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Cultivating and Supporting Learning Analytics Literacy using 3M Analytical Framework

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Abstract: The widespread adoption of personal computers and mobile devices has enabled learning analytics to become more pervasive among teachers, school administrators, students and parents. While the past decade has marked notable advancements in learning analytics, less attention has been paid to the unique characteristics of learning analytics that necessitate the notion of learning analytics literacy. Although researchers have documented the common use and misuse of learning analytics in education, there is still limited research that highlights the importance of cultivating literacy around the use of learning analytics for better understanding of teaching and learning practices. This paper describes how a Micro-Meso-Macro (3M) analytical approach can be used to support and enhance learning analytics literacy among education stakeholders, while raising the prospects of how a systematic implementation of raising learning analytics literacy can be done through two interacting themes: raising awareness and raising criticality.

Keywords: Learning analytics literacy, 3M framework, learning analytics, data literacy.

1. Introduction

Educational data have been readily collected from educational sites and institutions over the past few decades in hopes of providing a better understanding of teaching and learning. However, this avalanche of educational data has also contributed to emergent problems of how data can be better handled and analyzed to provide deeper insights for interventions (e.g., Jambunathan & Venkatesan, 2016; Lee & Tan, 2017). Data analysis has since revolved around the predominant use of learning analytics (LA), among other techniques such as big data methods and methodologies based on Artificial Intelligence (AI). Although LA has greatly influenced and impacted the use of technological tools for teaching and learning across the education spectrum, there remains limited research on how stakeholders within education systems can better interact with and approach the use of LA. In general, this calls for increased cultivation and support of LA literacy to address prominent challenges in adopting LA, such as more considerations that are required to establish communication channels among stakeholders and adopt pedagogy-based approaches to LA (Tsai & Gasevic, 2017). Further, it is imperative to review and further investigate the literacy levels of LA in individuals, factors influencing the use of LA at the institutional level, and educational policies and practices at the macro level across institutes and even possibly at a national level. The research question to be addressed is, “How can we support LA literacy for educational purposes at different levels of an educational ecosystem?”

2. Literature review

2.1 LA literacy

LA holds great potential in supporting personalized feedback at scale but impacts are inconsistent, reflecting the complexity of maximizing gains from using LA. A review of literature on teachers' and students' use of LA revealed that while they perceive LA to be beneficial (Pardo et al., 2019), they require more support to use it effectively (Lim et al., 2020). For instance, studies have found inconclusive effects on students' use of LA (Bodily & Verbert, 2017), as students may struggle to

interpret the LA report independently. As such, students' sensemaking of LA relies on the teachers' ability to interpret and communicate the results presented in the LA. Further, teachers are often assumed to be sufficiently well-equipped with the ability to use LA for their lessons (Yilmaz & Yilmaz, 2020). However, teachers struggle to use LA meaningfully in their teaching practice (van Leeuwen, 2019). In Ez-Zaouia, Tabard and Lavoué's (2020) study, teachers misused the LA dashboard that displays students' emotion data as a proxy to evaluate their teaching, broadly associating negative emotions with poor teaching. There appears an integral need for education stakeholders to go beyond the literal acceptance of LA's availability and existence and to transit towards a deeper appreciation and understanding of LA for meaningful use.

While LA can be used as part of mechanisms for closing the feedback loop during teaching and learning, the generalization of LA as a form of feedback often overlooks the unique characteristics and competencies required to utilize LA effectively. In this paper, we distinguish LA literacy from feedback literacy. This is attributed to the technical features of the LA reports, where the data and visualizations impact the complexity involved in sensemaking (Shibani, Knight & Shum, 2022). For instance, students require foundational competencies of interpreting data visualizations, evaluating the trustworthiness of the report and source, making sense of the results in the learning context and taking follow-up steps to improve based on the insights gathered, while teachers require additional competencies to communicate with their students LA reports and groom them to be LA readers. While data literacy focuses on competencies involved in working with data, LA literacy in this paper distinguishes itself with its focus on using analytics as feedback for teaching and learning. Thus, we view LA literacy as an intersection between feedback and data literacy and, in this paper, define LA literacy as the ability to appreciate, critique, interpret and use LA effectively to gather insights on teaching and learning.

2.2 Micro-Meso-Macro (3M) analytical framework

In line with workshops held in previous years, frameworks such as Ogata et al's (2018) were developed and discussed to benefit learners in technology-enhanced and evidence-based studies. In this paper, we also seek to assist the development and propagation of LA literacy while allowing benchmarking of standards by tapping on a micro-meso-macro architecture that stemmed from an economic perspective (Dopfer et al., 2004). This paper proposes a framework that can handle emergent and complex systems as a population, structure, and process of rules. For usage with multilevel classification and within educational research, it has also been adopted and utilized as an analytical framework (e.g., Lee et al., 2022) for understanding and studying learning behaviors and relations on different levels and to explain interaction patterns, activities, and outcomes designed for the educational context.

In this paper, the 3M analytical framework (Figure 1) by Lee et al. (2022) was designed and expanded for inculcating LA literacy among the three levels of an educational ecosystem, due to how different levels of the framework were designed to address different scopes and fields of the educational spectrum. These levels were crafted from an institutional perspective, consisting of the effect and impact on individual agents (inclusive of teachers and students) at the micro level, the cross-class or intergroups and possibly institutional-wide implementation of LA literacy practices by educators and teachers at the meso level, and the likelihood of LA literacy programs being developed and conducted across institutions and potentially on an international scale at the macro level.

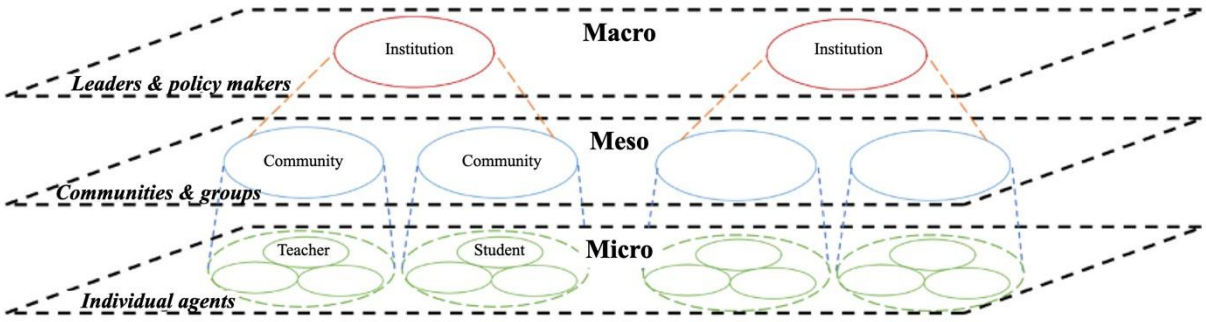

Figure 1. Micro-Meso-Macro framework for guiding LA literacy across institutes (Lee et al., 2022)

3. Enhancing and extending LA literacy across the different levels

Given that students' and teachers' LA literacy is influenced by the interplay between individual, contextual and organizational factors, it would be vital to consider cultivating LA literacy as the propagation of changes at different levels of an evolving ecological system (Dede, 2006). By leveraging the 3M framework (Figure 1), this section discusses how the push for LA literacy can be initiated and established at the respective micro, meso and macro levels to better coordinate LA practices within an education ecosystem.

Two vital themes are viewed to be necessary for the cultivation and support of LA literacy: raising awareness and raising criticality on the use of LA. As LA literacy is still not widely known in the education community, enabling the community to be more LA literate would require spreading the word on the need for cultivating literacy around the use of LA across different levels. Starting from the macro level, awareness of LA literacy can be initiated and raised, with resulting effects on the communities at the meso level and the individual micro-level agents. The second theme builds on the first theme by raising the criticality of using LA. In this theme, collaboration and communication across different groups of people across different levels are key to continuous efforts toward improving LA literacy. Through open channels of communication across communities, sustained exposure and participation in the use of LA will enable a deeper understanding of the common assumptions and pitfalls of LA, while at the same time increasing the appreciation for the role of LA in teaching and learning. The activities and interactions within and between the different levels of the 3M framework are exemplified in Figure 2, with details provided in the following sub-sections.

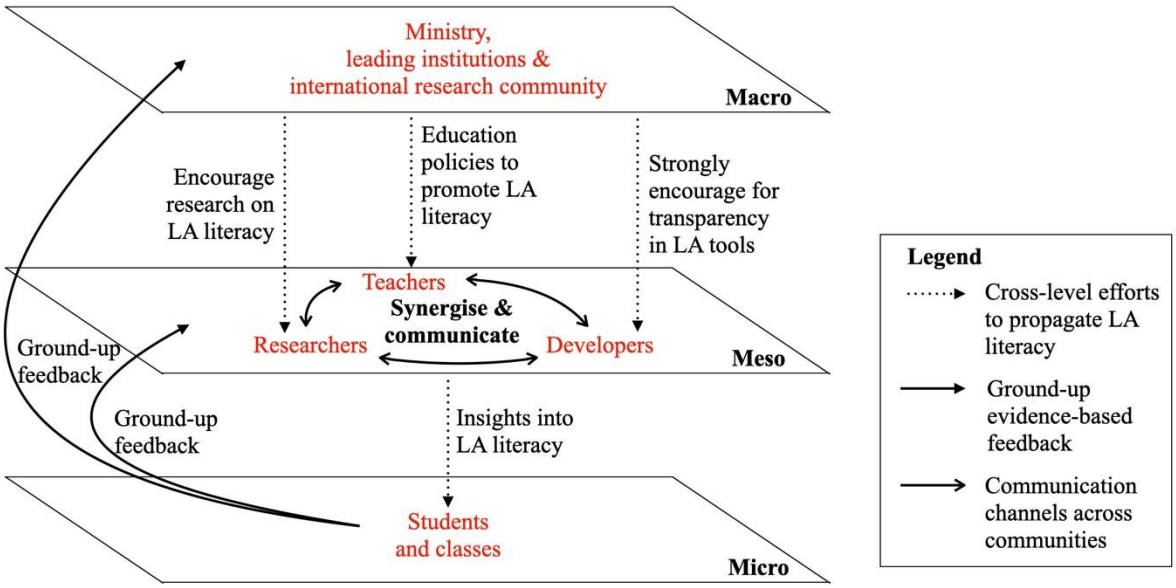

Figure 2. Activities and interactions that cultivate and support LA literacy in a 3M framework.

3.1 Macro level

At the macro level, the focus lies in the deliberate considerations over effective organizational moves and their resultant institute-wide effects. Recently, institutions and leading scholars decided to take significant steps toward a more ethical approach to safeguarding data providers, resulting in less effort and emphasis being placed on advancing stakeholders' competency in using LA. For instance, the Open University introduced eight principles in the Open University Policy to ensure the ethical use of student data for LA (The Open University UK, 2014). Other organizations and research communities followed suit, listing the responsibilities of institutions to ensure ethical LA (Sclater & Bailey, 2015) or creating checklists for ethical LA implementation (Drachsler & Greller, 2016). With huge steps already taken towards the ethical use of LA, more efforts could now be directed towards increasing the visibility of LA literacy and facilitating the motion towards cultivating LA literacy.

We anticipate that LA literacy at the macro level could be propagated via three channels. First, crafting education policies that necessitate the cultivation of LA literacy for teachers and students through the curriculum or learning activities will help raise awareness and the importance of LA literacy. Next, some funding support could be directed towards research efforts to encourage the characterization and design for cultivating LA literacy. Insights gathered from these research projects could then propel professional communities at the meso level towards more effective use of LA and address LA implementation concerns at the micro-level. Lastly, ministries and leading research communities can set up non-enforceable mandates to ensure higher transparency in the ecosystem of LA environments (i.e. infrastructure of the LA system, educational data used for LA and the development of LA tools. This can help reduce the likelihood of having black box systems that complicate the understanding and use of LA. LA developers could also be recast as guides to help stakeholders understand the developed tools.

3.2 Meso level

Entities at the meso level often encompass smaller communities and groups that are more agile and thus can be more flexible in the design and implementation of LA. The meso level can prioritise the open collaboration and communication between teachers, researchers and developers to support collaborative efforts toward developing interventions for cultivating LA literacy. Communities between different stakeholders are few, resulting in a lack of communication channels for intra- and inter-community discussions. The goal at the meso level is to forge a tripartite relationship where educators provide insights on learning experiences and the delivery of intervention, researchers provide theoretically grounded considerations and empirically validated approaches for comparative interventions, and LA developers provide technical expertise in the design and construction of technology and tools to support LA literacy. For instance, funded by the European Commission, Learn2Analyze (L2A) was created to forge an Academia-Industry Knowledge Alliance consisting of an international group of eLearning market leaders and educational data analytics academic teams to improve the community's competencies in the use of LA.

Open dialogues among teachers, researchers and developers should be encouraged, and these communication channels should also be sustained to raise the stakeholders' criticality towards using LA. The community of teachers, researchers and developers will be able to generate a knowledge base of insights into LA literacy, instructional strategies and pedagogical designs that we can further tap on to improve LA literacy for the education community.

3.3 Micro level

The micro level constitutes agents, with uneven attention predominantly centred on the students due to easily recognisable outcomes based on learning metrics and the subsequent effect sizes. The micro level focuses on testing implementation designs created to improve students' and teachers' LA literacy and to gather insights into their responses to these interventions. The pedagogies and LA tools that were developed at the meso level can be trialed in classrooms, and empirical data will be collected and analysed to measure the effects and impacts of the interventions on their LA literacy. This form of data provides critical feedback from the ground-up for further revisions to the designs at the meso level and assists the calibration of policies and funding directions at the macro level. As an iterative and cyclic process, it also completes the feedback loop for continued and sustained improvements for stakeholders like teachers and students.

4. Conclusion and Future work

In a nutshell, the field of learning analytics has progressed significantly over the past decade and has greatly benefited various stakeholders involved in teaching and learning processes. However, the amount of underlying work and efforts exhibited by stakeholders should be given more attention to avoid giving false impressions of LA being an all-round enabler with advantages without clear downsides. To guide this understanding, we propose the use of a 3M framework to highlight the importance of cultivating and supporting LA literacy for a better understanding of teaching and learning practices and further suggest how a systematic implementation of raising LA literacy can be conducted

via the two themes of raising awareness and raising criticality. This paper has focused on the need to cultivate LA literacy amongst education stakeholders as an approach to increase the effective use of LA. Details of the characteristics of LA literacy and the pedagogical designs in supporting LA literacy will be further examined in future work. We hope this paper can accentuate the need for LA literacy and encourage more researchers to articulate strategies and models to support LA literacy.

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