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REINVENTING UNIVERSITY.

THE DIGITAL CHALLENGE IN HIGHER EDUCATION

Edited by

Stefania Capogna, Ligita Šimanskienė, Erika Župerkienė

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1. UNIVERSITY TEACHERS' DATA LITERACY FOR PEDAGOGICAL DECISION MAKING

by Aleksandra Batuchina* and Julija Melnikova**

Abstract: *The article has specifically sought to discuss university teachers' data literacy skills that are important for the effective use of learning analytics in the teaching-learning process. Therefore, based on this analysis, teachers must achieve a certain level of data literacy to perform certain pedagogical actions. The main question of the current research is what data literacy skills teachers need to use learning analytics tools and make data-based pedagogical decisions. The article is based on the method of systemic literature analysis. The selected and analysed research papers allow us to present big data in education, highlight the pedagogical value of learning analytics technologies, and provide an overview of learning analytic tools. The results of the theoretical study showed that to use learning analytics tools, it is important for teachers to have skills such as digital literacy, data collection, data analysis and interpretation, etc.*

Keywords*:* Learning analytics, teachers' data literacy, systemic literature analysis.

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Introduction

Over the past decade, there has been a notable paradigm shift in education—from accountability-based to data-based education, emphasising continuous improvement and the purposeful use of data to enhance the quality of education in European countries (OECD, 2021; Baker, Hawn, 2021). Despite being a relatively new phenomenon in education, the value of information derived from data analytics is considerable, offering promising opportunities for personalised student learning and formulating effective educational policies.

The ongoing trend of digitalisation in education has spurred the rapid development of educational technologies (EdTech), encompassing computer-based learning environments, adaptive learning technologies, intelligent learning systems, and "smart classrooms." These technologies generate a wealth of learner data, ranging from simple time-based metrics to more complex indicators of task resolution. This diverse, digital, and often temporary data, capturing interactions during individual or group learning, is classified as big data (Mayer-Schönberger, Cukier, 2014; Mangaroska *et al.*, 2019; Ifenthaler *et al.*, 2020).

Learning analytics, as the domain of big data collected during the learning process, holds immense potential to provide insights crucial for making informed pedagogical decisions and enhancing the quality of student learning (Long, Siemens, 2011). These technologies, incorporating automated data analysis and potentially utilising artificial intelligence techniques, aim to aggregate data from diverse educational environments, facilitating its analysis for actionable improvements.

Researchers posit that teachers are one of the primary beneficiary groups of learning analytics data (Khine, 2018). However, realising this potential hinges on teachers' readiness to

use data to enhance pedagogical activities and decisions effectively. This connection between the essence of data analytics and educational theory and practice needs underscores the importance of teachers' data literacy (Mandinach, Gummer, 2016; Khine, 2018).

Highlighting the assertion that university teachers' use of data enhances their efficiency in pedagogical practice naturally leads to the question of how to unleash this potential. Consequently, the present study aims to address this gap in scientific insights by exploring the data literacy needs of university teachers. This effort aligns with the priorities outlined in educational and strategic documents, including the Digital Education Action Plan (2021-2027), as well as broader goals in teacher education and professional development. By delving into these aspects, the study seeks to contribute timely and relevant insights to the evolving landscape of educational practices.

1. Design of the research

The main question of the current research is what data literacy skills teachers need to use learning analytics tools and make data-based pedagogical decisions. The method of systemic literature analysis has been chosen to answer the research question. The systematic analysis of scientific literature has been designed according to the methodological recommendations of Lauren Atkinson and Andrea Cipriani (2018). The implementation plan for the systematic analysis of scientific literature comprised the following stages:

Preparation stage

The goal was to conduct an initial review of literature sources, get acquainted with concepts, constructs, and literature, delve into the theory, select significant words, and assess the sufficiency of research on the topic under consideration for meta-analysis. Thus, the plan to execute and properly document a systematic literature analysis has been developed.

Stage of systematic literature analysis

Considering the problem area in the preparation stage, the following problematic research questions are formulated: What is the "big data" in education and learning analytics in education? What is the pedagogical value of learning analytics technologies? What data literacy skills do teachers need to use learning analytics tools?

Research problem questions and significant words are transformed into search terms (keywords). Keywords and their translations are checked in controlled dictionaries, thesauri, e.g. ELSS, ERIC.

The following main keywords are *expected*: big data, learning analytics, learning analytics tools, and teachers' data literacy. It was decided to use the Google Scholar (GS) search tool to search for sources of scientific literature. Such a decision is based on the following arguments: The degree of coverage of GS social sciences and humanities (SH) publications is higher than Web of Science and Scopus (Van Leeuwen, 2019). GS allows basic Boolean operators (AND, OR, NOT) to be used in search term strings. GS allows you to search by keyword variations and also searches for keywords in the entire text of the article. GS searches various sources, such as conference proceedings and books that are not available in traditional databases (Haddaway, Collins,

Coughlin, 2015). GS finds articles cited by other related articles generated by the search.

It has been estimated that the sample of publications selected for analysis may consist of about 500 sources. Since the keywords will be adjusted (new main and additional ones will be introduced), this can partially expand, but at the same time narrow the search. In addition, the sample will depend on the agreed primary and secondary selection criteria.

Primary and secondary selection of sources

Researchers have carried out the selection of sources. This is done to avoid errors and biases. During the initial selection of sources, metadata and abstracts of publications were checked. Inclusion criteria: books and chapters with clear empirical information, journal articles, theses/dissertations.

Exclusion criteria: Conference reports, letters, book reviews, research abstracts, unpublished articles, and Publications before 2007. Secondary screening involves a full-text review of the source.

The data was entered into a prepared, coordinated, and tested data collection form (table). After that, the researchers conducted a detailed analysis of the resources.

2. Teachers' data literacy skills and learning analytics

Research studies (McNaughton, Lai, Hsaio, 2012; Poortman, Schildkamp, 2016; Van Geel *et al.*, 2016) have proven that data-driven decision-making can significantly improve student achievement. However, to fully harness the potential of data in education, there is a need for more scientific insights into how teachers can effectively integrate data into their pedagogical

practices (Poortman, Schildkamp, 2016). This evolution has led to the emergence of the concept of teacher data literacy competence, emphasising the skills required for teachers to engage in, collect, analyse, and interpret instructional data (Henderson, Corry, 2020). While the issue of data literacy among university teachers is relatively new (Kovanovic *et al.*, 2021), there are already established arguments suggesting a lack of data literacy among teachers, necessitating actions to address this gap (Reeves, Honig, 2015); moreover, the lack of data literacy that limits its power of influence in the public arena (Capogna, 2022). Key concerns revolve around empowering teachers to apply data to enhance instruction effectively (Bennett *et al.*, 2015; West *et al.*, 2016). Studies (Zhu, Urhahne, 2018) underscore the imperative to develop teachers' competencies in using data for pedagogical decisions. However, experiments (Corrin *et al.*, 2013) have revealed a lack of competence in correctly interpreting data among teachers, while others (Herodotus *et al.*, 2019) found difficulties in planning pedagogical interventions based on data. Rienties and colleagues (2018) emphasise the need for ongoing teacher competence development in data analytics applications.

Given the increasing use of digital learning environments in higher education institutions (Freeman *et al.*, 2017), recent research has focused on incorporating data generated by these environments into teachers' decision-making processes (Kovanovic *et al.*, 2021). Michos and Petko (2022) argue that effective use of these data depends on various factors, such as teachers' technological skills, age, gender, and pedagogical knowledge, highlighting the need for research on how these factors interact and impact pedagogical practice.

Understanding teachers, students, and learning processes is crucial for developing learning analytics tools. Henderson and Corry (2020) emphasise the need for teachers to possess data

literacy skills to interpret the data generated by these tools and integrate them with their pedagogical knowledge. Ellen Mandinach and Edith Gummer (2016) define data literacy skills as the ability to transform information into practical knowledge, involving collecting, analysing, and interpreting all types of data to inform pedagogical actions.

Learning analytics tools offer teachers valuable insights (Sergis *et al.*, 2020; Köse, Özdemir, 2023) into student learning, helping to identify areas of strength and weakness, monitor changes, and provide timely feedback. These tools bridge the gap between high and low-achieving students, inform decision-making, and enhance the effectiveness of assessment methods and training strategies.

By analysing student activities, learning analytics tools provide real-time advice and cues to students and offer teachers suggestions for feedback and formative assessment. This timely feedback promotes deeper engagement and interest in learning, moving beyond standardised test outcomes.

Over the last decade, education has shifted from accountability-based to continuous improvement, emphasising the need for data use in each sociocultural context. To address representational and measurement bias, researchers stress the importance of helping teachers collect "better data" and maintaining fairness in algorithm-based educational decisions (Baker, Hawn, 2021). Holstein *et al.* (2019) advocate for research-based "higher quality" datasets to increase fairness when using educational algorithms.

In conclusion, the effective integration of data in education requires a concerted effort to enhance teachers' data literacy skills. Learning analytics tools offer valuable insights, but the success of their implementation depends on teachers' ability to interpret and apply the generated data to improve pedagogical practices.

Addressing the challenges of data literacy among teachers and ensuring equity in educational algorithms are crucial steps towards fostering a data-informed and equitable educational landscape.

Implications

A wide array of data is generated throughout the general education process. However, detailed information regarding students' learning achievements, demographics, and more is not easily accessible to those who need it the most—teachers, educational institution heads, and support specialists. Furthermore, existing data often fails to provide a clear picture, preventing school staff from accurately identifying and effectively addressing teaching and learning problems.

While numerous analytics tools are available today, they operate independently, lacking integration into a cohesive data network. This lack of connectivity hampers the emergence of a unified data ecosystem. To develop effective solutions crucial for education, there should be a strong interest in collaboration among IT companies, educational researchers, practitioners, and policymakers.

The ability to make data-driven decisions is paramount for the target groups of learning analytics users, facilitating objective decision-making and learner-centred solutions. Additionally, learners themselves need to comprehend the significance of learning analytics in their educational journey and experience its empowering effect. Therefore, as data is collected from diverse sources and learning environments, researchers play a pivotal role in developing data analysis methods (algorithms) that effectively address learning-related challenges.

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