

Lesandro Ponciano

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Also known as: Lesandro Ponciano dos Santos

ORCID: <https://orcid.org/0000-0002-5724-0094>

Expertise: Collaborative Systems • HCI • e-Science • Citizen Science • Collective Intelligence

Experience: Quantitative Research • System Simulation • Data Modeling • Data Mining

Languages: Portuguese (native) • English (advanced)

Education

PhD. in Computer Science (2012 - 2015) • Federal University of Campina Grande, Brazil

- Thesis: Human Computation from the Perspective of the Engagement and Credibility of Humans and the Replication of Tasks
- Advisor: Francisco Brasileiro, PhD. Newcastle University (UK)

M.Sc. in Computer Science (2009 - 2011) • Federal University of Campina Grande, Brazil

- Thesis: Assessing Energy Saving Strategies in Peer-to-Peer Opportunistic Grids
- Advisor: Francisco Brasileiro, PhD. Newcastle University (UK)
- Distinction: **Summa cum laude**

B.Sc. in Information Systems (2005 - 2008) • Pontifical Catholic University of Minas Gerais, Brazil

- Distinction: **Summa cum laude (best grade)**

Research Experience

Pos-doc Researcher (01/2022 - 12/2022) • Dresden University of Technology, Germany

- Project: AI-Sprint - Artificial intelligence in Secure Privacy-preserving computing coNTinuum
- Funding: European Union Horizon 2020 (Grant Agreement No. 101016577)

Researcher (02/2016 - 12/2016) • Laboratory of Distributed Systems, Brazil

- Project: PrivIoT - Privacy on the Internet of Things
- Funding: Hewlett-Packard (HP)

Doctoral Researcher (02/2012 - 12/2015) • Federal University of Campina Grande, Brazil

- Brazilian National Council for Scientific and Technological Development (CNPq) scholarship
- Topics: Human computation, citizen science and distributed systems

Undergraduate Researcher (02/2006 - 01/2008) • Pontifical Catholic University of Minas Gerais, Brazil

- 2007 - Brazilian National Council for Scientific and Technological Development (CNPq) scholarship
- 2006 - Scientific Initiation Scholarship Program (PROBIC) scholarship

Academic Experience

Associate Professor (02/2016 - current) • Pontifical Catholic University of Minas Gerais, Brazil

- Institute of Exact Sciences and Informatics- Department of Software Engineering and Information Systems
- Programs: Computer Science, Software Engineering, Information Systems, Electrical Engineering

Advising and consulting (2020, 2023, 2025) • Institute of Educational Studies and Research (INEP), Brazil

- National Institute of Educational Studies and Research Anísio Teixeira (Inep).
- Developer of items with the National Item Bank (BNI) for the National Student Performance Exam (ENADE).

Analytics Tutor (01/2012 - 05/2013) • Federal University of Campina Grande, Brazil

- Funding: Hewlett-Packard (HP) Brazil
- Technical skills: R, Python, Data Visualization, Statistics

Scientific Awards

- 2024** **Special Recognitions for Outstanding Reviews**, the ACM Group 2024/25 Conference. Association for Computing Machinery
- 2022** **Special Recognitions for Outstanding Reviews**, the ACM Group 2022/23 Conference. Association for Computing Machinery
- 2021** **Best reviewers. Brazilian Symposium on Computer Education (EduComp)**. Brazilian Computer Society.
- 2020** **Honourable Mention in Exact Sciences as advisor of undergraduate research** (student Gabriel Moreira Chaves). The 28th Scientific Initiation Seminar, Pontifical Catholic University of Minas Gerais.
- 2019** **Special Recognitions for Outstanding Reviews**, the ACM CHI 2020 Conference. Association for Computing Machinery
- 2018** **Honourable Mention in Exact Sciences as advisor of undergraduate research** (student Arthur V. Soares Pereira). The 26th Scientific Initiation Seminar, Pontifical Catholic University of Minas Gerais.
- 2017** **Third best paper of the Brazilian Symposium on Collaborative Systems (SBSC)**, paper: "Analysis of the Popularity, Visibility and Activity of Different Types of Robots on the Social Network Twitter." Brazilian Computer Society.
- 2014** **Student Scholarship at the 10th IEEE International eScience Conference**, The IEEE eScience International Conference. IEEE Computer Society.
- 2011** **Best Computer Science Master Thesis in Brazil- Finalist** (one of 10). Brazilian Computer Society.
- 2010** **Honourable Mention for the paper "Analysis of Green Computing Strategies in Opportunistic Computational Grids"**. The XXVIII Brazilian Symposium on Computer Networks and Distributed Systems.
- 2008** **Honourable Mention for the work "Analysis of Classification and Clustering Algorithms in the Discovery and Prediction of the Behavior of Parallel Tasks"**. The 16th Scientific Initiation Seminar, Pontifical Catholic University of Minas Gerais.
- 2007** **Honourable Mention for the article "Technique for Characterization of Workload of Parallel Machines to Extract Information Used by a Reconfigurable Task Scheduler"**. Scientific Initiation Papers Competition, the VIII Symposium on Computer Systems (WSCAD-CSS). Brazilian Computer Society.
- 2007** **Honourable Mention for the work "Proposal, Implementation and Evaluation of a Workload Characterization Technique for Parallel Machines for the Extraction of Information Used by a Scheduler"**. The 15th Scientific Initiation Seminar, Pontifical Catholic University of Minas Gerais.
- 2006** **Honourable Mention for the work "Advancement and Exclusion: Two Faces of the Digital Age, A Sociotechnical Analysis of TIs"**. The 14th Scientific Initiation Seminar, Pontifical Catholic University of Minas Gerais.

Academic Awards

- 2024** **Honoured Professor award**, granted by students at their commencement ceremony. Software Engineering. The Pontifical Catholic University of Minas - Lourdes.
- 2021** **Honoured Professor award**, granted by students at their commencement ceremony. Information System Program. The Pontifical Catholic University of Minas - Contagem.
- 2020** **Honoured Professor award**, granted by students at their commencement ceremony. Information System Program. Pontifical Catholic University of Minas - Barreiro.
- 2019** **Honoured Professor award**, granted by students at their commencement ceremony. Information System Program. Pontifical Catholic University of Minas - Barreiro.
- 2019** **Outstanding Teaching Performance**, granted by Pontifical Catholic University of Minas Gerais
- 2018** **Honoured Professor award**, granted by students at their commencement ceremony. Information System Program. The Pontifical Catholic University of Minas - Contagem.
- 2018** **Outstanding Teaching Performance**, granted by Pontifical Catholic University of Minas Gerais
- 2011** **Summa cum laude: Master's dissertation approved with distinction**, Graduate Program in Computer Science, Center for Electrical Engineering and Informatics. Federal University of Campina Grande.
- 2008** **Summa cum laude: Second-best academic performance throughout the Bachelor's Degree in Information Systems**, Pontifical Catholic University of Minas Gerais (PUC Minas)

Peer-reviewed Conference and Journal Publications [Published in English]

- [1] Ponciano, L. **How citizens engage with the social media presence of climate authorities: the case of five Brazilian cities.** *npj Clim. Action* 2, 44 (2023). DOI: [10.1038/s44168-023-00080-3](https://doi.org/10.1038/s44168-023-00080-3) Full
- [2] Ramos, H.; Fonseca, M.; Ponciano, Lesandro. **Modeling and Evaluating Personas with Software Explainability Requirements.** In *VII Iberoamerican Workshop on Human-Computer Interaction*. 2021. DOI: [10.1007/978-3-030-92325-9_11](https://doi.org/10.1007/978-3-030-92325-9_11) Full

- [3] Nelson, M. A; Ponciano, Leandro, "**Experiences and insights from using Github Classroom to support Project-Based Courses**". In 2021 *Third International Workshop on Software Engineering Education for the Next Generation (SEENG)* at ICSE-JSEET. 2021. pp. 31-35. IEEE. DOI: [10.1109/SEENG53126.2021.00013](https://doi.org/10.1109/SEENG53126.2021.00013) Full
- [4] PILAND, N.; VARESE, M.; SOACHA, K.; Ponciano, Leandro; CASTANEDA, A.; ALVAREZ, H. G.; CUEVA, R.; DONOFRIO, G.; ESPITIA, J. E.; JURADO, C.; KOVACH, A.; LUIS, C.; MALDONADO, W.; CALLEJAS, S. M.; PIERA, J.; PLOS, A.; RESTREPO, J. F.; SANCHEZ, M.; SANDOVAL, M. J.; TORRES, D.; TORRICO, O.; WALLACE, R. B. **Citizen science from the Iberoamerican perspective: an overview, and insights by the RICAP network**. In: European Citizen Science Association Conference (ECSA Conference 2020), 2020, Trieste. DOI: [10.5281/zenodo.4019060](https://doi.org/10.5281/zenodo.4019060) Poster
- [5] de Macêdo Morais, L. A.; Andrade, N.; de Sousa, D. M. C.; Ponciano, Leandro. **Defamiliarization, representation granularity, and user experience: A qualitative study with two situated visualizations**. In *2019 IEEE Pacific Visualization Symposium (PacificVis)*. 2019, pp. 92-101. IEEE. DOI: [10.1109/PacificVis.2019.00019](https://doi.org/10.1109/PacificVis.2019.00019) Full
- [6] Ponciano, Leandro; Pereira, Thiago Emmanuel. "**Characterising volunteers' task execution patterns across projects on multi-project citizen science platforms**." *Proceedings of the 18th Brazilian Symposium on Human Factors in Computing Systems*. 2019. pp. 1-11. ACM. DOI: [10.1145/3357155.3358441](https://doi.org/10.1145/3357155.3358441) Full
- [7] Ponciano, Leandro. **HCI Support Card: Creating and Using a Support Card for Education in Human-Computer Interaction**. In: Workshop on HCI Education, *Extended Proceedings of the 18th Brazilian Symposium on Human Factors in Computing Systems*. Porto Alegre, Brasil: SBC, 2019. pp. 106-111. DOI: [10.5753/ihc.2019.8409](https://doi.org/10.5753/ihc.2019.8409) Full
- [8] Ponciano, Leandro; Brasileiro, Francisco. "**Agreement-based credibility assessment and task replication in human computation systems**." *Future Generation Computer Systems*, 87 (2018): 159-170. DOI: [10.1016/j.future.2018.05.028](https://doi.org/10.1016/j.future.2018.05.028) Full
- [9] Ponciano, Leandro; Barbosa, Pedro; Brasileiro, Francisco; Brito, Andrey; Andrade, Nazareno. "**Designing for Pragmatists and Fundamentalists: Privacy Concerns and Attitudes on the Internet of Things**." *Proceedings of the XVI Brazilian Symposium on Human Factors in Computing Systems*. 2017. pp. 1-10. ACM. DOI: [10.1145/3160504.3160545](https://doi.org/10.1145/3160504.3160545) Full
- [10] Eitzel, M.V., Cappadonna, J.L., Santos-Lang, C., Duerr, R.E., Virapongse, A., West, S.E., Kyba, C.C.M., Bowser, A., Cooper, C.B., Sforzi, A., Metcalfe, A.N., Harris, E.S., Thiel, M., Haklay, M., Ponciano, Leandro., Roche, J., Ceccaroni, L., Shilling, F.M., Dörler, D., Heigl, F., Kiessling, T., Davis, B.Y. and Jiang, Q., 2017. "**Citizen Science Terminology Matters: Exploring Key Terms**". *Citizen Science: Theory and Practice*, 2(1), p.1. DOI: [10.5334/cstp.96](https://doi.org/10.5334/cstp.96) Full
- [11] Ponciano, Leandro; Brasileiro, Francisco; Simpson, Robert; Smith, Arfon. "**Volunteers' Engagement in Human Computation for Astronomy Projects**". *Computing in Science & Engineering*, v. 16, p. 52-59, 2014. DOI: [10.1109/MCSE.2014.4](https://doi.org/10.1109/MCSE.2014.4) Full
- [12] Ponciano, Leandro; Brasileiro, Francisco. "**Finding Volunteers' Engagement Profiles in Human Computation for Citizen Science Projects**". *Human Computation*, v. 1, n. 1, p. 245-264, 2014. DOI: [10.15346/hc.v1i2.12](https://doi.org/10.15346/hc.v1i2.12) Full
- [13] Ponciano, Leandro; Brasileiro, Francisco; Andrade, Nazareno; Sampaio, Livia. "**Considering Human Aspects on Strategies for Designing and Managing Distributed Human Computation**". *Journal of Internet Services and Applications*, v. 5, p. 1-28, 2014. DOI: [10.1186/s13174-014-0010-4](https://doi.org/10.1186/s13174-014-0010-4) Full
- [14] Ponciano, Leandro; Brasileiro, Francisco. "**Assessing Green Strategies in Peer-to-Peer Opportunistic Grids**". *Journal of Grid Computing*, v. 11, p. 129-148, 2013. DOI: [10.1007/s10723-012-9218-3](https://doi.org/10.1007/s10723-012-9218-3) Full
- [15] PONCIANO, Leandro; Andrade, Nazareno; Brasileiro, Francisco. **BitTorrent traffic from a caching perspective**. *Journal of the Brazilian Computer Society*, v. 19, p. 475-491, 2013. DOI: [10.1007/s13173-013-0112-z](https://doi.org/10.1007/s13173-013-0112-z) Full
- [16] PONCIANO, Leandro; Brasileiro, Francisco; Gadelha, Guilherme. **Task Redundancy Strategy Based on Volunteers' Credibility for Volunteer Thinking Projects**. In: AAAI Conference on Human Computation and Crowdsourcing, 2013, Palm Springs. p. 60-61. short
- [17] Ponciano, Leandro; Brito, Andrey; Sampaio, Livia; Brasileiro, Francisco. **Energy-Efficient Computing through Productivity-Aware Frequency Scaling**. In: 2012 International Conference on Cloud and Green Computing (CGC), 2012, Xiangtan. 2012. p. 191-198. DOI: [10.1109/CGC.2012.59](https://doi.org/10.1109/CGC.2012.59) Full
- [18] Alves, Luiz; Maciel, Matheus; Ponciano, Leandro; Brito, Andrey. **Assessing the impact of the social network on marking photos as favorites in Flickr**. In: 18th Brazilian Symposium on Multimedia and the Web, 2012, São Paulo/SP. New York: ACM Press. p. 79-82. DOI: [10.1145/2382636.2382655](https://doi.org/10.1145/2382636.2382655) Full
- [19] Ponciano, Leandro; Brasileiro, Francisco. **On the impact of energy-saving strategies in opportunistic grids**. In: Energy Efficient Grids, Clouds and Clusters Workshop (E2GC2 2010), 2010, Brussels. 11th ACM/IEEE International Conference on Grid Computing (Grid 2010), 2010. v. 1. p. 282-289. DOI: [10.1109/GRID.2010.5698003](https://doi.org/10.1109/GRID.2010.5698003) Full

Peer-reviewed Conference and Journal Publications *[Published in Portuguese]*

- [1] LOUZADA, HENRIQUE; CHAVES, GABRIEL; Ponciano, Lesandro. **Exploring user profiles based on their explainability requirements in interactive systems**. In: IHC '20: XIX Brazilian Symposium on Human Factors in Computing Systems, 2020, Diamantina Brazil. New York: ACM, 2020. p. 1-6. DOI: [10.1145/3424953.3426545](https://doi.org/10.1145/3424953.3426545) Full
- [2] Ponciano, Lesandro. **"Structured Debate: A Pedagogical Strategy for Teaching and Learning Human Values in Human-Computer Interaction"**. (Portuguese: Debate Estruturado: Uma Estratégia Pedagógica para Ensino e Aprendizagem de Valores Humanos em Interação Humano-Computador). In: Workshop on HCI Education, 2018. Anais Estendidos do XVII Simpósio Brasileiro de Fatores Humanos em Sistemas Computacionais (IHC). DOI: [10.5753/ihc.2018.4209](https://doi.org/10.5753/ihc.2018.4209) Full
- [3] VALGAS, A.; CARMO, F.; Ponciano, Lesandro; GOES, L. **"Analysis of Popularity, Visibility and Activity of Different Types of Socialbots on Twitter Social Network"**. (Portuguese: Análise da Popularidade, Visibilidade e Atividade de Diferentes Tipos de Robôs na Rede Social Twitter). In: XIV Simpósio Brasileiro de Sistemas Colaborativos, 2017, São Paulo. XXXVII Congresso da Sociedade Brasileira de Computação. Porto Alegre: Sociedade Brasileira de Computação, 2017. v. 1. p. 1342-1355. DOI: [10.5753/sbsc.2017.9958](https://doi.org/10.5753/sbsc.2017.9958) Full
- [4] RAMOS, S. L. ; Góes, Luiz Fabrício; Ponciano, Lesandro; FRANCA, C.; MORAIS, H. . **"Assessing Players' Perception of Hearthstone Digital Card Game Combo Creativity"**. (Portuguese: Avaliação da Percepção de Jogadores sobre a Criatividade de Combos do Jogo Digital de Cartas Hearthstone). In: Simpósio Brasileiro de Jogos e Entretenimento Digital (SBGames), Porto Alegre: SBC, 2016. p. 190-193. Short
- [5] Ponciano, Lesandro; Brasileiro, Francisco; Gadelha, Guilherme; Furtado, Adabriand. **Adaptive Task Replication Strategy for Human Computation**. In: 2014 Brazilian Symposium on Computer Networks and Distributed Systems (SBRC), 2014, Florianopolis. p. 249-257. DOI: [10.1109/SBRC.2014.30](https://doi.org/10.1109/SBRC.2014.30) Full
- [6] Oliveira, Jeymisson; Ponciano, Lesandro; Andrade, Nazareno; Brasileiro, Francisco. **"Strategies for obtaining a maximum item in Human Computation"**. (Portuguese: Estratégias de obtenção de um item máximo em Computação por Humanos). In: XXXI Simpósio Brasileiro de Redes de Computadores e Sistemas Distribuídos (SBRC 2013), 2013, Brasília. Porto Alegre: SBC, 2013. p. 253-266. Full
- [7] ARAÚJO, E. C.; Gaudencio, Matheus; Menezes, Andrey; Ferreira, Iury; Ribeiro, Iara; Fagner, Alberto; Ponciano, Lesandro; Moraes, Fábio; Guerrero, Dalton; Figueiredo, Jorge. **"The Role of Study Habits in Student Programming Performance"**. (Portuguese: O papel do hábito de estudo no desempenho do aluno de programação). In: Workshop sobre Educação em Computação (WEI), 2013, Maceió. Congresso da Sociedade Brasileira da Computação (CSBC). Porto Alegre: Sociedade Brasileira da Computação, 2013. p. 730-738. Full
- [8] Ponciano, Lesandro; Santana, Jaíndson; Carvalho, Marcus; Gaudêncio, Matheus; Brasileiro, Francisco. **"Analysis of Green Computing Strategies in Opportunistic Computational Grids"**. (Portuguese: Análise de Estratégias de Computação Verde em Grades Computacionais Oportunistas). In: XXVIII Simpósio Brasileiro de Redes de Computadores (SBRC), 2010, Gramado. Porto Alegre, Brasil: SBC, 2010. v. 1. p. 307-320. Full
- [9] Ponciano, Lesandro; Brasileiro, Francisco; Santana, Jaíndson; Carvalho, Marcus; Gaudêncio, Matheus. **"Using Standby and Hibernate Strategies to Save Energy on Opportunistic Computational Grids."**. (Portuguese: Usando as Estratégias Sobreaviso e Hibernação para Economizar Energia em Grades Computacionais Oportunistas). Revista Brasileira de Redes de Computadores e Sistemas Distribuídos, v. 3, p. 9-20, 2010. Full

Open Access Datasets, Reports and Presentations

- [1] Ponciano, L. (2024). **Reflections on Community Communications for Climate Adaptation and Preparedness through Information and Communication Technologies**. Pernambuco Seminar on Visualization and Sustainability (PSVS24), Pernambuco, Brazil. Zenodo. <https://doi.org/10.5281/zenodo.14571997>
- [2] Ponciano, L. (2024). **Construindo Capacidade em Ciência Cidadã: Dados, Informações e Conhecimentos na Construção e Partilha do Saber**. Citizen Science Masterclass, jointly organized by the Association of European Research Libraries (LIBER) and the Hernán Santa Cruz Library of the Economic Commission for Latin America and the Caribbean (ECLAC). Zenodo. <https://doi.org/10.5281/zenodo.14571798>
- [3] Ponciano, L. (2023). **Meteorological warnings issued by INMET for the Brazilian cities of Belém, Belo Horizonte, Porto Alegre, Rio de Janeiro, and São Paulo between 2021 and 2022** [Data set]. In npj Clim. Action (1.0.0, Vol. 2, Número 1, p. 44). Zenodo. <https://doi.org/10.5281/zenodo.8018165>
- [4] Ponciano, L. (2023). **Publications from government weather and climate authorities on the X platform and replies from citizens in five Brazilian cities during a year between 2021 and 2022** [Data set]. In npj Clim. Action (1.0.0, Vol. 2, Número 1, p. 44). Zenodo. <https://doi.org/10.5281/zenodo.7831681>

Scientific Journal Services

- 2024-2025, reviewer for **npj Climate Action** journal
- 2022, reviewer for **PeerJ** journal
- 2022, reviewer for **IEEE Transactions on Cloud Computing** journal
- 2021, reviewer for **Frontiers in Psychology** journal
- 2021, reviewer for **Frontiers in Ecology and Evolution** journal
- 2019, reviewer for **SBC Journal on 3D Interactive Systems** journal
- 2014, reviewer for **IEEE Transactions on Human-Machine Systems** journal
- 2015-2018, reviewer for **Journal of Science Communication**
- 2015-2016, reviewer for **Human Computation** journal
- 2013-2016, reviewer for **IEEE Computing in Science & Engineering** journal

Scientific Society and Association Activities

- Since 2017, member of the **Brazilian Computer Society (SBC)**, Brazil.
- Since 2019, member of the **Brazilian Society for the Advancement of Science (SBPC)**, Brazil.
- Since 2019, member of the **Iberoamerican Network of Participatory Science (RICAP)**, Colombia.
- From 2015 until 2020, member of the **Citizen Science Association (CSA)**, United States.

Scientific Conference Services

Technical Program Committee

- 2021-2025: **ACM International Conference on Supporting Group Work (GROUP)**.
- 2021: **Ibero-American Conference on Human-Computer Interaction**.
- 2018 - 2021: **Brazilian Symposium on Human Factors in Computer Systems (IHC)**.
- 2017-2021: **Brazilian Symposium on Collaborative Systems (SBSC)**.
- 2021: **Brazilian Symposium on Computer Education (EduComp)**.
- 2020: **Contest for Scientific Initiation Papers in Software Engineering (CTIC-ES)** of the Brazilian Symposium on Software Engineering (SBES).

External Reviewer

- 2022: **ACM CHI Conference**. Case study papers.
- 2019-2020: **ACM CHI Conference**. Full Papers.
- 2014: **IEEE International Conference on Distributed Computing Systems (ICDCS)**
- 2011: **Workshop on P2P, Dynamic, Social and Content Oriented Networks (SBRC - Wp2p+)**
- 2011: **Symposium on Computer Systems (WSCAD-SSC)**
- 2011: **Scientific Initiation Workshop in Computer Architecture and High-Performance Computing (WSCAD-WIC)**

Attendee

- 2021 - International Conference on Discovery Science - Online
- 2021 - Brazilian Symposium on Computer Education - Online
- 2020 - European Citizen Science Conference - Online
- 2020 - Brazilian Symposium on Human Factors in Computing Systems - Online
- 2019 - Brazilian National Science and Technology Week - Ponte Nova/Brazil
- 2018 - Brazilian Symposium on Human Factors in Computing Systems - Belém/Brazil
- 2017 - Citizen Science Association Conference - Twin Cities/USA
- 2017 - Brazilian Symposium on Human Factors in Computing Systems - Joinville/Brazil
- 2017 - Congress of the Brazilian Computer Society - São Paulo/Brazil
- 2014 - IEEE International Conference on eScience - São Paulo/Brazil
- 2014 - Brazilian Symposium on Computer Networks and Distributed Systems - Florianópolis/Brazil
- 2013 - AAAI Conference on Human Computation and Crowdsourcing - Palm Spring/ USA
- 2012 - Congress of the Brazilian Computer Society - Curitiba/Brazil
- 2010 - IEEE/ACM International Conference on Grid Computing - Brussels/Belgium
- 2010 - Brazilian Symposium on Computer Networks and Distributed Systems - Gramado/Brazil
- 2007 - IEEE International Symposium on Computer Architecture and High-Performance Computing - Gramado/Brazil

Scientific Impact

- [Google Scholar](#): **(43 indexed documents)** received citations 1374 • h-index 11 • i10-index 12.
- [Scopus](#): **(17 indexed publications)** received citations 114 • h-index 5
- [Web of Science](#): **(13 indexed publications)** received citations 69 • h-index 5