

DOI: <https://doi.org/10.63332/joph.v5i7.2964>

Interdisciplinary Simulation as the Keys to Third-Generation University Training

Andrés Chiappe Laverde¹, Ricardo Andrés Novoa Álvarez², Thiago Andrés Navarro Álvarez³, Sandra Liliana Navarro Parra⁴

Abstract

The current scenario of university education calls for training spaces that go beyond direct instruction and knowledge memorization exercises. Such requirement stems from the need to articulate diverse knowledge and skills that the current professional must develop both in university practice and in their daily work. It is imperative to build new teaching experiences that articulate the space of practice and the knowledge that corresponds to it, as scenarios for the interdisciplinary and permanent construction of knowledge. A comprehensive review has been conducted to explore research from the last 20 years on the educational implementation of simulations in various professions. After conducting filtering and sampling processes, articles were read and reviewed in depth and to which qualitative processes of categorization and frequency analysis were applied. Results: Some advantages and limitations of simulations as learning resources are highlighted. They suggest the importance of their deployment from an interdisciplinary perspective of teaching, especially in health sciences. We reflect on the importance of approaching simulation-based learning from a curricular perspective, which brings learning in higher education closer to the complex realities of the world of work. Great challenges and transformative effects of its implementation on university educational structures and models are stood out.

Keywords: Interdiscipline, Transdiscipline, University Training, Clinical Simulation, Third-Generation University.

Introduction

Today's world is characterized by both uncertainty and ambiguity (1,2). This educational scenario involves a great diversity of problems of a practical order. The search for quality and the interest in fostering the development of professional competencies lead the student to be surrounded by the tensions of a complex, mutable and uncertain reality (3,4).

This condition was largely exacerbated by the emergence of the SARS-CoV-2 (COVID-19) pandemic, which not only brought to the fore a series of public health questions for researchers and health professionals (5), but also for other disciplinary fields, especially education. These questions call to attention the future possibilities of and need for social and educational transformations that can open in multiple scenarios to address regional or global crises.

Furthermore, the educational experience forced upon us for almost two years because of the

¹ Profesor Titular de la Facultad de Educación de la Universidad de La Sabana, Chiappe, A., Email: andres.chiappe@unisabana.edu.co, ORCID: <https://orcid.org/0000-0002-9664-4833>

² Profesor Titular de la Facultad de Ciencias de la Salud y Ciencias Básicas de la Fundación Universitaria Navarra. Novoa, RA., Email: ra.novoa@uninavarra.edu.co, <https://orcid.org/0000-0001-9892-3468>

³ Profesor Titular de la Facultad de Ciencias de la Salud y Ciencias Básicas de la Fundación Universitaria Navarra Navarro, TA., Email: thiago.navarro@uninavarra.edu.co, ORCID: <https://orcid.org/0000-0002-3272-4711>

⁴ Rectora de la Fundación Universitaria Navarra Novoa, RA., Email: rectoria@uninavarra.edu.co, ORCID: <https://orcid.org/0000-0001-7335-1811>



pandemic has posed questions to education systems worldwide. The pandemic has called into question these systems' principles (6,7), paradigms, and present operational forms, which make persistent forms of knowledge construction based on the disciplinary separation or fragmentation of knowledge. This is an issue because it could lead to subject-based curricular proposals that make it difficult to implement educational strategies closer to the context and daily realities of students (8,9). In this sense, Acosta (10) highlighted the urgent need to consolidate broader and more comprehensive views on the construction of knowledge so that more relevant educational scenarios are promoted in response to the complexities of a 21st century education.

Third Generation Universities (3GU)

The concepts that constitute '21st century education' are so broad and diverse that the specification of this term's characteristics is a demanding conceptual exercise. On the one hand, Karunaratne (11), Ament and Edwards (12), and Mohd & Shahbodin (2) pointed out that 21st century education is characterized by a marked tendency to generate personalized training processes, and consequently, the need to foster personal routes to learning is highlighted. On the other hand, Eng (13) and Fernández & Dias (14) argued that the tension between equality and equity has emphasized the need to promote the processes of educational innovation aimed at eliminating the homogenization of learning because of educational structures based on standards. In addition, Szpytma & Szpytma (15) and Wahyu et al. (16) emphasized the relevance and importance of curricula that can exceed undisciplinary limits and borders in this context, thus realizing the possibility of phenomena, life projects, and solutions to real problems, such as the basis of contemporary learning. Wahyu et al. pointed out a fascinating direction in the framework of educational development in higher education: the consolidation of third-generation university (3GU) training.

The 3GU implies the existence of a substantial difference between the first and second generation (17). This implies the existence of a structural and operational convergence of two of the three substantive functions of universities (teaching, research, and social projection) based on the function of a third. First generation universities are known as 'teaching universities' (18). In second-generation universities, teaching and social projection converge with research, so they are known as 'research universities' (19). Finally, in 3GUs, teaching and research converge into social projection, so they end up integrating teaching and research considering the problem solution specific to the context (20).

The training of professionals from third-generation universities faces multiple challenges derived from the nature of this type of generation. In fact, professors at a university of this kind are expected not only to teach what they research, and research what they teach, but both simultaneously. In this sense, the convergence between teaching and research makes full sense when considering the solution of real problems through interdisciplinary and even transdisciplinary approaches in university education. This is because the problems of everyday life are complex by nature and require the integration of multiple types of knowledge (21,22). However, to understand the scope and implications of the need for transdisciplinary training, it is appropriate to address several concepts in detail and to differentiate them. Specifically, these concepts are discipline, multidiscipline, interdiscipline, and transdiscipline.

In this regard, it is important to highlight research production over the last few years. Figure 1 shows a comparison of the number of publications in journals indexed in the Scimago Journal Rankings (SJR). Over more than three decades, many authors have committed themselves to

developing conceptual proposals in this respect. It is not our intention to make a theoretical re-elaboration but to propose a synthesis exercise for the purposes of establishing a common understanding framework. This would make it possible to determine the role that 3GU training and simulations could play as an educational resource.

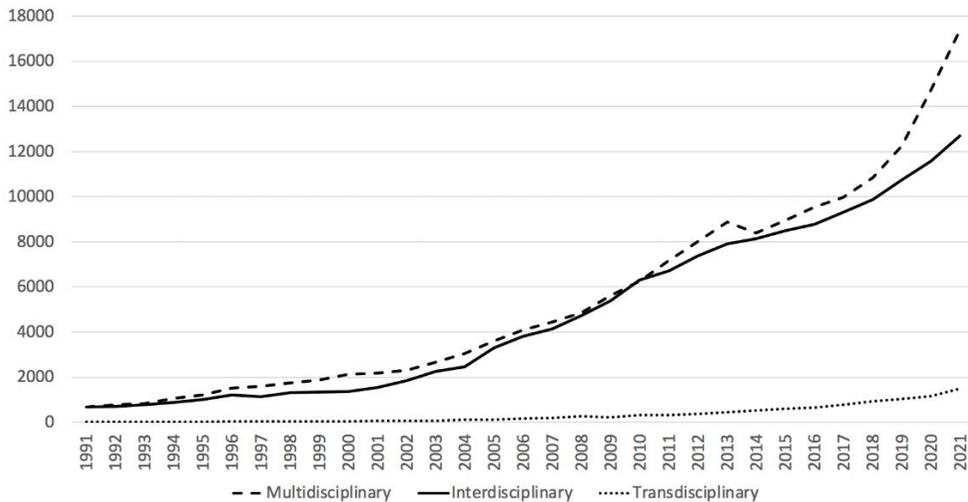


Figure 1: Research on inter, multi and transdiscipline

The disciplinary framework: The traditional way of looking at knowledge

The first concept to be considered is ‘discipline’, not as an isolated term but in relation to the very condition of thinking and the orientation that makes up knowledge. This implies that a discipline is a space of dispute and the confrontation of positions that respond to problems that have emerged in social dynamics (23,24). With this, we argue that disciplines build and define the limits of what exists. Therefore, disciplines are not static; instead, they extend their horizons and borders in this scenario of constant expansion, thus facing new problems and tensions all the time (25).

From the point of view of 3GU training, a disciplinary approach is inconvenient because of the complex nature of the problems of reality (26). Considering that the essence of this type of training is primarily focused on making students learn by participating in solving and simulating problems related to contextual processes, whether local, regional, or global, this complexity implies a certain inability of the individual disciplines to adequately answer or solve these problems.

When a Single Look is not Enough

Therefore, to understand a phenomenon in a complete and comprehensive manner, it is necessary to involve various disciplines to find different narratives of observation and explanations (27,28). This implies that in this scenario, these different disciplines contribute to explaining the phenomena we observe, with the particularity that these explanations can only be made within the space of their own disciplinary borders without entering any cooperation or generating any ruptures with other disciplines (29,30).

Although multiplicity and plurality are considered appropriate for understanding reality as a complex scenario, it is essential to recognize the inherent risk in the tendency of disciplines to solidify their borders. This is because the exchanges or dialogues between the different kinds of knowledge are hindered as a result, which then leads to a fragmented vision of reality (31).

This affects one of the fundamental characteristics of 3GUs: convergence. In this sense, adding without integrating only yields the benefits of complementarity, but it is not enough to build the processes that lead to the convergence of the pillars of university training.

An Integrated Perspective on Addressing Reality

In this way, the first approach to interdisciplinarity implies focusing our gaze on the real interactions that establish different disciplinary fields. This intercommunication and enrichment are given in hierarchies, and vertical orientations on the understanding of the problems are eliminated (32). There are processes of establishing relationships and articulation of problems in which each result is the product of an interrelationship built on cooperation and not on isolated responses to reality (33). This perspective is suitable for the exercise of building third-generation learning experiences, but it also represents a great challenge for university curricular and academic management structures.

On the one hand, it must be recognized that university traditions have made teaching and research processes run through different management structures, most of which have been designed from a disciplinary perspective (34). Teaching and research, from an interdisciplinary perspective, will require greater curricular flexibility, without separate teaching spaces.

One More Step Ahead: Mobility and Disciplinary Fusion in Response to The Problems of Reality

Transdisciplinarity promotes the possibility of knowledge through exchanges between different fields that are not exclusively constituted in the dynamics of the response to problems; rather, they operate from the mobility and fusion of methods and theoretical bodies that can be expanded as epistemic crossings that eventually produce new possibilities of professional training (35–38). This approach takes into account a significant complexity Nicolescu (39) called the ‘third not included’, a kind of commitment to the prefix ‘trans’ and its amalgam of the meanings in which hybridization, non-linearity, reflexivity, and heterogeneity are necessary conditions to assume and develop research processes in the complex scenarios of reality. In this respect, Choi and Pak (40) highlighted collaboration and work on shared conceptual frameworks as the elements of transdisciplinarity, which are the key elements in confronting problems commonly found in different disciplines.

Transdisciplinarity allows the opening and emergence of mixed, hybrid, and mobile analytical spaces that are nuanced by their own relationships within the complex world. According to Rodrigo-Comino et al. (41), transdisciplinary understanding frameworks allow the possibility of the very transformation of knowledge and even the generation of new professional spaces.

Simulation as an Interdisciplinary Educational Resource

Characterized by growing uncertainty, ambiguity, and complexity, today’s world (42) has seen the emergence of problems that make it necessary to engage in academic exercises in which the dialogues of knowledge and crossings between different disciplines are emphasized. Simulations could allow for the rethinking of teaching and learning (43,44) dynamics in an interdisciplinary

and transdisciplinary sense (45,46).

However, from an educational perspective, what is meant by simulation? According to Lyons (47), simulation is a construct based on learning technologies that allow the replicating of human spaces, processes, or interactions that are normally developed in physical reality. According to Cleland et al. (48), educational simulations make it possible to manage the variables involved in the reproduction of experiential learning scenarios.

Recently, in the case of medical or health sciences education, because of the COVID-19 pandemic, various teaching practices supported by digital technologies were consistently carried out. Despite many reported difficulties and negative cases, many cases have also reported the empowerment of communication and the fostering of practical knowledge (49). These simulations also drive teaching processes without putting the health or integrity of patients at risk; thus, involving simulations in academic scenarios is not only formative but also has a comprehensive ethical component. However, to ensure that these simulation environments are as close to real life as possible, the integration of several professions or more complex forms of research processes with methods and frameworks common to several disciplines are required. Furthermore, these environments must be properly framed in the dynamics of a 3GU, where its approach to learning begins with solving the problems of the environment.

Curricular Implications of Simulations

The curriculum gives meaning to practice, and in general, day-to-day schooling; that is, it leads the organization and direction of all the dynamics of training. Then, if the curriculum is oriented and organized toward facilitating practice, it would be pertinent to think that, in the dynamics of 3GUs, the curriculum should focus on adaptation processes that extend to the learning needs of students. This way of perceiving curricula would cause what Inciarte González (50) highlights as a 'constant transgression of disciplines', that is, as a horizon that opens to give way to training that goes from interdisciplinarity to transdisciplinarity.

Therefore, curricula should focus on action and not on knowledge. To do this, the problem-solving process must address multiple pieces of knowledge related to different disciplines. Therefore, the curricula employed by a 3GU must not be understood as goods owned by a particular school or programmes that are deployed by default for all students, but as shared inter-professional goods activated by an architecture 'tailored' to the requirements of the problem to be resolved. Furthermore, simulations would be used to address, either in face-to-face contexts or as a mechanism to determine progress, test, and enable controlled pilots, and replicate the conditions of the real situation in which they intend to intervene.

Research and Simulation in the Interdisciplinary Training Contexts of 3GUs

In 3GUs, which focus on inter and transdiscipline scenarios, research dynamics are central to academic development with a global, joint, cooperative, and holistic vision (51). For this, it is not only necessary to develop a framework of transformation and dynamics of knowledge but to open a path from two possibilities: 1) the emergence of integrated and systemic knowledge connected with the dynamics of the contemporary world and 2) the development of scientific research competencies that respond to the training needs of professionals and the dynamics of the context and its problems. University training not only must respond to particular conditions of action on the teaching–learning relationship but also aims to influence both the work and daily lives of the subjects (52). In the case of a 3GU, this is channeled through the solutions to problems

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of the context, which are directly related to students' professional lives.

However, it is important to review the first aspect mentioned above regarding research processes and their relationship to the generation of new integrated and systemic knowledge. These are based on the claim that knowledge is not a fixed place of arrival but a constant relationship of tensions, productions, and transits in epistemic limits. It is precisely at this nexus that the possibility of training is from and where interdisciplinarity and transdisciplinarity are enabled (53). In this scenario of training mediated by interdisciplinary simulations learning is pivotal for the advancement of universities towards a third-generation paradigm (54). This approach rigorously fosters the development of critical competencies in students, including but not limited to teamwork, complex problem-solving, critical thinking, innovation, and adaptive professional modeling. Such cultivation of high-order skills demonstrably contributes to a more robust academic environment and, consequently, catalyzes broader community development (54).

Conclusions

In line with many of the criticisms that have been made by the literature, regarding the social relevance of the university institution, we could say that the university, in its contemporary manifestation, is not an institution that responds coherently to the complex dynamics of the present time. On the contrary, its relationship with the present is still rooted in rigid structures that aim to preserve the legitimacy of the disciplines as separate universes where solving complex problems of reality is still difficult. In 3GUs, an accelerated transformation of their teaching processes is required, which must prioritize its research characteristics from the inter and transdisciplinary horizons as a fundamental imperative of the whole process. This implies that 'teaching what is researched, and researching is what is taught'.

The paradigm shift of the university has led to the rethinking of the debate around the epistemic and formative place that occupies the questions of disciplinary, multidisciplinary, interdisciplinary, and transdisciplinary curricular programmes. This is not an evolutionary overcoming of concepts but of dialogues, mixtures, and the hybridization of the epistemological borders of knowledge in the interest of building formative proposals relevant to global needs and the professional interests of students. Formative processes, from an interdisciplinary and transdisciplinary perspective, require thinking and reflection on knowledge, competencies, and training practices.

A proposal for the transformation of the university from the interdisciplinary and transdisciplinary perspectives requires a new way of thinking about and building the curriculum. This entails the abandonment of any structure based on disciplines and the fragmentation of knowledge by a curriculum that prioritizes research, practice, and adaptation to the needs of learning and to the creation of solutions to contemporary and global problems. The curriculum required of 3GUs needs to put the formation of new knowledge and perspectives on the horizon, in which the student takes a fundamental role in its professional projection, while it potentiates research as the place of action and emergence of new possibilities of knowledge.

This formative transformation has as the axis of articulation research processes, with the guarantee of not being spaces for the verification of theories but for the creation of new analytical frameworks for understanding problems. With this, we argue that research in 3GUs must be seen as a constant relationship of tensions, productions, and transits of epistemic limits; that is, this research must adapt to global needs, to the new demands of knowledge. The didactic proposal of

using simulations presents a significant possibility for thinking about the formative processes of the university, since this is a gateway to interdisciplinarity and transdisciplinarity. Simulations establish the direct relationships between knowing, competition, and context, in which the problems of the complexity of the world are circulated and presented. The simulation is a guarantee of entry and positioning in the 21st century, not only because of the linking of technological artifacts that show the advances in present-day management but because they give a new role to professionals who occupy a central space in this new reality.

Conflicts of Interest Statement

The authors declare no conflicts of interest.

References

- Bell DVJ. Twenty-first Century Education: Transformative Education for Sustainability and Responsible Citizenship. *Journal of Teacher Education for Sustainability*. 2016;18(1):48–56.
- Mohd CKNCK, Shahbodin F. Personalized Learning Environment (PLE) Integration in the 21st Century Classroom. *International Journal of Computer Information Systems and Industrial Management Applications* [Internet]. 2015 [cited 2023 Feb 18];7(1):014–21. Available from: https://www.mirlabs.net/ijcisim/regular_papers_2015/IJCISIM_2.pdf
- Bühler JL, Nikitin J. Sociohistorical context and adult social development: New directions for 21st century research. *American Psychologist*. 2020;75(4):457–69.
- Khvostova K. The Place of historical Science in the System of contemporary Knowledge. *Vopr Filos* [Internet]. 2019 [cited 2023 Feb 19];(9):108–17. Available from: <https://doi.org/10.31857/S004287440006323-0>
- Di Tommaso M. Una strategia di resilienza intelligente per il dopo coronavirus. Sulla centralità della domanda e offerta di politica industriale. *L'industria*. 2020;1:3–20.
- Naukkarinen J, Jouhkimo L. Toward Integrated and Inclusive Education for Sustainability with School–University Cooperation. *Sustainability*. 2021;13(22):12486.
- Yan KCA. Understanding civic education in Hong Kong: a Bernsteinian approach. *Discourse: Studies in the Cultural Politics of Education*. 2021;42(4):615–27.
- Bose M, Ye L. Cross-cultural perspective of situated learning and coping: understanding psychological closeness as mediator. *Journal of Consumer Marketing*. 2019;37(1):10–20.
- Donaldson T, Fore GA, Filippelli GM, Hess JL. A systematic review of the literature on situated learning in the geosciences: beyond the classroom. *Int J Sci Educ*. 2020;42(5):722–43.
- Acosta J. Interdisciplinarietà y transdisciplinarietà: perspectivas para la concepción de la universidad por venir. *Alteridad*. 2016;11(2):148.
- Karunaratne T. For Learning Analytics to Be Sustainable under GDPR—Consequences and Way Forward. *Sustainability*. 2021;13(20):11524.
- Amen V, Edwards R. Better teaching and more learning in mobile learning courses: Towards a model of personable learning. In: *Proceedings of the 14th International Conference on Mobile Learning* [Internet]. 2018 [cited 2023 Feb 19]. p. 214–8. Available from: <https://files.eric.ed.gov/fulltext/ED590379.pdf>
- Eng N. The Impact of Demographics on 21st Century Education. *Society*. 2013;50(3):272–82.
- Fernández TM, Dias B. Turbulent waters: the overlap of the educational turn in art and the pictorial turn in education. *Artnodes*. 2016;(17).
- Szpytma C, Szpytma M. Model of 21st century physical learning environment (MoPLE21). *Think Skills Creat*. 2019;34:100591.
- Wahyu Y, Sadia IW, Suarni NK, Suastra IW. The Effect of science learning bases-STEM assisted

- by augmented reality toward scientific attitudes and science outcomes. *J Phys Conf Ser.* 2020;1567(4):042015.
- Ghorbani AA, Sohrabi Z, Yazdani S, Khalili Azandehi S. Towards the third generation universities: The core innovative function approach. *Med J Islam Repub Iran.* 2021;35:32.
- Karahan M, Peşmen S. Some Universities Performance Evaluation of Entrepreneurship and Innovation in Turkey with Multiple Criteria Decision Making Methods. In: *Digital Conversion on the Way to Industry 40.* Springer International Publishing; 2021. p. 569–83.
- Bahoo-Toroodi T, Yousefi-Saidabadi R, Saffarian Hamedani S. The Role of Leading Professors and Responsive Teaching on Development of Third Generation University and Presenting a Model in Mazandaran University of Medical Sciences. *Journal of Mazandaran University of Medical Sciences [Internet].* 2020 [cited 2024 Feb 20];30(188):116–24. Available from: <https://jmums.mazums.ac.ir/article-1-14468-en.html>
- Ghorbani AA, Sohrabi Z, Yazdani S, Khalili Azandehi S. <p>Structural Requirements of the Third-Generation University: The Case of Medical Sciences Universities in Iran</p>. *Adv Med Educ Pract.* 2020;11:63–70.
- Bielicki M, Stevenson B. Business Pre-Incubators as Structures for Change Toward the Entrepreneurial and Third Generation University. In: *Proceedings of the 15th European Conference on Innovation and Entrepreneurship a Virtual Conference.* Academic Conferences and Publishing International Limited; 2020. p. 120–7.
- Suyadi S, Widodo H. Millennialization of Islamic Education Based on Neuroscience in the Third Generation University in Yogyakarta Indonesia. *QIJIS (Qudus International Journal of Islamic Studies).* 2019;7(1):173.
- Parentelli V. Interdisciplina: La polisemia y la concepción de los docentes. *InterCambios Dilemas y Transiciones de la Educación Superior.* 2015;2(2):62–9.
- Revel Chion A. La interdisciplina, entendida como estrategia metodológica de integración de contenidos. *Ciencias sociales y educación.* 2013;2(4):21–40.
- Luengo González E. Hacia la síntesis de conocimientos. *Interdisciplina, transdisciplina y complejidad. Espiral (Guadalaj).* 2021;28(80):47–76.
- Panychev A, Pokrovskaya O. The Third-Generation University Ecosystem in the Context of Global Digitalization. In: *International Scientific Siberian Transport Forum TransSiberia.* Springer International Publishing; 2022. p. 100–8.
- Garcés LJ. ¿Educación, disciplina sin fronteras? Utopía y praxis latinoamericana: revista internacional de filosofía iberoamericana y teoría social. 2021;94:128–36.
- Santangelo J, Hobbie L, Lee J, Pullin M, Villa-Cuesta E, Hyslop A. The (STEM)2 Network: a multi-institution, multidisciplinary approach to transforming undergraduate STEM education. *Int J STEM Educ.* 2021;8(1):3.
- Aris SRS, Isa WARWM, Yahaya WAW, Mohamad SNA. Multidisciplinary curriculum design approaches towards balanced and holistic graduates. In: *2017 IEEE 9th International Conference on Engineering Education (ICEED).* IEEE; 2017. p. 17–22.
- Oliveira S, Olsen L, Malki-Epshtein L, Mumovic D, D’Ayala D. Transcending disciplines in architecture, structural and building services engineering: a new multidisciplinary educational approach. *Int J Technol Des Educ.* 2022;32(2):1247–65.
- Alley W, Burns C, Hartman N, Askew K, Mahler S. 3 for the Price of 1: Teaching Chest Pain Risk Stratification in a Multidisciplinary, Problem-based Learning Workshop. *Western Journal of Emergency Medicine.* 2018;19(3):613–8.
- Kuiphuis-Aagten D, Slotman KMJ, MacLeod M A J. Interdisciplinary education: A case study

- at the University of Twente. In: Nagy B V, Murphy M, Jarvinen HM, Kalman A, editors. SEFI 47th Annual Conference: *Varietas Delectat*. Complexity is the New Normality, Proceedings. Societe Europeenne pour la Formation des Ingenieurs (SEFI); 2019. p. 32–57.
- Chira RG. From mathematics to literature – an interdisciplinary approach. *THE JOURNAL OF LINGUISTIC AND INTERCULTURAL EDUCATION*. 2019;12(1):19–34.
- McKinley J, McIntosh S, Milligan L, Mikolajewska A. Eyes on the enterprise: problematising the concept of a teaching-research nexus in UK higher education. *High Educ (Dordr)*. 2021;81(5):1023–41.
- Augsburg T. Becoming Transdisciplinary: The Emergence of the Transdisciplinary Individual. *World Futures*. 2014;70(3–4):233–47.
- Wang Z, Gong Y, Wu F fei, Li Y. Five key issues in inter- and transdisciplinary research grant: A literature review. In: 2016 International Conference on Management Science and Engineering (ICMSE). IEEE; 2016. p. 837–42.
- Lattanzio S, Nassehi A, Parry G, Newnes LB. Concepts of transdisciplinary engineering: a transdisciplinary landscape. *International Journal of Agile Systems and Management*. 2021;14(2):292–312.
- Olivé Morett L, Argueta Villamar A, Puchet Anyul M. Interdisciplina y transdisciplina frente a los conocimientos tradicionales. *CTS*. 2018;13(38):135–53.
- Nicolescu B. *Manifesto of transdisciplinarity*. Suny Press; 2002.
- Choi BCK, Pak AWP. Multidisciplinarity, interdisciplinarity and transdisciplinarity in health research, services, education and policy: 1. Definitions, objectives, and evidence of effectiveness. *Clin Invest Med*. 2006;29(6):351–64.
- Rodrigo-Comino J, López-Vicente M, Kumar V, Rodríguez-Seijo A, Valkó O, Rojas C, et al. Soil Science Challenges in a New Era: A Transdisciplinary Overview of Relevant Topics. *Air, Soil and Water Research*. 2020;13:117862212097749.
- Asmolov AG. Race for the Future. *Russian Education & Society*. 2018;60(5):381–91.
- Sukcharoen K, Everson M, van Hamel C. A novel approach to Junior Doctor Induction: A near-peer based curriculum developed and delivered by outgoing Foundation year doctors. *BMJ Qual Improv Rep*. 2014;3(1):u203556.w1603.
- Selberg H, Fuglsang S, Bloch C. 7 Measuring the effects of simulation training for 3rd year nursing students: an experimental study. In: Abstracts. British Medical Journal Publishing Group; 2023. p. A4–A4.
- Tofil NM, Morris JL, Peterson DT, Watts P, Epps C, Harrington KF, et al. Interprofessional simulation training improves knowledge and teamwork in nursing and medical students during internal medicine clerkship. *J Hosp Med*. 2014;9(3):189–92.
- Mileder LP, Schwabberger B, Baik-Schneditz N, Ribitsch M, Pansy J, Raith W, et al. Sustained decrease in latent safety threats through regular interprofessional in situ simulation training of neonatal emergencies. *BMJ Open Qual*. 2023;12(4):e002567.
- Lyons J. Learning with technology: theoretical foundations underpinning simulations in higher education. In: Brown M, Hartnett M, Stewart T, editors. Tertiary Education Annual Conference. Australasian Society for Computers in Learning in Tertiary Education; 2012.
- Cleland JA, Abe K, Rethans JJ. The use of simulated patients in medical education: AMEE Guide No 42. *Med Teach*. 2009;31(6):477–86.
- Ng KKC. A review of the impact of the COVID-19 pandemic on pre-registration medical radiation science education. *Radiography*. 2022;28(1):222–31.
- Inciarte González A. Interdisciplinarietà y formación de postgrado. *Revista Venezolana de*

- Ciencias Sociales. 2005;9(1):36–51.
- Carvajal Escobar Y. Interdisciplinariedad:desafío para la educación superior y la investigación. *Luna azul*. 2010;31:156–69.
- García Magna D, Castillo Rodríguez C, Rios Moyano S, Cristofol Rodríguez C, Carrasco Santos MJ, Rodríguez Mérida RM, et al. La interdisciplinariedad en la educación superior: Propuesta de una guía para el diseño de juegos de rol. *Teoría de la Educación Educación y Cultura en la Sociedad de la Información*. 2011;12(1):383–413.
- Henao Villa CF, García Arango DA, Aguirre Mesa ED, González García A, Bracho Aconcha R, Solorzano Movilla JG, et al. Multidisciplinariedad, interdisciplinariedad y transdisciplinariedad en la formación para la investigación en ingeniería. *Rev Lasallista Investig*. 2017;14(1):179–97.
- Navarro-Parra SL, Chiappe A. Simulated learning environments as an interdisciplinary option for vocational training: A systematic review. *Simul Gaming*. 2023;55(2):104-123. doi:10.1177/10468781231221904.