. However, there is currently a lack of systematized pedagogical proposals.

Ultimately, we propose to enhance the following lines of development [32]:

- Learning and teaching strategies for a ubiquitous social and intelligent pedagogy [36];
- Highly technological and singular services supported by technological ecosystems [37,38,39], both for local students on campus and remote students online, to create learning ecologies within which knowledge may be created, managed, transformed, and transferred [40];
- Configurations of innovative, adaptive classrooms and centres that facilitate easy local/remote interactions among students and teachers;
- Design and development of multimedia-enriched contents with interactive presentations, videoconferences, questionnaires, and assessments that allow instant and individualized evaluation;
- Other affordances and managed environments with technology and adaptive software;
- An ethical use of the learning and academic analytics to increase the support given to students and academic managers in regard to their learning processes and decision-making processes, respectively [41,42];
- A more natural incorporation, recognition, and mixture of the informal learning processes into formal education [43].

As we mentioned earlier, we have learned about various education innovations from several countries during the CITIE 2018. Now, our duty is to analyse how we can benefit from those innovations within our own educational context. Therefore, we should analyse our education challenges and then modify the innovation to meet our local needs according to the recognized challenges. Moreover, it is important that we find proper ways to support the transfer of innovation. In general, the transfer of educational innovation from one context to another has been considered challenging. Successful transfer requires strong collaboration and development within an open and trusting atmosphere depending on the local characteristics of the context. In the area of education, local characteristics include teachers' pedagogical orientation, their teaching and learning beliefs, and the leadership and support available to them in school. Moreover, the educational context of the country (e.g., a curriculum, level of accountability, policy, and school inspection) influence teachers' decisions as they consider adopting the innovation. Consequently, the transfer of an educational innovation is regarded as a complex and highly contextualized task.

References

1. OECD. PISA 2012. Results in focus. What 15-year-olds know and what they can do with what they know. Paris: OECD (2013).
2. OECD. Talis 2013 Results: An international perspective on teaching and learning. Paris: OECD Publishing. (2014).
3. Ramírez-Montoya, M. S. (Ed.). Handbook of research on driving STEM learning with educational technologies. Hershey PA, USA: IGI Global. (2017).

4. Ananiadou, K., & Claro, M. 21st century skills and competences for new millennium learners in OECD Countries. OECD Education Working Papers, 41. (2009).
5. Voogt, J. & Roblin, N.P. A comparative analysis of international frameworks for 21st century competences: Implications for national curriculum policies. Journal of Curriculum Studies, 44(3), 299–321. (2012). doi:10.1080/00220272.2012.668938
6. OECD. Definition and selection of competencies (DeSeCo): Executive summary. Paris: OECD Publishing. (2005).
7. Wing, J. M. Computational thinking. Communications of the ACM, 49(3), 33–35. (2006). doi:10.1145/1118178.1118215
8. Zapata-Ros, M. Pensamiento computacional: Una nueva alfabetización digital. RED, Revista de Educación a distancia, 46. (2015).
9. García-Peñalvo, F. J., & Mendes, J. A. Exploring the computational thinking effects in pre-university education. Computers in Human Behavior, 80, 407–411. (2018). doi:10.1016/j.chb.2017.12.005
10. Mohaghegh, M., & McCauley, M. Computational thinking: The skill set of the 21st century. International Journal of Computer Science and Information Technologies, 7(3), 1524–1530. (2016).
11. Pérez-Paredes, P., & Zapata-Ros, M. El pensamiento computacional, análisis de una competencia clave. Scotts Valley, CA, USA: Createspace Independent Publishing Platform. (2018).
12. García-Peñalvo, F. J., Reimann, D., Tuul, M., Rees, A., & Jormanainen, I. An overview of the most relevant literature on coding and computational thinking with emphasis on the relevant issues for teachers. Belgium: TACCLE3. (2016). doi:10.5281/zenodo.165123
13. DePryck, K. From computational thinking to coding and back. 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. 27–29). New York, NY, USA: ACM. (2016). doi:10.1145/3012430.3012492
14. Curto, B., & Moreno, V. Robotics in education. Journal of Intelligent and Robotic Systems, 81(1), 3–4. (2016). doi:10.1007/s10846-015-0314-z
15. Fernández-Llamas, C., Conde-González, M. Á., Rodríguez-Lera, F. J., Rodríguez-Sedano, F. J., & García-Peñalvo, F. J. May I teach you? Students' behavior when lectured by robotic vs. human teachers. Computers in Human Behavior, 80, 460–469. doi:10.1016/j.chb.2017.09.028. (2018).
16. Reimann, D., & Maday, C. Enseñanza y aprendizaje del modelado computacional en procesos creativos y contextos estéticos. Education in the Knowledge Society, 18(3), 87–97. (2017). doi:10.14201/eks20171838797
17. García-Peñalvo, F. J., Reimann, D., & Maday, C. Introducing coding and computational thinking in the schools: The TACCLE 3 – coding project experience. In M. S. Khine (Ed.), Computational thinking in the STEM disciplines. Foundations and research highlights (pp. 213–226). Cham, Switzerland: Springer. (2018).doi:10.1007/978-3-319-93566-9_11
18. García-Peñalvo, F. J. 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. (2016). doi:10.1109/SIIE.2016.7751876
19. TACCLE 3 Consortium. TACCLE 3: Coding Erasmus + project website. (2017). Retrieved from https://goo.gl/f4QZUA
20. Balanskat, A., & Engelhardt, K. Computing our future. Computer programming and coding priorities, school curricula and initiatives across Europe. Brussels, Belgium: European Schoolnet. (2015).

21. Velázquez-Iturbide, J. Á. Report of the Spanish computing scientific society on computing education in pre-university stages. In F. J. García-Peñalvo (Ed.), Proceedings TEEM'18. Sixth International Conference on Technological Ecosystems for Enhancing Multiculturality (Salamanca, Spain, October 24–26, 2018) (pp. 2–7). New York, NY, USA: ACM. (2018). doi:10.1145/3284179.3284180
22. Velázquez-Iturbide, J. Á., Bahamonde, A., Dabic, S., Escalona, M. J., Feito, F., Fernández Cabaleiro, S., . . . & Zapata Ros, M. Informe del grupo de trabajo SCIE/CODDII sobre la enseñanza preuniversitaria de la informática. España: Sociedad Científica Informática de España, Conferencia de Decanos y Directores de Ingeniería Informática. (2018).
23. Yadav, A., Gretter, S., Good, J., & McLean, T. Computational thinking in teacher education. In P. J. Rich & C. B. Hodges (Eds.), Emerging research, practice, and policy on computational thinking (pp. 205–220). Cham, Switzerland: Springer. (2017). doi:10.1007/978-3-319-52691-1_13
24. Villalba-Condori, K. O. Teaching formation to develop computational thinking. In F. J. García-Peñalvo (Ed.), Global implications of emerging technology trends (pp. 59–72). Hershey, PA, USA: IGI Global. (2018). doi:10.4018/978-1-5225-4944-4.ch004
25. Villalba-Condori, K. O., Castro Cuba-Sayco, S. E., Guillen Chávez, E. P., Deco, C., & Bender, C. Approaches of learning and computational thinking in students that get into the computer sciences career. In F. J. García-Peñalvo (Ed.), Proceedings TEEM'18. Sixth International Conference on Technological Ecosystems for Enhancing Multiculturality (Salamanca, Spain, October 24–26, 2018) (pp. 36–40). New York, NY, USA: ACM. (2018). doi:10.1145/3284179.3284185
26. Michavila, F., Martínez, J. M., Martín-González, M., García-Peñalvo, F. J., & Cruz-Benito, J. Barómetro de empleabilidad y empleo de los universitarios en España, 2015 (Primer informe de resultados). Madrid: Observatorio de Empleabilidad y Empleo Universitarios. (2016).
27. Michavila, F., Martínez, J. M., Martín-González, M., García-Peñalvo, F. J., & Cruz Benito, J. Empleabilidad de los titulados universitarios en España. Proyecto OEEU. Education in the Knowledge Society, 19(1), 21–39. (2018a). doi:10.14201/eks20181912139
28. Michavila, F., Martínez, J. M., Martín-González, M., García-Peñalvo, F. J., Cruz-Benito, J., & Vázquez-Ingelmo, A. Barómetro de empleabilidad y empleo universitarios. Edición Máster 2017. Madrid, España: Observatorio de Empleabilidad y Empleo Universitarios. (2018b).
29. Beach, D., Bagley, C., Eriksson, A. & Player-Koro, C. Changing teacher education in Sweden: Using meta-ethnographic analysis to understand and describe policy making and educational changes. Teaching and Teacher Education, 44, 160–167. (2016).
30. Burns, T., & Köster, F. (Eds.). Governing education in a complex world. Paris: OECD Publishing. (2016). doi:10.1787/9789264255364-en
31. Berlanga, A. J., & García-Peñalvo, F. J. Learning design in adaptive educational hypermedia systems. Journal of Universal Computer Science, 14(22), 3627–3647. (2008). doi:10.3217/jucs-014-22-3627
32. Zapata-Ros, M. La universidad inteligente. La transición de los LMS a los sistemas inteligentes de aprendizaje en educación superior. RED, Revista de Educación a distancia, 57(10). (2018). doi:10.6018/red/57/10
33. Molina-Carmona, R., & Villagrá-Arnedo, C. J. Smart learning. In F. J. García-Peñalvo (Ed.), Proceedings TEEM'18. Sixth International Conference on Technological Ecosystems for Enhancing Multiculturality (Salamanca, Spain, October 24–26, 2018) (pp. 645–647). New York, NY, USA: ACM. (2018). doi:10.1145/3284179.3284288

34. Lerís, D., & Sein-Echaluce, M. L. La personalización del aprendizaje: Un objetivo del paradigma educativo centrado en el aprendizaje. Arbor, 187 (Extra_3), 123–134. (2011). doi:10.3989/arbor.2011.Extra-3n3135
35. Conde-González, M. Á., Colomo-Palacios, R., García-Peñalvo, F. J., & Larrueca, X. Teamwork assessment in the educational web of data: A learning analytics approach towards ISO 10018. Telematics and Informatics, 35(3), 551–563. (2018). doi:10.1016/j.tele.2017.02.001
36. Fidalgo-Blanco, Á., Sein-Echaluce, M. L., & García-Peñalvo, F. J. Micro flip teaching with collective intelligence (2018). In P. Zaphiris & A. Ioannou (Eds.), Learning and collaboration technologies. Design, development and technological innovation. 5th International Conference, LCT 2018, held as part of HCI International 2018, Las Vegas, NV, USA, July 15–20, 2018, Proceedings, Part I (pp. 400–415). Cham, Switzerland: Springer. doi:10.1007/978-3-319-91743-6_30
37. Llorens-Largo, F., Molina-Carmona, R., Compañ, P., & Satorre, R. Technological ecosystem for open education. In R. Neves-Silva, G. A. Tsihrintzis, V. Uskov, R. J. Howlett, & L. C. Jain (Eds.), Smart digital futures 2014. (pp. 706–715). Amsterdam, The Netherlands: IOS Press. (2014).
38. García-Peñalvo, F. J. Ecosistemas tecnológicos universitarios. In J. Gómez (Ed.), UNIVERSITIC 2017. Análisis de las TIC en las Universidades Españolas (pp. 164–170). Madrid, España: Crue Universidades Españolas. (2018).
39. García-Holgado, A., & García-Peñalvo, F. J. Validation of the learning ecosystem metamodel using transformation rules. Future Generation Computer Systems, 91, 300–310. (2019). doi:10.1016/j.future.2018.09.011
40. Rubio Royo, E., Cranfield McKay, S., Nelson-Santana, J. C., Delgado Rodríguez, R. N., & Occon-Carreras, A. A. Web knowledge turbine as a proposal for personal and professional self-organisation in complex times. Journal of Information Technology Research, 11(1), 70–90. (2018). doi:10.4018/JITR.2018010105
41. Ferguson, R. Learning analytics: Drivers, developments and challenges. International Journal of Technology Enhanced Learning, 4(5/6), 304–317. (2012). doi:10.1504/IJTEL.2012.051816
42. Conde-González, M. Á., & Hernández-García, Á. Learning analytics for educational decision making. Computers in Human Behavior, 47, 1–3. (2015). doi:10.1016/j.chb.2014.12.03
43. Griffiths, D., & García-Peñalvo, F. J. Informal learning recognition and management. Computers in Human Behavior, 55A, 501–503. (2016). doi:10.1016/j.chb.2015.10.019