Concluding remarks of the NetSciLA22 Workshop

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Abstract
The NetScila22 workshop builds on the previous iterations of network analysis workshops. The current year themes addressed educational challenges as well as opportunities for future research and for strengthening the community. The workshop included valuable discussions and interactions with both experts and emerging researchers. Such discussions were augmented by a survey that gathered insights form workshop attendees. The discussants recommended improving methodological rigor, leveraging methods that positively impact learning, address data issues, e.g., collection, privacy and reporting as well as better alignment with theory. Other recommendations proposed human-centred artificial intelligence approaches grounded on cognitive science, better communication with stakeholders, sharing ideas within the community and organizing hands-on seminar. The workshop also included presentations that address methodological advances and future opportunities, e.g., temporal networks, semantic networks and attention network.

Keywords
network analysis, network science, learning analytics,, temporal network analysis, semantic networks

1. Introduction

This is the introductory article to the Networks and Learning Analytics (NetSciLA22) Workshop, held within the broader context of the 12th International Conference on Learning Analytics & Knowledge (LAK22), organized by the Society for Learning Analytics Research (SoLAR) online. The main objective of the workshop was to address new themes that might emerge as challenges and opportunities, while sharing perspectives and strengthening the community ties

of scholars working in the field of learning network analytics [1]. The workshop continued the work already done at NetSciLa21 last year [2].

At the core of NetSciLA is Social Network Analysis (SNA), a method that has gained important traction in learning analytics research. SNA has been used to analyze learners' interactions, to inform learning design, and to model students' performance. The previous edition of the workshop resulted in valuable insights and outcomes, such as guidelines for better reporting, methodological improvements, and discussions of several novel research threads; that is, the focus of the conversation has been on the methodological issues of SNA. As stated above, in this edition we aimed to extend the conversation by maintaining the focus on what learning analytics of networks in learning settings can do to improve learning and educational opportunities.

2. The NetSciLA22 Workshop: Addressing Educational Challenges

To achieve the main goals established, the workshop was structured in three sequential stages: submission of research studies, survey to participants and the workshop session. This section focuses on the second stage, while the first and third will be covered in Section 4.

2.1. Questionnaire to participants

To foster discussion during the second part of the workshop session (see Section 4), an online questionnaire (delivered via Google Forms) was sent to all contributing authors and registered participants one week before the workshop session. More precisely, the questionnaire asked the following questions:

- What educational challenge can we address together as a community?
- What challenges are of a priority to our research community?
- Which of these challenges are of common concern to all kinds of stakeholders, i.e. learners, instructors, administrators, institutions?
- What are your suggestions to help advance our field/community?
- Do you want to participate in a forum/special interest group for continuous discussion as a community?

Ten responses to the questionnaire were received from authors and workshop participants (who might not necessarily be authors). The first three questions were key to the development of the discussion during the workshop session, by exploring the most important challenges that a community on network science applied to learning analytics might address first, and how they related to all different agents and stakeholders involved.

The responses to the first question were very diverse and covered the following topics: measurement and collection/analysis/visualization of educational data, leveraging social network analysis to improve learning, learning design and emotional and social learning, building more resilient online and face-to-face learning platforms, and fostering learning communities at scale.

Regarding the challenges identified as priorities, while there was not a predominant challenge, three respondents mentioned data collection issues (e.g., one respondent indicated that as

"networks become complex with more data [they] need partial human intervention to clean them"), followed by operationalization and explanation of results. Other respondents mentioned understanding the impact of the COVID-19 pandemic on learning, data privacy policies, diversity, equity and inclusion, or the objective of decreasing dropout rates. Most respondents indicated the same priorities when asked which of them were of common concern to all stakeholders.

When asked for suggestions, only five respondents provided an answer to the fifth question, ranging from the proposal of novel human-centred artificial intelligence approaches grounded on cognitive science, improving communication with stakeholders to share the benefits of SNA in education, incorporation of more theory to better understand the formation and meaning of networks, sharing ideas within the community and organizing hands-on seminars.

The fifth and final question explored the interest of participants in formally establishing a special interest group focused on SNA for learning analytics. Seven respondents provided an affirmative answer, one participant declared that he/she was not interested and the remaining two were not sure. This result suggests that there is not only a need but also an interest in further advancing the field among contributors and participants. A recurring idea during the discussion, also in line with the responses to previous question, is that participants expressed their interest in having a more informal way to meet (compared to conferences or workshops) and discuss with other networks researchers, in which they could stay abreast of the latest advances in the field and discuss their findings. As network analysis is a multidisciplinary field that is not contained only within learning analytics, both organizers and participants agreed that it is challenging to find the right platform to hold these informal encounters among researchers.

3. Contributions to the workshop

In addition to this preface, four contributions were accepted to be published in this volume of the Workshop Proceedings. This section summarizes the topic, main findings and contributions of these research studies:

- In *Analysis of Discussion Forum Interactions for Different Teaching Modalities based on Temporal Social Networks*, López-Flores, Óskarsdóttir and Islind [3] investigate the students' activity and interaction dynamics in online forums across across different teaching modalities, following the instructional changes due to the COVID-19 pandemic, the shift to emergency remote teaching and the "new normality" (from fully on-site learning to fully online learning). The authors compare the data emerging from three temporal networks, one per year, consisting each of them of twelve snapshots of weekly interactions in forum threads. The analysis reveals differences in the students' and teachers' activity among the different teaching modalities. For students, the study finds higher activity in fully online courses, higher grades in active students (across all modalities, but especially in fully online teaching), faster network growth number of unique connections and engagement in fully online teaching. For instructors, the research finds higher influence of teachers in information diffusion in fully online teaching, as well as more and faster responses in this modality. The study also analyzes the content of the conversations, and finds that fully online teaching facilitates longer and more complex posts, and decreases the amount of anonymous posts.

- In *Reviewing Theoretical and Generalizable Text Network Analysis: Forma Mentis Networks in Cognitive Science*, Poquet and Stella [4] present an alternative approach to network representations of the text in learning settings, using the concept of Forma Mentis Networks, that is theory-based and can be applied to data sources that are either elicited from individuals or collected from written text, where network ties can be interpreted as associations or as sequences. The authors conclude that Forma Mentis Networks allow for a rigorous and scalable approach to represent network structures.
- In *The Why, the What and the How to Model a Dynamic Relational Learning Process with Temporal Networks*, Saqr and López-Pernas [5] outline the fundamentals of temporal network analysis, its potential for learning analytics purposes, and they analyze the differences of temporal network analysis and other types of network analysis and tools. The authors also provide readers with indications and resources on how to initiate themselves in this topic.
- In *Participation and Interaction Patterns of MOOC Learners with Different Learning Achievements: a Collective Attention Network Perspective*, Gao and Zhang [6] apply ecological models and complexity thinking to attention allocation in online environment. The authors adopt an open-flow network approach to investigate how different learning achievement groups allocate their attention at a collective level, using data from four editions one MOOC course as an example. The research finds that students' final performance is associated with their attention to the progress of the course and timely learning. The results also show differences in the patterns of collective attention among different learning achievement groups, with high-performing students being more likely to attend to the course syllabus and learning progress and low-performing students being more likely to wander around. The authors also find that the cost of collective attention while visiting different resources follows the pre-designed course structure, which emphasizes the influence of course design in students' behavior in the platform.

4. Organization details of the NetSciLA22 Workshop

4.1. Submission stage

After the workshop proposal was accepted in LAK22, the submission stage took place between October and December 2021. The call for participation was distributed via relevant mail lists, social networking sites and online websites related to research on social network analysis. A webpage (https://lak-sna.github.io) contained all the information about the workshop: organization, relevant dates, main topics to be addressed and information about the submission process. Authors were asked to submit an extended abstract of no less than 500 words through the EasyChair platform (https://easychair.org/conferences/?conf=netscila22), which would be reviewed by experts in the field. A total of eight submissions were received.

4.2. Questionnaire to participants

This stage has been explained in detail in Section 2.

4.3. Workshop session

The workshop session took place on March 21, 2022, via Zoom. The session was structured in two parts of 105 and 60 minutes, respectively. The first part of the session included an introduction by the organizers, as well as an overview of the status of network science for learning analytics, which was followed by a self-introduction of the participants in the session and four presentations of the submitted contributions to the workshop.

In the second part of the session, after a break, six participants discussed about the different questions asked in the online questionnaire. From the discussion, three ideas directly related to the research community of SNA in learning analytics: the need to better explain the benefits of SNA for learning analytics to all stakeholders, the fundamental role of higher education institutions' managers in supporting SNA initiatives, and the preference of using simple communication mechanisms among researchers in the community (e.g., message boards and mailing lists).

5. Conclusion

The NetSciLA22 workshop constituted a valuable opportunity for emerging and seasoned researchers in network analysis in education to meet and discuss shared challenges and available opportunities in the field. As a takeaway from the workshop, it became clear that the field faces numerous challenges that beg the need for further research. The main challenges are related to network data itself, regarding its collection from different sources, processing and cleaning the data, and analyzing and interpreting the results in context. Some of the challenges transcend to how we build better educational technology for improving collaborative learning while addressing diversity, equity and inclusion, and complying with current data privacy standards. Another conclusion gathered from the workshop is the need for the field of network analysis in education —due to its interdisciplinarity— to have a platform of its own —aside from the broad scope of learning analytics—, that would allow to incorporate network researchers in other areas to advance tools, findings and solutions.

Acknowledgments

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