Towards a strengthened learning analytics and explainable artificial intelligence framework: An initial SWOT analysis

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Abstract: The increasing use of learning analytics (LA) and artificial intelligence (AI) in education technology can benefit learning, resource allocation, and decision-making. However, issues remain in supporting the adoption of such systems and mitigating the multifaceted ethical, credibility, and interpretability challenges they pose. Developing a strengthened trustworthy LA and explainable AI (XAI) framework is crucial for the future of technology-rich education. This paper presents an initial SWOT analysis to systematically assess existing trustable LA and XAI frameworks in education. This analysis potentially empowers stakeholders to make more informed decisions about the choice of frameworks for evaluating the adoption and development of such systems. Moreover, insights from the analysis will provide a basis for creating a new framework for addressing and strengthening the gaps in existing frameworks.

Keywords: learning analytics, explainable AI, ethics, SWOT, framework

1. Introduction

The proliferation of learning analytics (LA) and artificial intelligence (AI) in education is revolutionizing teaching and learning, encouraging innovations in educational technology (EdTech) systems for learners, teachers and in educational institutions. These EdTech systems have potential to personalize learning, optimize resource allocation, and support data-driven and evidence-based decision-making processes (Alfredo et al., 2024). However, as the adoption and innovations of LA and AI in education (AIED) continue to grow, critical issues have surfaced, including interpretability of AI predictions, protection of privacy and data, system trustworthiness, and other ethical aspects associated with these systems.

Considerable efforts have been made to identify and address these issues. Systematic reviews (e.g., Alfredo et al., 2024) and frameworks (e.g., Li & Gu, 2023) have advocated for LA and AI systems that are both effective and ethical and trustworthy. A substantial body of work related to trustable LA and explainable AI (XAI) in education has emerged, aiming to mitigate ethical concerns and enhance the credibility and interpretability of these systems. Despite these advancements, existing frameworks have had limited impact in supporting the adoption of such EdTech systems. These frameworks also often fall short in comprehensively addressing the multifaceted challenges posed by these technologies (Alfredo et al., 2024).

To bridge this gap, a SWOT analysis of existing trustable LA and XAI frameworks in education can provide greater insights to assist key stakeholders. A SWOT analysis evaluates the strengths, weaknesses, opportunities, and threats of an approach for a comprehensive and strategic understanding of their potential and limitations. Drawing from the organizational science field, this analysis is a strategic planning method that has been used in AI adoption and EdTech decision-making (Farrokhnia et al., 2024). This paper thus employs the SWOT analysis to systematically assess existing frameworks, to identify areas where they excel and pinpoint weaknesses and threats to be addressed. Moreover, insights from the analysis will provide a basis for creating a new framework designed to address and strengthen the gaps identified in existing frameworks. The paper will first highlight key frameworks for LA and AIED EdTech. Next, an initial SWOT analysis is performed. A discussion with implications for future analyses and a proposed framework concludes the paper. In all, developing a strengthened trustworthy LA and XAI framework is crucial for the future of technology-rich education. Rather

than being ethically poor, the framework needs to address social, technical and humanistic issues to compel and impact current and future EdTech innovations and adoptions.

2. Existing Frameworks

Our literature search has surfaced several frameworks and ethical concerns from trustable LA have been identified namely DELICATE (Drachsler & Greller, 2016), an eight-point checklist, and the privacy-preserving analytics framework (Marshall et al., 2022). Although there has been much active research of XAI in general and systematic literature reviews, there have been limited frameworks specifically for education. Currently, only the AIED risk framework (Li & Gu, 2023) was surfaced in a literature scan. Lastly, there has been some but limited research that has covered both LA and AIED namely the XAI-ED framework (Khosravi et al., 2022).

3. SWOT Analysis

Based on our literature scan, we have identified four frameworks to which we will perform an initial SWOT analysis. The microenvironment, which is the framework's internal strengths and weaknesses will be examined first (Table 1).

Table 1. *Strengths and weaknesses of trustable LA and XAI frameworks in education*

Framework	Target audience	Strengths	Weaknesses
DELICATE (Drachsler & Greller, 2016)	Educational institutions leaders	Easy to understand checklist as a planning tool.	Does not cover technical (model) and socio-technical aspects of adoption. Not designed for AI
Privacy-preserving analytics (Marshall et al., 2022)	Whole of institute or larger systems	Very comprehensive operational privacy preservation framework encompassing human (trust frameworks), security (collaboration environment), regular review, with data governed by privacy first principle (as default) and mandatory metadata. The subsequent methodology for using data is guided by ethical purpose, accuracy, correctness, and transparency. A privacy risk evaluator is used as a basis of the privacy levels. This innovative achievement was also trialed in several studies.	Too detailed and requires adoption and buy-in on many levels as well as technical know-how and experts to use and practically execute.
AIED Risk (Li & Gu, 2023)	AIED application designers and evaluators	Identifies eight risk indicators in AI-based EdTech with respective weights shown in risk order (highest risk first): mismatch of AI pedagogy, misuse of AI resources, accountability risk, privacy security risk, transparency risk, perceived risk, bias risk and misunderstanding of human-centred AI. This framework does well to draw from literature and empirical results from a Delphi and analytic hierarchy process method. Clear weighted risks provide a reference standard for the risk governance of EdTech.	Empirical results were based on experts who worked in China only. No definitions of each risk indicator. Does not cover implementation details. Does not explicitly cover LA work.
XAI-ED (Khosravi et al., 2022)	EdTech system designers and evaluators	Clear and technically sound with many layers of technicalities. Helpfully illustrates several case studies.	No standardization of what is "right"; LA is less emphasized compared to AIED

The opportunities and threats of SWOT refer to the external macro environment. We identified a list of external dimensions in Table 2 and analyzed how these are present or lacking with four descriptors (none, limited, basic, good). The 'threat' column briefly describes what can reduce the use of the framework.

Table 2. *Opportunities and threats of trustable LA and XAI frameworks in education*

Framework	Technical comprehensiveness	Educational soundness	Ease of use	Practical execution	Socio-technical management	Eco-impact assessment	Threats
DELICATE	Basic	Limited	Good	Limited	Limited	None	Individual adoptees; More technical requirements especially for AI-embedded LA
Privacy-preserving analytics	Good	Good	Basic	Good	Basic	None	Easier to use and less resource intensive frameworks
AIED Risk	Basic	Good	Good	Basic	None	None	More technical requirements
XAI-ED	Good	Good	Good	Limited	Limited	None	Simpler and less technical frameworks; AI technology changes

4. Discussion and Conclusion

The presented SWOT analysis provides a holistic view of the selected frameworks' potential and limitations from micro and macro perspectives. While preliminary, this analysis potentially empowers EdTech stakeholders to make more informed decisions about the choice of frameworks for evaluating the adoption and/or development of LA and AIED systems. The structured and clear communication facilitated by the SWOT analysis also enables us to disseminate the framework's analysis to diverse audiences. Furthermore, this analysis has pinpointed where existing gaps are, for instance, that the framework should be clear for various stakeholders and cover technical and socio-technical aspects.

Even though this paper focused on selected frameworks, the analysis can be further refined through a more comprehensive literature review and incorporating systematic literature reviews. The criteria for the opportunities and threats can also be enhanced. Nevertheless, the analysis provides a holistic view of the framework's internal and external factors, to identify strengths, weaknesses, opportunities and threats. Ultimately, our discussion circles back to the impetus of the paper: a future framework designed to enhance the trustworthiness and explainability of LA and AIED systems, emphasizing its potential to benefit various stakeholders by promoting learning and teaching, socio-technical and ecological management, while minimizing risks. We hope to design such a framework to cater to the needs of various stakeholders, including EdTech system developers, researchers, education institution leaders, teachers, and students.

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