Networks and Learning Analytics:
Addressing Educational Challenges

Mohammed Saqr [1], Sonsoles López-Pernas [1], Ángel Hernández García [2], Miguel Ángel Conde [3] and Oleksandra Poquet [4]

[1] *University of Eastern Finland, Yliopistokatu 2, Joensuu, 80100, Finland*
[2] *Univerisidad Politécnica de Madrid, Av. Complutense 30, Madrid, 28040, Spain*
[3] *University of León, Campus de Vegazana s/n, León, 24071, Spain*
[4] *University of South Australia, City West Campus, Adelaide, 5000, Australia*

Abstract
Network Analysis is an established method in learning analytics research. Network Analysis has been used to analyze learners' interactions, to inform learning design, and to model students' performance. The workshop entitled "Using Network Science in Learning Analytics: Building Bridges towards a Common Agenda", carried out within the LAK2021 conference, resulted in valuable insights and outcomes: guidelines for better reporting, methodological improvements, and discussions of several novel research threads. Traditionally, the focus of the conversation has been on methodological issues of network analysis. This year, we would like to extend the conversation by slightly shifting the focus to what network analysis can do to improve learning and educational opportunities. As such, this new edition of the workshop aims to build on the fruitful achievements of the previous iteration to address new themes, which we refer to as "challenges and opportunities" in relation to practice. This edition of the workshop sought contributions around examples of applications and impact, including those that can help address societal challenges embedded within educational practices and those that foster an open conversation about privacy and ethical implications of network data.

Keywords
Social network analysis, network science, learning analytics, network analysis

Networks are the fundamental building blocks behind several related fields, such as Social Network Analysis, Network Science and Network Analysis. In education, these terms have been loosely and interchangeably employed across several domains of applications. Therefore, we use the term network analysis to refer to any application of network-based techniques in education. Network analysis predates the birth of learning analytics as a field. However, a significant upsurge of research at the intersection of networks and education has been kindled by the growing interest in learning analytics [1]. Such an upsurge has made network analysis methods gain popularity in learning analytics research. The wealth, ease, and flexibility of network analysis have contributed to a wide range of applications across several domains (Borgatti et al., 2009). Early applications of network analysis included tools for the analysis of learners' interactions and the patterns derived from those interactions, as well as using SNA to inform learning (Lockyer et al., 2013). Combining network analysis with other quantitative methods has augmented our understanding of collaborative learning interactions and discourse [2] and improved the identification of relevant actors and roles in the learning process [3], among others. Recently, a growing number of research articles have looked at

the usefulness of network analysis as a method for modelling students' performance [4] and modelling novel interaction platforms, such as instant messaging [5], to mention a few.

The rapid development of the field of social network analysis and the closely related fields (e.g., network science, complexity science and psychological networks) has progressed our understanding of the world: from the structure of genes to the spread of diseases and the development of efficient algorithms [6]. Nonetheless, the pace of research in learning analytics has not harnessed the full potential of emerging and rapidly-developing network methods [2,7]. Several recent systematic reviews, discussion papers and scholars have highlighted some of the challenges in this research area: predominance of descriptive methods, paucity of temporal network analysis, underusage of network inference methods, lag of adoption of modern analytics techniques (e.g., psychological network methods) and sub-optimal reporting [1,2,7]. The challenges faced by network researchers and educationists can be varied, complex and rapidly changing. However, issues that address methodological rigor and impact are arguably more urgent to address. Rigor, better reporting and replicability allow researchers to build on research findings and advance our understanding of theory and practice [2], while impactful research helps researchers, practitioners and society at large better adopt the methods.

This workshop aims to address new themes, building on the fruitful accomplishments of the previous iterations. The themes emerge as "challenges and opportunities" in relation to practice. The workshop was designed to foster the sharing of perspectives, strengthen the community of scholars working in the network community, and generate new ideas regarding the future of the field. To address the current challenges of SNA in the field of learning analytics, participants were invited to contribute their latest research in one of the following themes:

- How can methodological rigor and reporting be balanced with practical relevance?
- How can researchers address the issues of practical applications and impact? In other words, how can we translate research results from academic and scholarly publications into actionable tools or methods that teachers can use in their teaching practice.
- How can network approaches inform socio-emotional and communication skills?
- How can network approaches contribute to the development of equitable educational practices?
- What are the ethical and privacy applications for using network analysis in learning analytics?
- How to implement successful network analytical applications that analyze systems to help advance impact in learning analytics?
- What interdisciplinary bridges between the field and other closely related fields can contribute to addressing educational challenges via network analytics approaches?
- How can educational researchers use modern network methods (e.g., psychological networks, inference network methods and network science) to advance current theoretical models and frameworks?
- How can education researchers contribute to the development of novel network methods, measures or techniques that considers the contextual factors that are specific to learning and teaching?
- How can network researchers contribute to more reproducible research?

The workshop also welcomed contributions discussing the potentials of novel methods or novel applications of existing methods and reflections on their relevance to practical applications, including but not limited to:

- Recent advances in SNA methods and approaches including new tools, measures, and techniques applied to learning.
- Innovative data collection, analysis, presentation, and visualization methods.
- Temporal networks, and temporal aspects of networks in general.
- Psychological networks.
- Generative network models.
- Software demonstration for analysis of learning networks.

Acknowledgements

References

[1] R. Kaliisa, B. Rienties, A.I. Mørch, A. Kluge, Social learning analytics in computer-supported collaborative learning environments: A systematic review of empirical studies, Computers and Education Open. 3 (2022) 100073.

[2] O. Poquet, M. Saqr, B. Chen, Recommendations for Network Research in Learning Analytics: To Open a Conversation, in: Proceedings of the NetSciLA21 Workshop, 2021.

[3] Á. Hernández-García, I. González-González, A.I. Jiménez-Zarco, J. Chaparro-Peláez, Applying social learning analytics to message boards in online distance learning: A case study, Comput. Human Behav. 47 (2015) 68–80.

[4] M. Saqr, J. Nouri, I. Jormanainen, A Learning Analytics Study of the Effect of Group Size on Social Dynamics and Performance in Online Collaborative Learning, in: M. Scheffel, J. Broisin, V. Pammer-Schindler, A. Ioannou, J. Schneider (Eds.), Transforming Learning with Meaningful Technologies, Springer International Publishing, 2019: pp. 466–479.

[5] M.Á. Conde, F.J. Rodríguez-Sedano, Á. Hernández-García, A. Gutiérrez-Fernández, Á.M. Guerrero-Higueras, Your teammate just sent you a new message! The effects of using telegram on individual acquisition of teamwork competence, Int. j. Interact. Multimed. Artif. Intell. 6 (2021) 225.

[6] M. Newman, Networks, 2nd ed., Oxford University Press, London, England, 2018.

[7] M. Dado, D. Bodemer, A review of methodological applications of social network analysis in computer-supported collaborative learning, Educational Research Review. 22 (2017) 159–180.